ECS5550 Series

Software Release
v3.1.6.253

CLI Reference Guide

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CLI Reference Guide

ECS5550-30X

L2+/L3 Lite 10G Top of Rack switch
with 24 10GBASE-X SFP+ ports
and 6 40/100G QSFP28 ports

ECS5550-54X

L2+/L3 Lite 10G Top of Rack switch
with 48 10GBASE-X SFP+ ports
and 6 40/100G QSFP28 ports

E102025-CS-R03

About This Guide

This guide includes detailed information on the switch software, including how to operate and use the management functions of the switch. To deploy this switch effectively and ensure trouble-free operation, you should first read the relevant sections in this guide so that you are familiar with all of its software features.

Who Should Read This Guide?

This guide is for network administrators who are responsible for operating and maintaining network equipment. The guide assumes a basic working knowledge of LANs (Local Area Networks), the Internet Protocol (IP), and Simple Network Management Protocol (SNMP).

How This Guide is Organized

This guide describes the switch's command line interface (CLI). For more detailed information on the switch's key features or information about the web browser management interface refer to the *Web Management Guide*.

The guide includes these sections:

- Section I "Getting Started" — Includes information on initial configuration and how to use the CLI.
- Section II "CLI Commands" — Includes all management options available through the CLI.
- Section III "Appendices" — Includes information on troubleshooting switch management access.

Related Documentation

This guide focuses on switch software configuration through the CLI.

For information on how to manage the switch through the Web management interface, see the following guide:

Web Management Guide

For information on how to install the switch, see the following guide:

Quick Start Guide

For all safety information and regulatory statements, see the following documents:

Quick Start Guide
Safety and Regulatory Information

Conventions

The following conventions are used throughout this guide to show information:

Note: Emphasizes important information or calls your attention to related features or instructions.

Caution: Alerts you to a potential hazard that could cause loss of data, or damage the system or equipment.

Warning: Alerts you to a potential hazard that could cause personal injury.

Documentation Notice

This documentation is provided for general information purposes only. If any product feature details in this documentation conflict with the product datasheet, refer to the datasheet for the latest information.

Revision History

This section summarizes the changes in each revision of this guide.

Revision	Date	Change Description
v3.1.6.253	10/2025	Added: ■ "Dying Gasp" on page 148 ■ "show license function-detail" on page 73 ■ "show remote-license" on page 74 ■ "copy remote-license" on page 92 Modified: ■ "show license" on page 72 ■ "show license file" on page 72 ■ "copy" on page 88 ■ "delete" on page 94 ■ "radius-server type radsec" on page 197 ■ "snmp-server community" on page 152 ■ "snmp-server group" on page 161 ■ "show snmp group" on page 165

Revision	Date	Change Description
v2.4.8.251	04/2025	Added: ■ "RIP Commands" on page 910 ■ "OSPF Commands" on page 934 ■ "BGPv4 Commands" on page 996 ■ "Policy-Based Routing Commands" on page 1086 ■ "PIM Commands" on page 1092 ■ "Multicast Routing Commands" on page 1104 ■ "VRRP Commands" on page 892 ■ "IGMP (Layer 3)" on page 682
v1.1.6.243	10/2024	Initial release

Contents

List of CLI Commands

Section I

Getting Started

This section describes how to configure the switch for management access and how to use the CLI.

This section includes these chapters:

1 Initial Switch Configuration

This chapter includes information on connecting to the switch command-line interface (CLI) and basic configuration procedures.

Connecting to the Switch Console Port

The switch CLI can be accessed by a direct connection to its RS-232 serial console port, or remotely by a Telnet or Secure Shell (SSH) connection over the network.

CLI Command Levels

The CLI provides two different command levels:

- **Normal Exec** — Normal access level. The commands available at the Normal Exec level are a limited subset and allow you to only display information and use basic utilities.
- **Privileged Exec** — Privileged access level. Provides access to the full set of CLI commands. To fully configure the switch parameters, you must access the CLI at the Privileged Exec level.

Access to both CLI levels are controlled by user names and passwords. The switch has a default user name and password for each level.

Logging Into the CLI

Attach a VT100-compatible terminal, or a PC running a terminal emulation program to the switch console port. Use the console cable provided with the device, or use a null-modem cable that complies with the wiring assignments shown in the *Quick Start Guide*.

To connect to the console port and log into the CLI at the Privileged Exec level using the default user name and password, complete the following steps:

1. Make sure the terminal emulation software is set as follows:
   - Select the appropriate serial port (COM port 1 or COM port 2).
   - Set the baud rate to 115200 bps.
   - Set the data format to 8 data bits, 1 stop bit, and no parity.
   - Set flow control to none.
   - Set the emulation mode to VT100.

2. Power on the switch.

   After the system completes the boot cycle, the logon screen appears.

3. To initiate your console connection, press <Enter>. The "User Access Verification" procedure starts.

4. At the User Name prompt, enter "admin."

5. At the Password prompt, also enter "admin." (The password characters are not displayed on the console screen.)

6. The session is opened and the CLI displays the "Console#" prompt indicating you have access at the Privileged Exec level.

```
User Access Verification

Username: admin
Password:
  CLI session with the ECS5550-54X is opened.
  To end the CLI session, enter [Exit].

Console#
```

Setting Passwords

The first time you log into the CLI, you should define new passwords for both default user names ("admin" and "guest") using the "username" command, record them and put them in a safe place.

Passwords can consist of up to 32 alphanumeric characters and are case sensitive. To prevent unauthorized access to the switch, set the passwords as follows:

1. Open the console interface with the default user name and password "admin" to access the Privileged Exec level.

2. Type "configure" and press <Enter>.

3. Type "username guest password 0 *password*," for the Normal Exec level, where *password* is your new password. Press <Enter>.

4. Type "username admin password 0 *password*," for the Privileged Exec level, where *password* is your new password. Press <Enter>.

```
Username: admin
Password:

 CLI session with the ECS5550-54X is opened.
```

```
 To end the CLI session, enter [Exit].

Console#configure
Console(config)#username guest password 0 [password]
Console(config)#username admin password 0 [password]
Console(config)#
```

Configuring the Switch for Remote Management

Prior to accessing the switch through a network connection, you must first configure the network interface or Craft port with a valid IPv4 or IPv6 address.

The default network interface is VLAN 1 which includes all switch ports. However, note that the switch also includes a Craft port on the front panel that provides a secure management channel isolated from all other ports on the switch. This interface is not configured with an IP address by default, but may be manually configured with an IPv4 address. The Craft port is specified with the name "craft" in the commands used to configure its IP address (see "interface" on page 377).

After configuring the switch's IP parameters, the CLI can be accessed using Telnet or SSH from any computer attached to the network. The switch can also be managed by any computer using a standard web browser, or from a network computer using SNMP network management software.

Note: This switch supports eight Telnet or SSH sessions.

Note: Any VLAN group can be assigned an IP interface address for managing the switch.

Note: The default IPv4 address and subnet mask for VLAN 1 is 192.168.2.10 255.255.255.0, with no defined default gateway.

Using the Craft Port or Network Interface

The Craft port is a dedicated for out-of-band management. In general, the Craft port should be used to manage the switch for security reasons. Traffic on this port is segregated from normal network traffic on other switch ports and cannot be switched or routed to the operational network. Additionally, if the operational network is experiencing problems, the Craft port still allows you to access the switch's management interface and troubleshoot network problems. Configuration options on the Craft port are limited, which makes it difficult to accidentally cut off management access to the switch.

Alternatively, the switch can be managed through the operational network, known as in-band management. Because in-band management traffic is mixed in with operational network traffic, it is subject to all of the filtering rules usually applied to a standard network ports such as ACLs and VLAN tagging. In-band network management can be accessed through a connection to any network port.

Setting an IP Address

You must establish IPv4 or IPv6 address information for a switch to obtain management access through the network.

To assign an IPv4 address to the switch, use the "ip address" command from the VLAN 1 interface-configuration mode. You might also need to set the IP address of the default gateway for the network to which the switch belongs.

```
Console#configure
Console(config)#interface vlan 1
Console(config-if)#ip address 192.168.1.5 255.255.255.0
Console(config-if)#exit
Console(config)#ip default-gateway 192.168.1.254
```

To configure an IPv6 link-local address (prefix in the range of FE80-FEBF) for the switch, use the "ipv6 address" command from the VLAN 1 interface-configuration mode.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 address FE80::260:3EFF:FE11:6700 link-local
Console(config-if)#ipv6 enable
Console(config-if)#
```

Alternatively, to set an IPv6 global unicast address for the switch, you must define the full address, including a network prefix and the host address for the switch. You can specify either the full IPv6 address, or the IPv6 address and prefix length.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 address 2001:DB8:2222:7272::/64
Console(config-if)#exit
Console(config)#ipv6 default-gateway 2001:DB8:2222:7272::254
Console(config)end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled.
Link-local address:
  fe80::260:3eff:fe11:6700%1/64
Global unicast address(es):
  2001:db8:2222:7272::/64, subnet is 2001:db8:2222:7272::/
  64[TEN][INVALID][INVAL
ID]
Joined group address(es):
ff02::1:ff00:0
ff02::1:ff11:6700
ff02::1:2
ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#show ipv6 default-gateway
```

```
IPv6 default gateway 2001:db8:2222:7272::254
Console#
```

Note: To dynamically obtain an IPv4 address through DHCP or BOOTP, see "IPv4 Interface" on page 838.

Note: For detailed information on the other ways to assign IPv6 addresses, see "IPv6 Interface" on page 853.

Configuring the Switch for Cloud Management

The Edgecore ecCLOUD Controller is a cloud-based network service available from anywhere through a web-browser interface. The switch can be managed by the ecCLOUD controller once you have set up an account and registered the device on the system.

By default, the cloud management agent is disabled on the switch. Setting the cloud management agent to enabled allows the switch to be managed through the ecCLOUD system after the next reboot.

To enable the cloud management agent, log into the CLI and use the **mgmt enable** command from the Global Config level. Then reboot the switch to initiate communications with the ecCLOUD controller.

```
Username: admin
Password:

 CLI session with the ECS5550-54X is opened.
 To end the CLI session, enter [Exit].

Console#configure
Console(config)#mgmt enable
Console(config)#exit
Console#reload
System will be restarted, continue <y/n>? y
```

For more information on cloud management configuration, see "Cloud Management" on page 53.

Managing System Files

The switch's flash memory supports three types of system files that can be managed by the CLI program, the web interface, or SNMP. The switch's file system allows files to be uploaded and downloaded, copied, deleted, and set as a start-up file.

The types of files are:

- **Configuration** — This file type stores system configuration information and is created when configuration settings are saved. Saved configuration files can be selected as a system start-up file or can be uploaded via FTP/SFTP/TFTP to a server for backup. The file named "Factory_Default_Config.cfg" contains all the system default settings and cannot be deleted from the system. If the system is booted with the factory default settings, the switch will also create a file named "startup1.cfg" that contains system settings for switch initialization, including information about the unit identifier, and MAC address for the switch. The configuration settings from the factory defaults configuration file are copied to this file, which is then used to boot the switch. See "Saving or Restoring Configuration Settings" on page 33 for more information.

- **Operation Code** — System software that is executed after boot-up, also known as run-time code. This code runs the switch operations and provides the CLI and web management interfaces.

- **Diagnostic Code** — Software that is run during system boot-up, also known as POST (Power On Self-Test).

Note: The Boot ROM and Loader cannot be uploaded or downloaded from the FTP/SFTP/TFTP server. You must follow the instructions in the release notes for new firmware, or contact your distributor for help.

Due to the size limit of the flash memory, the switch supports only two operation code files. However, you can have as many diagnostic code files and configuration files as available flash memory space allows. The available flash memory can be checked by using the **dir** command.

In the system flash memory, one file of each type must be set as the start-up file. During a system boot, the diagnostic and operation code files set as the start-up file are run, and then the start-up configuration file is loaded.

Note that configuration files should be downloaded using a file name that reflects the contents or usage of the file settings. If you download directly to the running-config, the system will reboot, and the settings will have to be copied from the running-config to a permanent file.

Upgrading the Operation Code

The following example shows how to download new firmware to the switch and activate it. The TFTP server could be any standards-compliant server running on Windows or Linux. When downloading from an FTP server, the logon interface will prompt for a user name and password configured on the remote server. Note that "anonymous" is set as the default user name.

File names on the switch are case-sensitive. The destination file name should not contain slashes (\ or /), and the maximum length for file names is 32 characters for files on the switch or 128 characters for files on the server. (Valid characters: A-Z, a-z, 0-9, ".", "-")

```
Console#copy tftp file
TFTP server IP address: 192.168.2.243
Choose file type:
 1. config; 2. opcode: 2
Source file name: ECS5550_V1.1.3.243.bix
Destination file name: ECS5550_V1.1.3.243.bix
Flash programming started.
Flash programming completed.
Success.
Console#config
Console(config)#boot system opcode:ECS5550_V1.1.3.243.bix
Success.
Console(config)#exit
Console#dir
File Name                      Type    Startup Modified Time       Size (bytes)
---------------------------- ------- ------- ------------------- ------------
 Unit 1:
ECS5550_V1.1.2.243.bix       OpCode  N       2024-07-16 07:33:47   39,400,747
ECS5550_V1.1.3.243.bix       OpCode  Y       2024-07-15 13:21:27   39,401,799
Factory_Default_Config.cfg   Config  N       2024-07-11 08:22:53          390
startup1.cfg                 Config  Y       2024-07-15 13:23:22        2,212
test.cfg                     Config  N       2024-07-11 08:45:36        2,684
-----------------------------------------------------------------------------
                    Free space for compressed user config files: 2,543,143,936
                                                  Total space: 3,082,760,192

Console#
```

Saving or Restoring Configuration Settings

Configuration commands only modify the running configuration file and are not saved when the switch is rebooted. To save all your configuration changes in nonvolatile storage, you must copy the running configuration file to the start-up configuration file using the "copy" command.

New startup configuration files must have a name specified. File names on the switch are case-sensitive, can be from 1 to 31 characters, must not contain slashes (\ or /), and the leading letter of the file name must not be a period (.). (Valid characters: A-Z, a-z, 0-9, ".", "-", "_")

There can be more than one user-defined configuration file saved in the switch's flash memory, but only one is designated as the "startup" file that is loaded when the switch boots. The **copy running-config startup-config** command always sets the new file as the startup file. To select a previously saved configuration file, use the **boot system config:**<*filename*> command.

The maximum number of saved configuration files depends on available flash memory. The amount of available flash memory can be checked by using the **dir** command.

To save the current configuration settings, enter the following command:

1. From the Privileged Exec mode prompt, type "copy running-config startup-config" and press <Enter>.

2. Enter the name of the start-up file. Press <Enter>.

```
Console#copy running-config startup-config
Startup configuration file name []: startup
\Write to FLASH Programming.

\Write to FLASH finish.
Success.

Console#
```

To restore configuration settings from a backup server, enter the following command:

1. From the Privileged Exec mode prompt, type "copy tftp startup-config" and press <Enter>.

2. Enter the address of the TFTP server. Press <Enter>.

3. Enter the name of the startup file stored on the server. Press <Enter>.

4. Enter the name for the startup file on the switch. Press <Enter>.

```
Console#copy tftp startup-config
TFTP server IP address: 192.168.0.4
Source configuration file name: startup-rd.cfg
Startup configuration file name [startup1.cfg]:

Success.
Console#
```

2 Using the CLI

This chapter describes how to use the Command Line Interface (CLI).

Entering Commands

This section describes how to enter CLI commands.

Keywords and Arguments

A CLI command is a series of keywords and arguments. Keywords identify a command, and arguments specify configuration parameters. For example, in the command "show interfaces status ethernet 1/5," **show interfaces** and **status** are keywords, **ethernet** is an argument that specifies the interface type, and **1/5** specifies the unit/port.

Minimum Abbreviation

The CLI will accept a minimum number of characters that uniquely identify a command. For example, the command "configure" can be entered as **con**. If an entry is ambiguous, the system will prompt for further input.

Command Completion

If you terminate input with a Tab key, the CLI will print the remaining characters of a partial keyword up to the point of ambiguity. In the "logging history" example, typing **log** followed by a tab will result in printing the command up to "**logging**."

Getting Help on Commands

You can display a brief description of the help system by entering the **help** command. You can also display command syntax by using the "?" character to list keywords or parameters.

Showing Commands

If you enter a "?" at the command prompt, the system will display the first level of keywords or command groups. You can also display a list of valid keywords for a specific command. For example, the command "**show system ?**" displays a list of possible show commands:

```
Console#show ?
  access-group          Access groups
  access-list           Access lists
  accounting            Uses the specified accounting list
  arp                   Information of ARP cache
  authorization         Information of authorization
```

```
auto-traffic-control  Auto traffic control information
banner                Banner info
bridge-ext            Bridge extension information
calendar              Date and time information
class-map             Displays class maps
cloud-mgmt            Displays cloud management information
cluster               Display cluster
debug                 State of each debugging option
discard               Discard packet
dns                   DNS information
dos-protection        Shows the system dos-protection summary information
dot1q-tunnel          dot1q-tunnel
dot1x                 802.1X content
efm                   Ethernet First Mile feature
erps                  Displays ERPS configuration
ethernet              Shows Metro Ethernet information
excluded-vlan         Excluded vlan information
garp                  GARP properties
gvrp                  GVRP interface information
hardware              hardware related functions
history               Shows history information
hosts                 Host information
interfaces            Shows interface information
ip                    IP information
ipv6                  IPv6 information
l2protocol-tunnel     Layer 2 protocol tunneling configuration
lacp                  LACP statistics
license               Shows license information
line                  TTY line information
lldp                  LLDP
log                   Log records
logging               Logging setting
loop                  Shows the information of loopback
loopback-detection    Shows loopback detection information
mac                   MAC access list
mac-address-table     Configuration of the address table
mac-vlan              MAC-based VLAN information
management            Shows management information
memory                Memory utilization
mgmt                  Mgmt information
mlag                  Displays MLAG information
mvr                   multicast vlan registration
mvr6                  IPv6 Multicast VLAN registration
network-access        Shows the entries of the secure port.
nlm                   Show notification log
ntp                   Network Time Protocol configuration
policy-map            Displays policy maps
port                  Port characteristics
port-channel          Port channel information
pppoe                 Displays PPPoE configuration
privilege             Shows current privilege level
process               Device process
protocol-vlan         Protocol-VLAN information
public-key            Public key information
qos                   Quality of Service
queue                 Priority queue information
radius-server         RADIUS server information
reload                Shows the reload settings
rmon                  Remote monitoring information
rspan                 Display status of the current RSPAN configuration
running-config        Information on the running configuration
sflow                 Shows the sflow information
sftp                  sftp command
smart-pair            Displays backup port information
snmp                  Simple Network Management Protocol configuration and
```

```
                      statistics
  snmp-server         Displays SNMP server configuration
  sntp                Simple Network Time Protocol configuration
  spanning-tree       Spanning-tree configuration
  ssh                 Secure shell server connections
  startup-config      Startup system configuration
  subnet-vlan         IP subnet-based VLAN information
  system              System information
  tacacs-server       TACACS server information
  tech-support        Technical information
  time-range          Time range
  traffic-segmentation  Traffic segmentation information
  twamp               TWAMP configuration, statistics and session information
  udld                Displays UDLD information
  upgrade             Shows upgrade information
  users               Information about users logged in
  version             System hardware and software versions
  vlan                Shows virtual LAN settings
  vlan-translation    VLAN translation information
  voice               Shows the voice VLAN information
  watchdog            Displays watchdog status
  web-auth            Shows web authentication configuration
Console#show
```

The command "**show interfaces ?**" will display the following information:

```
Console#show interfaces ?
  brief                 Shows brief interface description
  counters              Interface counters information
  history               Historical sample of interface counters information
  protocol-vlan         Protocol-VLAN information
  status                Shows interface status
  switchport            Shows interface switchport information
  transceiver           Interface of transceiver information
  transceiver-threshold  Interface of transceiver-threshold information
Console#
```

Show commands that display more than one page of information (e.g., **show running-config**) pause and require you to press the [Space] bar to continue displaying one more page, the [Enter] key to display one more line, or the [a] key to display the rest of the information without stopping. You can press any other key to terminate the display.

Partial Keyword Lookup

If you terminate a partial keyword with a question mark, alternatives that match the initial letters are provided. (Remember not to leave a space between the command and question mark.) For example "**s?**" shows all the keywords starting with "s."

```
Console#show s?
sflow           sftp            smart-pair      snmp            snmp-server

sntp            spanning-tree   ssh             startup-config  subnet-vlan

system

Console#show s
```

Negating the Effect of Commands

For many configuration commands you can enter the prefix keyword "**no**" to cancel the effect of a command or reset the configuration to the default value. For example, the **logging** command will log system messages to a host server. To disable logging, specify the **no logging** command. This guide describes the negation effect for all applicable commands.

Using Command History

The CLI maintains a history of commands that have been entered. You can scroll back through the history of commands by pressing the up arrow key. Any command displayed in the history list can be executed again, or first modified and then executed.

Using the **show history** command displays a longer list of recently executed commands.

Understanding Command Modes

The command set is divided into Exec and Configuration classes. Exec commands generally display information on system status or clear statistical counters. Configuration commands, on the other hand, modify interface parameters or enable certain switching functions. These classes are further divided into different modes. Available commands depend on the selected mode. You can always enter a question mark "**?**" at the prompt to display a list of the commands available for the current mode. The command classes and associated modes are displayed in the following table:

Table 1: General Command Modes

Class	Mode	
Exec	Normal Privileged	
Configuration	Global*	Access Control List Class Map DHCP ERPS IGMP Profile Interface Line Multiple Spanning Tree Time Range VLAN Database

* You must be in Privileged Exec mode to access the Global configuration mode.
You must be in Global Configuration mode to access any of the other configuration modes.

Exec Commands

When you open a new console session on the switch with the user name and password "guest," the system enters the Normal Exec command mode (or guest mode), displaying the "Console>" command prompt. Only a limited number of the commands are available in this mode. You can access all commands only from the Privileged Exec command mode (or administrator mode). To access Privilege Exec mode, open a new console session with the user name and password "admin." The system will now display the "Console#" command prompt. You can also enter Privileged Exec mode from within Normal Exec mode, by entering the enable command, followed by the privileged level password "super."

To enter Privileged Exec mode, enter the following user names and passwords:

```
Username: admin
Password: [admin login password]

  CLI session with the ECS5550-54X is opened.
  To end the CLI session, enter [Exit].

Console#
```

```
Username: guest
Password: [guest login password]

  CLI session with the ECS5550-54X is opened.
  To end the CLI session, enter [Exit].

Console>enable
Password: [privileged level password]
Console#
```

Configuration Commands

Configuration commands are privileged level commands used to modify switch settings. These commands modify the running configuration only and are not saved when the switch is rebooted. To store the running configuration in non-volatile storage, use the **copy running-config startup-config** command.

To enter the Global Configuration mode, enter the command **configure** in Privileged Exec mode. The system prompt will change to "Console(config)#", which gives you access privilege to all Global Configuration commands.

```
Console#configure
Console(config)#
```

To enter the other modes, at the configuration prompt type one of the following commands. Use the **exit** or **end** command to return to the Privileged Exec mode.

Table 2: Configuration Command Modes

Mode	Command	Prompt	Page
Access Control List	access-list arp	Console(config-arp-acl)	371
	access-list ip standard	Console(config-std-acl)	353
	access-list ip extended	Console(config-ext-acl)	353
	access-list ipv6 standard	Console(config-std-ipv6-acl)	359
	access-list ipv6 extended	Console(config-ext-ipv6-acl)	359
	access-list mac	Console(config-mac-acl)	365
Class Map	class-map	Console(config-cmap)	603
ERPS	erps instance	Console(config-erps-inst)	561
	erps ring	Console(config-erps-ring)	560
DHCP	ip dhcp pool	Console(config-dhcp)	825
Interface	interface {ethernet *port* | port-channel *id* | vlan *id*}	Console(config-if)	377
Line	line {console | vty}	Console(config-line)	103
MSTP	spanning-tree mst-configuration	Console(config-mstp)	481
Control Plane	control-plane	Console(config-cp)	620
Time Range	time-range	Console(config-time-range)	139
VLAN	vlan database	Console(config-vlan)	512

The access modes in this guide are indicated by these abbreviations:

ACL (Access Control List Configuration)
CM (Class Map Configuration)
CP (Control Plane Interface Configuration)
ERPS (Ethernet Ring Protection Switching Configuration)
GC (Global Configuration)
IC (Interface Configuration)
IPC (IGMP Profile Configuration)
LC (Line Configuration)
MST (Multiple Spanning Tree)
NE (Normal Exec)
PE (Privileged Exec)
VC (VLAN Database Configuration)

Command Line Processing

Commands are not case sensitive. You can abbreviate commands and parameters as long as they contain enough letters to differentiate them from any other currently available commands or parameters. You can use the Tab key to complete partial commands, or enter a partial command followed by the "?" character to display a list of possible matches. You can also use the following editing keystrokes for command-line processing:

Table 3: Keystroke Commands

Keystroke	Function
Ctrl-A	Shifts cursor to start of command line.
Ctrl-B	Shifts cursor to the left one character.
Ctrl-C	Terminates the current task and displays the command prompt.
Ctrl-E	Shifts cursor to end of command line.
Ctrl-F	Shifts cursor to the right one character.
Ctrl-K	Deletes all characters from the cursor to the end of the line.
Ctrl-L	Repeats current command line on a new line.
Ctrl-N	Enters the next command line in the history buffer.
Ctrl-P	Enters the last command.
Ctrl-R	Repeats current command line on a new line.
Ctrl-U	Deletes from the cursor to the beginning of the line.
Ctrl-W	Deletes the last word typed.
Esc-B	Moves the cursor back one word.
Esc-D	Deletes from the cursor to the end of the word.
Esc-F	Moves the cursor forward one word.
Delete key or backspace key	Erases a mistake when entering a command.

Showing Status Information

There are various "show" commands which display configuration settings or the status of specified processes. Many of these commands will not display any information unless the switch is properly configured, and in some cases the interface to which a command applies is up.

For example, if a static router port is configured, the corresponding show command will not display any information unless IGMP snooping is enabled, and the link for the static router port is up.

```
Console#configure
Console(config)#ip igmp snooping vlan 1 mrouter ethernet 1/11
Console(config)#end
Console#show ip igmp snooping mrouter
 VLAN M'cast Router Ports Type
 ---- ------------------- -------
Console#configure
```

```
Console(config)#ip igmp snooping
Console(config)#end
Console#show ip igmp snooping mrouter
 VLAN M'cast Router Ports Type
 ---- ------------------- -------
 1    Eth 1/11            Static
Console#
```

3 ECS5550 Switch Platform

Some CLI options and parameters vary by switch platform, this chapter includes platform-specific information related to the CLI.

Identifying Switch Ports in the CLI

CLI commands use the following format to identify physical switch ports:

ethernet *unit/port*

unit - Stack unit identifier.

port - Physical port number.

For aggregated port links, the CLI uses this format:

port-channel *channel-id*

channel-id - The aggregated link (trunk) index.

All CLI commands in this guide accept the following range of values for *unit*, *port*, and *channel-id*, unless otherwise specified.

Table 4: CLI Port Identification Ranges

Switch Model	Unit	Port	Channel ID
ECS5550-30X	Always 1	1-30	1-28
ECS5550-54X	Always 1	1-54	1-28

For example, the following CLI command enters the configuration mode for port 7.

```
Console(config)#interface ethernet 1/7
Console(config-if)#
```

Section II

CLI Commands

This section provides a detailed description of the CLI, along with examples for all of the commands.

This section includes these chapters:

4 General Commands

The general commands are used to control the command access mode, configuration mode, and other basic functions.

Table 5: General Commands

Command	Function	Mode
prompt	Customizes the CLI prompt	GC
reload	Restarts the system at a specified time, after a specified delay, or at a periodic interval	GC
enable	Activates privileged mode	NE
quit	Exits a CLI session	NE, PE
show history	Shows the command history buffer	NE, PE
configure	Activates global configuration mode	PE
disable	Returns to normal mode from privileged mode	PE
reload	Restarts the system immediately	PE
show reload	Displays the current reload settings, and the time at which next scheduled reload will take place	PE
end	Returns to Privileged Exec mode	any config. mode
exit	Returns to the previous configuration mode, or exits the CLI	any mode

prompt

This command customizes the CLI prompt. Use the **no** form to restore the default prompt.

Syntax

prompt *string*

no prompt

string - Any alphanumeric string to use for the CLI prompt. (Maximum length: 32 characters)

Default Setting

Console

Command Mode

Global Configuration

Command Usage

This command can be used to set the command line prompt as shown in the example below. Using the **no** form of either command will restore the default command line prompt.

Example

```
Console(config)#prompt RD2
RD2(config)#
```

reload (Global Configuration)

This command restarts the system at a specified time, after a specified delay, or at a periodic interval. You can reboot the system immediately, or you can configure the switch to reset after a specified amount of time. Use the **cancel** option to remove a configured setting.

Syntax

reload {**at** *hour minute* [{*month day* | *day month*} [*year*]] |
in {**hour** *hours* | **minute** *minutes* | **hour** *hours* **minute** *minutes*} |
regulary *hour minute* [**period** {**daily** | **weekly** *day-of-week* |
monthly *day-of-month*}] | **cancel** [**at** | **in** | **regulary**]}

reload at - A specified time at which to reload the switch.

hour - The hour at which to reload. (Range: 0-23)

minute - The minute at which to reload. (Range: 0-59)

month - The month at which to reload. (january ... december)

day - The day of the month at which to reload. (Range: 1-31)

year - The year at which to reload. (Range: 1970-2037)

reload in - An interval after which to reload the switch.

hours - The number of hours, combined with the minutes, before the switch resets. (Range: 0-576)

minutes - The number of minutes, combined with the hours, before the switch resets. (Range: 0-34560)

reload regulary - A periodic interval at which to reload the switch.

hour - The hour at which to reload. (Range: 0-23)

minute - The minute at which to reload. (Range: 0-59)

day-of-week - Day of the week at which to reload.
(Range: monday ... saturday)

day-of-month - Day of the month at which to reload. (Range: 1-31)

reload cancel - Cancels the specified reload option.

Default Setting

None

Command Mode
Privileged Exec, Global Configuration

Command Usage
- This command resets the entire system.
- Any combination of reload options may be specified. If the same option is re-specified, the previous setting will be overwritten.
- When the system is restarted, it will always run the Power-On Self-Test. It will also retain all configuration information stored in non-volatile memory by the copy running-config startup-config command (See "copy" on page 88).

Example
This example shows how to reset the switch after 30 minutes:

```
Console(config)#reload in minute 30
***
*** --- Rebooting at January  1 02:10:43 2016 ---
***

Are you sure to reboot the system at the specified time? <y/n>
```

enable
This command activates Privileged Exec mode. In privileged mode, additional commands are available, and certain commands display additional information. See "Understanding Command Modes" on page 38.

Syntax
enable [*level*]

level - Privilege level to log into the device.

The device has two predefined privilege levels: 0: Normal Exec, 15: Privileged Exec. Enter level 15 to access Privileged Exec mode.

Default Setting
Level 15

Command Mode
Normal Exec

Command Usage
- "super" is the default password required to change the command mode from Normal Exec to Privileged Exec. (To set this password, see the enable password command.)
- The "#" character is appended to the end of the prompt to indicate that the system is in privileged access mode.

Example

```
Console>enable
Password: [privileged level password]
Console#
```

quit

This command exits the configuration program.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

The **quit** and **exit** commands can both exit the configuration program.

Example

This example shows how to quit a CLI session:

```
Console#quit

Press ENTER to start session

User Access Verification

Username:
```

show history

This command shows the contents of the command history buffer.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

The history buffer size is fixed at 10 Execution commands and 10 Configuration commands.

Example

In this example, the show history command lists the contents of the command history buffer:

```
Console#show history
Execution command history:
 2 config
```

```
 1 show history

Configuration command history:
 4 interface vlan 1
 3 exit
 2 interface vlan 1
 1 end

Console#
```

The ! command repeats commands from the Execution command history buffer when you are in Normal Exec or Privileged Exec Mode, and commands from the Configuration command history buffer when you are in any of the configuration modes. In this example, the !2 command repeats the second command in the Execution history buffer (config).

```
Console#!2
Console#config
Console(config)#
```

configure

This command activates Global Configuration mode. You must enter this mode to modify any settings on the switch. You must also enter Global Configuration mode prior to enabling some of the other configuration modes, such as Interface Configuration, Line Configuration, and VLAN Database Configuration. See "Understanding Command Modes" on page 38.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#configure
Console(config)#
```

disable

This command returns to Normal Exec mode from privileged mode. In normal access mode, you can only display basic information on the switch's configuration or Ethernet statistics. To gain access to all commands, you must use the privileged mode. See "Understanding Command Modes" on page 38.

Default Setting

None

Command Mode

Privileged Exec

Command Usage
The ">" character is appended to the end of the prompt to indicate that the system is in normal access mode.

Example

```
Console#disable
Console>
```

reload (Privileged Exec)
This command restarts the system.

Note: When the system is restarted, it will always run the Power-On Self-Test. It will also retain all configuration information stored in non-volatile memory by the copy running-config startup-config command.

Default Setting
None

Command Mode
Privileged Exec

Command Usage
This command resets the entire system.

Example
This example shows how to reset the switch:

```
Console#reload
System will be restarted, continue <y/n>? y
```

show reload
This command displays the current reload settings, and the time at which next scheduled reload will take place.

Command Mode
Privileged Exec

Example

```
Console#show reload
Reloading switch in time:                       0 hours 29 minutes.

The switch will be rebooted at January  1 02:11:50 2015.
Remaining Time: 0 days, 0 hours, 29 minutes, 52 seconds.
Console#
```

end This command returns to Privileged Exec mode.

Default Setting
None

Command Mode
Global Configuration, Interface Configuration, Line Configuration, VLAN Database Configuration, and Multiple Spanning Tree Configuration.

Example
This example shows how to return to the Privileged Exec mode from the Interface Configuration mode:

```
Console(config-if)#end
Console#
```

exit This command returns to the previous configuration mode or exits the configuration program.

Default Setting
None

Command Mode
Any

Example
This example shows how to return to the Privileged Exec mode from the Global Configuration mode, and then quit the CLI session:

```
Console(config)#exit
Console#exit

Press ENTER to start session

User Access Verification

Username:
```

5 System Management Commands

The system management commands are used to control system logs, passwords, user names, management options, and display or configure a variety of other system information.

Table 6: System Management Commands

Command Group	Function
Cloud Management	Configures the switch for management from the ecCLOUD system
Device Designation	Configures information that uniquely identifies this switch
Banner Information	Configures administrative contact, device identification and location
System Status	Displays system configuration, active managers, and version information
Fan Control	Forces fans to full speed
Thermal Thresholds	Sets system rising and falling temperature thresholds
Frame Size	Enables support for jumbo frames
File Management	Manages code image or switch configuration files
Line	Sets communication parameters for the serial port, including baud rate and console time-out
Event Logging	Controls logging of error messages
SMTP Alerts	Configures SMTP email alerts
Time (System Clock)	Sets the system clock automatically via NTP/SNTP server or manually
Time Range	Sets a time range for use by other functions, such as Access Control Lists
Switch Clustering	Configures management of multiple devices via a single IP address
Dying Gasp	Configures dying gasp messages when the device looses power

Cloud Management

This section describes commands used to configure the cloud management agent on the switch for management through ecCLOUD.

Table 7: Cloud Management Commands

Command	Function	Mode
mgmt	Enables or disables cloud management for the switch	GC
mgmt loglevel	Sets the minimum level for logging messages	GC

Table 7: Cloud Management Commands

Command	Function	Mode
mgmt setoption	Sets various options for the cloud management agent	GC
mgmt property	Sets cloud management settings to default values	GC
mgmt upgrade	Upgrades the cloud management agent code on the switch	PE
show mgmt status	Displays the cloud management agent status	PE
show mgmt version	Displays the cloud management agent code version	PE
show mgmt log	Displays log messages from the cloud management agent	PE
show mgmt option	Displays the cloud management agent configuration options	PE

mgmt

This command enables or disables the cloud management agent for the switch.

Syntax

mgmt {enable | disable}

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- Setting the cloud management agent to enabled allows the switch to be managed through the ecCLOUD system after the next reboot. By default, the cloud management agent is disabled.
- After setting the cloud management agent to enabled or disabled, it requires a reboot of the switch to take effect.

Example

```
Console(config)#mgmt enable
Console(config)#
```

mgmt loglevel

This command sets the minimum level for cloud management agent logging messages. Use the **no** form to reset to the default level.

Syntax

mgmt loglevel *level*

no mgmt loglevel

level - The minimum logging level. (Options: trace, debug, info, warn, error)

Default Setting

Info

Command Mode

Global Configuration

Command Usage

- The logging levels from minimum severity to maximum severity are: Trace, Debug, Info, Warn, Error.
- This command configures messages logged by the cloud management agent based on severity. Messages from the configured level up to the maximum level are logged. Therefore, if Info is the configured level, all messages for Info, Warn, and Error are logged.

Example

```
Console(config)#mgmt loglevel info
Console(config)#
```

mgmt setoption

This command sets options for the cloud management agent. Use the **no** form to delete the specified option.

Syntax

mgmt setoption *option*

no mgmt setoption *option*

option - The option to set in the format "option name=value".

Default Setting

None

Command Mode

Global Configuration

Command Usage

- This command configures cloud management agent settings that are used in communications between the switch and the ecCLOUD controller.
- The following table lists all the cloud management agent options.

Table 8: Cloud Management Agent Options

Name	Type	Required	Default	Notes
acn.settings.latitude	decimal	no	0	Latitude of device.
acn.settings.longitude	decimal	no	0	Longitude of device.
acn.settings.name	string	yes	"IgniteNet" (depends on brand)	Device's name used with the controller.
acn.mgmt.enabled	boolean	no	0	Whether or not to enable mgmtd agent. Used by external process which runs the actual mgmtd.
acn.mgmt.loglevel	string	no	"info"	Various logging levels for mgmtd. Possible values in lowering order: error, warn, info, debug, trace.
acn.mgmt.hb_interval	int	no	60	Heartbeat message sending interval.
acn.mgmt.hb_ack_timeout	int	no	57	Heartbeat acknowledgement timeout (to consider connection problem is present)
acn.mgmt.hb_retry_count	int	no	3	How many times to try and send a heartbeat without a received acknowledgment.
acn.mgmt.status_interval	int	no	300	How often to send events/client data/etc.
acn.mgmt.status_min_offset	int	no	0	Minimum time delay value for randomized offset for sending first status message.
acn.mgmt.status_max_offset	int	no	60	Maximum time delay value for randomized offset for sending first status message.
acn.mgmt.response_repetitions	int	no	120	How many response repetitions to send to the Controller (for live data, like graphs).
acn.mgmt.response_interval	int	no	3	Interval between subsequent repetitions.
acn.mgmt.fw_update_interval	int	no	5	Firmware update delay after receiving appropriate task.
acn.mgmt.fw_download_retries	int	no	10	Count of firmware download retries.
acn.mgmt.mac_tbl_interval	int	no	300	How often to send the MAC address table.
acn.mgmt.registration_inverval	int	no	60	Interval between registration attempts (if fails).
acn.mgmt.restart_interval	int	no	86400	(Temporary) interval between mgmtd restarts to free leaked memory.
acn.mgmt.task_expiry_interval	int	no	3600	Interval to check for expired tasks.
acn.mgmt.task_expiry_time	int	no	86400	Time after which task is considered to be expired.
acn.mgmt.acn.register.port	CS list	no	5222,443	Can contain multiple port values: 5222,443 for example. When more ports are present, mgmtd on first connection failure retries with the next port in the list.
acn.mgmt.os_time_tolerance	int	no	240	Maximum time difference between device OS time and cloud time to tolerate. If difference is bigger, mgmtd sets OS time to the controller's value.
acn.mgmt.dev_ca_off	int	no	0	Set this value to 1 to bypass SSL certificates check against registration service and XMPP server. Not to be used outside development scope.

Table 8: Cloud Management Agent Options (Continued)

Name	Type	Required	Default	Notes
acn.register.state	boolean	yes	0	Registration state: 0 = unreg, 1 = registered
acn.register.url	string	yes	https://regsvc.igniten et.com/register	Registration URL.
acn.register.login	string	depends	(empty)	This is the xmpp username - it will ONLY be set after a successful registration.
acn.register.pass	string	depends	(empty)	This is the xmpp password - it will ONLY be set after a successful registration.
acn.register.host	string	depends	(empty)	This is the xmpp server - it will ONLY be set after a successful registration.

Example

```
Console(config)#mgmt setoption acn.mgmt.status_interval=600
Console(config)#
```

mgmt property

This command sets the cloud management agent properties to their default values.

Syntax

mgmt property default

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#mgmt property default
Console(config)#
```

mgmt upgrade

This command upgrades the cloud management agent software from a file on a TFTP server.

Syntax

mgmt upgrade {*file-url*}

file-url - The path to a tar.gz archive file on a TFTP server in the format: tftp://<ip>/<folder>/<file>

Default Setting

None

Command Mode
Privileged Exec

Command Usage
The upgrade software file must be contained in a tar.gz archive file and include an MD5 checksum.

Example
```
Console#mgmt upgrade tftp://192.168.1.9/download/mgmt.tar.gz
Console#
```

show mgmt status
This command displays the status of the cloud management agent.

Syntax
show mgmt status

Command Mode
Privileged Exec

Example
```
Console#show mgmt status
Console#
```

show mgmt version
This command displays the version of the cloud management agent.

Syntax
show mgmt version

Command Mode
Privileged Exec

Example
```
Console#show mgmt version
Mgmtd version: 1.7.8-17203
Console#
```

show mgmt log

This command displays the cloud management agent log messages.

Syntax

show mgmt log

Command Mode

Privileged Exec

Example

```
Console#show mgmt log
Mgmtd log:
2020-10-26 10:19:38 [info]: calling arg: result: true; nil
2020-10-26 10:19:38 [info]: Starting mgmtd
2020-10-26 10:19:38 [info]: No default route, but uptime: 3907
2020-10-26 10:19:39 [info]: flash read
2020-10-26 10:19:39 [info]: Starting registration process
2020-10-26 10:19:39 [info]: mgmtd status set to UNREGISTERED
2020-10-26 10:19:39 [info]: Sending registration request
2020-10-26 10:19:39 [info]: HTTPS: nil, host or service not provided, or not
  known, nil, nil
2020-10-26 10:19:39 [info]: mgmtd status set to REG_FAILED
2020-10-26 10:19:39 [error]: Error: Unable to contact registration service!
  (Empty response)
Console#
```

show mgmt option

This command displays the cloud management agent options.

Syntax

show mgmt option

Command Mode

Privileged Exec

Example

```
Console#show mgmt option
Mgmtd Option:
acn.mgmt.enabled=0
acn.mgmt=acn
acn.mgmt.loglevel=info
acn.register=register
acn.register.state=0
acn.register.url=https://regsvc.ignitenet.com/register
acn.register.url_in=https://regsvc.ignitenet.in/register
acn.settings.longitude=0
acn.settings.latitude=0
acn.settings.name=IgniteNet-Switch
Console#
```

Device Designation

This section describes commands used to configure information that uniquely identifies the switch.

Table 9: Device Designation Commands

Command	Function	Mode
hostname	Specifies the host name for the switch	GC
snmp-server contact	Sets the system contact string	GC
snmp-server location	Sets the system location string	GC

hostname

This command specifies or modifies the host name for this device. Use the **no** form to restore the default host name.

Syntax

hostname *name*

no hostname

name - The name of this host. (Maximum length: 255 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- The host name specified by this command is displayed by the show system command and on the Show > System web page.

Example

```
Console(config)#hostname RD#1
Console(config)#
```

Banner Information

These commands are used to configure and manage administrative information about the switch, its exact data center location, details of the electrical and network circuits that supply the switch, as well as contact information for the network administrator and system manager. This information is only available via the CLI and is automatically displayed before login as soon as a console or telnet connection has been established.

Table 10: Banner Commands

Command	Function	Mode
banner configure	Configures the banner information that is displayed before login	GC
banner configure company	Configures the Company information that is displayed by banner	GC
banner configure dc-power-info	Configures the DC Power information that is displayed by banner	GC
banner configure department	Configures the Department information that is displayed by banner	GC
banner configure equipment-info	Configures the Equipment information that is displayed by banner	GC
banner configure equipment-location	Configures the Equipment Location information that is displayed by banner	GC
banner configure ip-lan	Configures the IP and LAN information that is displayed by banner	GC
banner configure lp-number	Configures the LP Number information that is displayed by banner	GC
banner configure manager-info	Configures the Manager contact information that is displayed by banner	GC
banner configure mux	Configures the MUX information that is displayed by banner	GC
banner configure note	Configures miscellaneous information that is displayed by banner under the Notes heading	GC
show banner	Displays all banner information	PE

banner configure

This command is used to interactively specify administrative information for this device.

Syntax

banner configure

Default Setting

None

Command Mode
Global Configuration

Command Usage
The administrator can batch-input all details for the switch with one command. When the administrator finishes typing the company name and presses the enter key, the script prompts for the next piece of information, and so on, until all information has been entered. Pressing enter without inputting information at any prompt during the script's operation will leave the field empty. Spaces can be used during script mode because pressing the enter key signifies the end of data input. The delete and left-arrow keys terminate the script. The use of the backspace key during script mode is not supported. If, for example, a mistake is made in the company name, it can be corrected with the **banner configure company** command.

Example

```
Console(config)#banner configure

Company: Edgecore Networks
Responsible department: R&D Dept
Name and telephone to Contact the management people
Manager1 name: Sr. Network Admin
 phone number: 123-555-1212
Manager2 name: Jr. Network Admin
 phone number: 123-555-1213
Manager3 name: Night-shift Net Admin / Janitor
 phone number: 123-555-1214
The physical location of the equipment.
City and street address: 12 Straight St. Motown, Zimbabwe
Information about this equipment:
Manufacturer: Edgecore Networks
ID: 123_unique_id_number
Floor: 2
Row: 7
Rack: 29
Shelf in this rack: 8
Information about DC power supply.
Floor: 2
Row: 7
Rack: 25
Electrical circuit: : ec-177743209-xb
Number of LP:12
Position of the equipment in the MUX:1/23
IP LAN:192.168.1.1
Note: This is a random note about this managed switch and can contain
  miscellaneous information.
Console(config)#
```

banner configure company

This command is used to configure company information displayed in the banner. Use the **no** form to remove the company name from the banner display.

Syntax

banner configure company *name*

no banner configure company

name - The name of the company. (Maximum length: 32 characters)

Default Setting
None

Command Mode
Global Configuration

Command Usage
Input strings cannot contain spaces. The **banner configure company** command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

Example

```
Console(config)#banner configure company Big-Ben
Console(config)#
```

banner configure dc-power-info

This command is use to configure DC power information displayed in the banner. Use the **no** form to restore the default setting.

Syntax

banner configure dc-power-info floor *floor-id* **row** *row-id* **rack** *rack-id* **electrical-circuit** *ec-id*

no banner configure dc-power-info [**floor** | **row** | **rack** | **electrical-circuit**]

floor-id - The floor number.

row-id - The row number.

rack-id - The rack number.

ec-id - The electrical circuit ID.

Maximum length of each parameter: 32 characters

Default Setting
None

Command Mode
Global Configuration

Command Usage
Input strings cannot contain spaces. The **banner configure dc-power-info** command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

Example

```
Console(config)#banner configure dc-power-info floor 3 row 15 rack 24
  electrical-circuit 48v-id_3.15.24.2
Console(config)#
```

banner configure department

This command is used to configure the department information displayed in the banner. Use the **no** form to restore the default setting.

Syntax

banner configure department *dept-name*

no banner configure department

dept-name - The name of the department. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

Input strings cannot contain spaces. The **banner configure department** command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

Example

```
Console(config)#banner configure department R&D
Console(config)#
```

banner configure equipment-info

This command is used to configure the equipment information displayed in the banner. Use the **no** form to restore the default setting.

Syntax

banner configure equipment-info manufacturer-id *mfr-id* **floor** *floor-id* **row** *row-id* **rack** *rack-id* **shelf-rack** *sr-id* **manufacturer** *mfr-name*

no banner configure equipment-info [**floor** | **manufacturer** | **manufacturer-id** | **rack** | **row** | **shelf-rack**]

mfr-id - The name of the device model number.

floor-id - The floor number.

row-id - The row number.

rack-id - The rack number.

sr-id - The shelf number in the rack.

mfr-name - The name of the device manufacturer.

Maximum length of each parameter: 32 characters

Default Setting
None

Command Mode
Global Configuration

Command Usage
Input strings cannot contain spaces. The **banner configure equipment-info** command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

Example

```
Console(config)#banner configure equipment-info manufacturer-id ECS5550-54X
  floor 3 row 10 rack 15 shelf-rack 12 manufacturer Edgecore
Console(config)#
```

banner configure equipment-location

This command is used to configure the equipment location information displayed in the banner. Use the **no** form to restore the default setting.

Syntax

banner configure equipment-location *location*

no banner configure equipment-location

location - The address location of the device. (Maximum length: 32 characters)

Default Setting
None

Command Mode
Global Configuration

Command Usage
Input strings cannot contain spaces. The **banner configure equipment-location** command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

Example

```
Console(config)#banner configure equipment-location
  710_Network_Path,_Indianapolis
Console(config)#
```

banner configure ip-lan

This command is used to configure the device IP address and subnet mask information displayed in the banner. Use the **no** form to restore the default setting.

Syntax

banner configure ip-lan *ip-mask*

no banner configure ip-lan

ip-mask - The IP address and subnet mask of the device. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

Input strings cannot contain spaces. The **banner configure ip-lan** command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

Example

```
Console(config)#banner configure ip-lan 192.168.1.1/255.255.255.0
Console(config)#
```

banner configure lp-number

This command is used to configure the LP number information displayed in the banner. Use the **no** form to restore the default setting.

Syntax

banner configure lp-number *lp-num*

no banner configure lp-number

lp-num - The LP number. (Maximum length: 32 characters)

Default Setting

None

Command Mode
Global Configuration

Command Usage
Input strings cannot contain spaces. The **banner configure lp-number** command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

Example

```
Console(config)#banner configure lp-number 12
Console(config)#
```

banner configure manager-info

This command is used to configure the manager contact information displayed in the banner. Use the **no** form to restore the default setting.

Syntax

banner configure manager-info
name *mgr1-name* **phone-number** *mgr1-number*
[**name2** *mgr2-name* **phone-number** *mgr2-number* |
name3 *mgr3-name* **phone-number** *mgr3-number*]

no banner configure manager-info [**name1** | **name2** | **name3**]

mgr1-name - The name of the first manager.

mgr1-number - The phone number of the first manager.

mgr2-name - The name of the second manager.

mgr2-number - The phone number of the second manager.

mgr3-name - The name of the third manager.

mgr3-number - The phone number of the third manager.

Maximum length of each parameter: 32 characters

Default Setting
None

Command Mode
Global Configuration

Command Usage
Input strings cannot contain spaces. The **banner configure manager-info** command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

Example

```
Console(config)#banner configure manager-info name Albert_Einstein phone-
  number 123-555-1212 name2 Lamar phone-number 123-555-1219
Console(config)#
```

banner configure mux

This command is used to configure the mux information displayed in the banner. Use the **no** form to restore the default setting.

Syntax

banner configure mux *muxinfo*

no banner configure mux

muxinfo - The circuit and PVC to which the switch is connected. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

Input strings cannot contain spaces. The **banner configure mux** command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

Example

```
Console(config)#banner configure mux telco-8734212kx_PVC-1/23
Console(config)#
```

banner configure note

This command is used to configure the note displayed in the banner. Use the **no** form to restore the default setting.

Syntax

banner configure note *note-info*

no banner configure note

note-info - Miscellaneous information that does not fit the other banner categories, or any other information of importance to users of the switch CLI. (Maximum length: 150 characters)

Default Setting

None

Command Mode
Global Configuration

Command Usage
Input strings cannot contain spaces. The **banner configure note** command interprets spaces as data input boundaries. The use of underscores (_) or other unobtrusive non-letter characters is suggested for situations where white space is necessary for clarity.

Example

```
Console(config)#banner configure note !!!!!ROUTINE_MAINTENANCE_firmware-
  upgrade_0100-0500_GMT-0500_20071022!!!!!_20min_network_impact_expected
Console(config)#
```

show banner
This command displays all banner information.

Command Mode
Privileged Exec

Example

```
Console#show banner
Edgecore
WARNING - MONITORED ACTIONS AND ACCESSES
R&D

Albert_Einstein - 123-555-1212
Lamar - 123-555-1219

Station's information:
710_Network_Path,_Indianapolis

 ECS5550-54X
Floor / Row / Rack / Sub-Rack
 3/ 10 / 15 / 12
DC power supply:
Power Source A: Floor / Row / Rack / Electrical circuit
 3/ 15 / 24 / 48v-id_3.15.24.2
Number of LP: 12
Position MUX: telco-8734212kx_PVC-1/23
IP LAN: 192.168.1.1/255.255.255.0
Note: !!!!!ROUTINE_MAINTENANCE_firmware-upgrade_0100-0500_GMT-
  0500_20071022!!!!!_20min_network_
Console#
```

System Status

This section describes commands used to display system information.

Table 11: System Status Commands

Command	Function	Mode
tech-support save flash	Writes all the content of show tech-support into flash and saves it as a log file	PE
show access-list tcam-utilization	Shows utilization parameters for TCAM	PE
show license	Shows all the function profile options of existing licenses	PE
show license file	Shows the contents of the current license file in the switch	PE
show license function-detail	Shows detailed function information of the current license	PE
show remote-license	Displays remote license file information	PE
show memory	Shows memory utilization parameters	PE
show process cpu	Shows CPU utilization parameters	PE
show process cpu guard	Shows the CPU utilization watermark and threshold	NE
show process cpu task	Shows CPU utilization per process	PE
show running-config	Displays the configuration data currently in use	PE
show startup-config	Displays the contents of the configuration file (stored in flash memory) that is used to start up the system	PE
show system	Displays system information	NE, PE
show tech-support	Displays a detailed list of system settings designed to help technical support resolve configuration or functional problems	PE
show users	Shows all active console and Telnet sessions, including user name, idle time, and IP address of Telnet clients	NE, PE
show version	Displays version information for the system	NE, PE
show watchdog	Shows if watchdog debugging is enabled	PE
watchdog software	Monitors key processes, and automatically reboots the system if any of these processes are not responding correctly	PE

tech-support save flash

This command writes all the content of the show tech-support command into flash and saves it as a log file.

Syntax

tech-support save flash

Command Mode

Privileged Exec

Command Usage

This command writes the content of the show tech-support command to flash memory and saves it as a log file. The log file can then be downloaded using the copy log command.

Example

```
Console#tech-support save flash
tech-support save succcess
Console#
```

show access-list tcam-utilization

This command shows utilization parameters for TCAM (Ternary Content Addressable Memory), including the number policy control entries in use, and the number of free entries.

Command Mode

Privileged Exec

Command Usage

Policy control entries (PCEs) are used by various system functions which rely on rule-based searches, including Access Control Lists (ACLs), IP Source Guard filter rules, Quality of Service (QoS) processes, or traps.

For example, when binding an ACL to a port, each rule in an ACL will use two PCEs; and when setting an IP Source Guard filter rule for a port, the system will also use two PCEs.

Example

```
Console#show access-list tcam-utilization
Pool capability code:
  AM - MAC ACL, A4 - IPv4 ACL, A6S - IPv6 Standard ACL,
  A6E - IPv6 extended ACL, DM - MAC diffServ, D4 - IPv4 diffServ,
  D6S - IPv6 standard diffServ, D6E - IPv6 extended diffServ,
  I - IP source guard, C - CPU interface, L - Link local,
  Reserved - Reserved, ALL - All supported function,

Unit Device Pool Total Used  Free  Capability
---- ------ ---- ----- ----- ----- ----------------------------------------
   1      0    0   128   128     0 R
   1      0    1    64     0    64 A6S A6E
   1      0    2   128     0   128 A4
   1      0    3   128     0   128 AM
   1      0    4    64     0    64 D6S D6E
   1      0    5   128     0   128 D4 W IPSV
   1      0    6   128     0   128 DM
   1      0    7   128     0   128 MV PV VV
   1      0    8    64     0    64 I
   1      0    9    64     0    64 I6
   1      0   10    64    64     0 C
   1      0   11    64    64     0 C L
   1      0   12    64     0    64 AE6S AE6E
   1      0   13   128     0   128 AE4
   1      0   14   128     0   128 AEM
   1      0   15    64     0    64 DE6S DE6E
   1      0   16   128     0   128 DE4
```

```
   1      0   17   128     0   128 DEM
Console#
```

show license

This command displays the current license profile of the system operation code and the active and inactive functions.

Syntax

show license

Command Mode

Privileged Exec

Command Usage

- An "L2+, cloud-u" profile indicates a L2+ license that does not support cloud management. An "L2+, cloud-m" profile indicates a L2+ license that supports cloud management.
- The "Essential" basic features are those not controlled by a function license. Features controlled by license must be activated by a function license.

Example

```
Console#show license
Current Image Profile:
  Essential, cloud-m
Active functions:

Inactive functions:
  L3 Premium
Console#
```

show license file

This command displays the contents of the current license file in the switch.

Command Mode

Privileged Exec

Example

```
Console#show license file
ID Expired Date Feature
-- ------------ -------------------------------------------------
 1 2025-12-05   Essential, cloud-m

Input ID to show detail: 1

sw-license/1.1
Name: NTC
CPU-MAC-Address: B4-6A-D4-B2-EE-69
Project-Number: ECS5550
Accept-Mode: *
```

```
License-Number: 8d39540f-eeea-42e4-be7e-f29f80cd63b3
License-Issue-Date: Fri Sep  5 07:33:49 2025
License-Valid-Start-Date: Fri Sep  5 00:00:00 2025
License-Valid-End-Date: Fri Dec  5 00:00:00 2025
License-Profile: Essential, cloud-m
License-Profile-Digest: da407b2c4c92090ced9e3b9c5f8747ab
License-Access-List: XosSpoAHWl65GISZrWSjkEFGx/
  BHN4IDXGMhzebN+tsA1xsvFvnl41KSTzH
104BWniwwKGCB7YXi3E4lJKr3wSDUXi2nZiIdzJ9VuQMC7eI4VacJFqoGuQ812EwefgYIRTzU6P3
  fBKk
QDJjaXR0WfnFYMLjEhjR6BpBiScnVma4FNrupDElm5USNepX0MM2i0EB2/
  saMVZ6v2QSur+S8Ab9uvrPpST/KDhIq/iMtj337DViFUW6kbXGP
mWUSGPNQRuSL7jpYZ6uNG8jcljugiHp5qIixk/
  0E91rTBhfqw+JGK5e9oQqYKkhy+xFa9git4d5bvs7N
nldjxgqkvCM5iDoC5iCCdHb6QhLjCSp633oAtpT6iOkja2hp4xH+hA5qnBLyl7fCe3Kg9sd6chbs
  x4weInMV6VavkjpNvuq0ioa+eVsba81gy
EUxc4nSLqP9ad3OkmxvPgHh4sXfdqif0w==
Signature1: AfZvpKuxo0M0Ir1/
  7D8x0SLjibnOf7nU2TMjWlzo5sZHocmupJnTGPjqWu3bBIU8YImy
UJQgNi9PQQ8LSXIdi9fR+bxdaX/
  8tKAcdbQiOu7LGqBlwhLsYPNhvHJwRu6OWls9fb15eIrfJBW6Tuar
VQZgUWyVLhbFcyFBjAoIqh2NDodBHI32h07vX0JtVxunigwgJwEYULv+DGK4Y/
  wb9nZjajR7U7zWIvIm1gHkp3PN8pkFNStYSZCHLy6P9Eqnx
bDQGIEU+s7Tm0jm4uDrk1brKoxhhiQyBSUDVE7mi1B3dTl9lxQhMgjp9Vg1b+BjwiZv+sNpJp+ZA
  fufb
EUJNA==
Signature2: cRcOMCEmJnyb4F4DVJcIpeY0S/Dm4/
  q2HmyYT7NSj5n6dnUqlKlhUDYYmxgkqNAzYXEi
+wFQT67WT1Q7862VvBekuimWVoXlBqvvvy1EkfqPxHCwMQARw7/luyeuQF/
  iwtyyF0xGSKKzfAPekogN
eJKFsBr6S5g42I0sWq0B9kOZy3RhRRLg1JESwR6QGhvb5YgwGIuWycJ25w48B5FafvixCNs2HaWx
  Jwpf/Pt0edaerpJ0KPsDyuBp79xEknYoW
CdzLaC8LCjXpPNtv4BFnVp7/pkSG+Z4zSaMFVowoFWvv3CWMj6Dwoyov9iFV8/
  Q1b20++YFT6yH9dDtx
WtvYg==
Console#
```

show license function-detail

This command displays the detailed information of function groups supported by the system operation code.

Syntax

show license function-detail

Command Mode

Privileged Exec

Example

```
Console#show license function-detail
LL3 Premium: OSPF, OSPFv3, BGP, RIPng, IGMP, PIM, VRRP, PBR,
             UDP Helper, Loopback Interface, Null Interface
Console#
```

show remote-license

This command displays licenses available for the switch that are on a remote server.

Syntax

show remote-license

Command Mode

Privileged Exec

Command Usage

- After you have purchased a license from Edgecore, it will be available on a remote server for download to the switch using the copy remote-license command.
- This command only displays licenses available on the remote server. To check license details, first download the license to the switch and then use the show license file command.
- Before using remote license commands, make sure the switch has an Internet connection and an accurate UTC time is set.

Example

```
Console#show remote-license
Pure License:
  Existent
Profile License:
  ID Profile Name
---- ---------------------------------------------------
   1 L2+, cloud-u
   2 L3
   3 inverse-vector
Function License:
  ID Function List
---- ---------------------------------------------------
   1 FunctionA
   2 L3 Super,FunctionB

Console#
```

show memory

This command shows memory utilization parameters, and alarm thresholds.

Command Mode

Privileged Exec

Command Usage

This command shows the amount of memory currently free for use, the amount of memory allocated to active processes, the total amount of system memory, and the alarm thresholds.

Example

```
Console#show memory
 Status Bytes      %
 ------ ---------- ---
 Free   3598147584  83
 Used    696819712  17
 Total  4294967296

 Alarm Configuration
  Rising Threshold         : 90%
  Falling Threshold        : 70%

Console#
```

show process cpu

This command shows the CPU utilization parameters, alarm status, and alarm thresholds.

Command Mode

Privileged Exec

Example

```
Console#show process cpu
 CPU Utilization in the past 5 seconds : 24%

 CPU Utilization in the past 60 seconds
  Average Utilization      : 24%
  Maximum Utilization      : 25%

 Alarm Status
  Current Alarm Status     : Off
  Last Alarm Start Time    : Dec 31 00:00:19 2000
  Last Alarm Duration Time : 15 seconds

 Alarm Configuration
  Rising Threshold         : 90%
  Falling Threshold        : 70%

Console#
```

show process cpu guard

This command shows the CPU utilization watermark and threshold settings.

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show process cpu guard
 CPU Guard Configuration
  Status            : Disabled
  High Watermark    : 90%
  Low Watermark     : 70%
  Maximum Threshold : 500 packets per second
  Minimum Threshold : 50 packets per second
```

```
  Trap Status       : Disabled
 CPU Guard Operation
  Current Threshold : 500 packets per second

Console#
```

show process cpu task

This command shows the CPU utilization per process.

Command Mode

Privileged Exec

Example

```
Console#show process cpu task
Task            Util (%) Avg (%)  Max (%)
--------------- -------- -------- --------
AMTR_ADDRESS        0.00     0.00     0.00
AMTRL3              0.00     0.00     0.00
AMTRL3_GROUP        0.00     0.00     0.00
APP_PROTOCOL_PR     0.00     0.00     0.00
AUTH_GROUP          0.00     0.00     0.00
AUTH_PROC           0.00     0.00     0.00
BGP_TD              0.00     0.00     0.00
CFGDB_TD            0.00     0.00     0.00
CFM_GROUP           0.00     0.00     0.00
CLITASK0            0.00     0.00     0.00
CORE_UTIL_PROC      0.00     0.00     0.00
DHCPSNP_GROUP       0.00     0.00     0.00
DOT1X_SUP_GROUP     0.00     0.00     0.00
DRIVER_GROUP        1.00     0.75     2.00
DRIVER_GROUP_FR     0.00     0.00     0.00
DRIVER_GROUP_TX     0.00     0.00     0.00
FS                  0.00     0.00     0.00
HTTP_TD             0.00     0.00     5.00
HW_WTDOG_TD         0.00     0.00     0.00
IML_TX              0.00     0.00     0.00
IP_SERVICE_GROU     0.00     0.00     0.00
KEYGEN_TD           0.00     0.00     0.00
L2_L4_PROCESS       0.00     0.00     4.00
L2MCAST_GROUP       0.00     0.00     0.00
L2MUX_GROUP         0.00     0.00     0.00
L4_GROUP            0.00     0.00     0.00
LACP_GROUP          0.00     0.00     0.00
MSL_TD              0.00     0.00     0.00
NETACCESS_GROUP     0.00     0.00     0.00
NETACCESS_NMTR      0.00     0.25     2.00
NETCFG_GROUP        0.00     0.00     0.00
NETCFG_PROC         0.00     0.08     1.00
NIC                 0.00     0.00     0.00
NMTRDRV             1.00     1.66     4.00
NSM_GROUP           0.00     0.00     0.00
NSM_PROC            0.00     0.00     0.00
NSM_TD              0.00     0.00     0.00
OSPF6_TD            0.00     0.00     0.00
OSPF_TD             0.00     0.00     0.00
PIM_GROUP           0.00     0.00     0.00
PIM_PROC            0.00     0.00     0.00
PIM_SM_TD           0.00     0.00     0.00
POE_PROC            0.00     0.00     0.00
RIP_TD              0.00     0.00     0.00
```

```
SNMP_GROUP           0.00      0.00      0.00
SNMP_TD              0.00      0.00      0.00
SSH_GROUP            0.00      0.00      0.00
SSH_TD               0.00      0.00      0.00
STA_GROUP            0.00      0.00      0.00
STKCTRL_GROUP        0.00      0.00      0.00
STKTPLG_GROUP        0.00      0.00      0.00
SWCTRL_GROUP         0.00      0.00      0.00
SWCTRL_TD            0.00      0.00      0.00
SWDRV_MONITOR       21.00     19.25     21.00
SYS_MGMT_PROC        0.00      0.00      0.00
SYSDRV               0.00      0.00      0.00
SYSLOG_TD            0.00      0.00      0.00
SYSMGMT_GROUP        0.00      0.00      0.00
SYSTEM               0.00      0.00      0.00
UDLD_GROUP           0.00      0.00      0.00
WTDOG_PROC           0.00      0.00      0.00
XFER_GROUP           0.00      0.00      0.00
XFER_TD              0.00      0.00      0.00

Console#
```

show running-config

This command displays the configuration information currently in use.

Syntax

show running-config [**interface** *interface* | *key-word*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* (Range: 1-4094)

key-word - One of the following keywords that identify a feature:

acl, aclaccessgroup, autotrafficcontrol, cfm, controlplane, createtrunk, dai, dhcpsnooping, dns, dot1x, erps, ethernet, excludedvlan, heartbeat, http, igmpfilter, igmpmldfilter, igmpsnooping, interface, ipdhcpsnooping, interface, ipaddress, ipv4dhcpdynamic, ipv6, ipv6dhcp, ipv6dhcpdynamic, ipv6dhcpsnooping, ipv6ndsnooping, l3global, lbd, line, lldp, loopback, macaddresstable, macvlan, managementip, mdns, mlag, mldsnooping, mvr, mvr6, netaccess, ntp, pppoeia, privilegelevel, protocolvlan, qos, qosclassmap, qosglobalmap,

qospolicymap, reload, remoteauthaaa, rmon, rspan, smartpair, smtp, snmp, sourceguard, spanningtreemstp, spanningtreestp, spanningtreexstp, ssh, subnetvlan, syslog, system, tftp, timerange, trafficseg, trunk, twampglobal, udld, userauth, vdslglobal, vlan, vlandatabase, voicevlan, webauth

Command Mode

Privileged Exec

Command Usage

- Use the **interface** keyword to display configuration data for the specified interface.
- Use this command in conjunction with the **show startup-config** command to compare the information in running memory to the information stored in non-volatile memory.
- This command displays settings for key command modes. Each mode group is separated by "!" symbols, and includes the configuration mode command, and corresponding commands. This command displays the following information:
  - MAC address
  - SNMP community strings
  - Users (names, access levels, and encrypted passwords)
  - VLAN database (VLAN ID, name and state)
  - VLAN configuration settings for each interface
  - Multiple spanning tree instances (name and interfaces)
  - IP address configured for VLANs
  - Routing protocol configuration settings
  - Spanning tree settings
  - Interface settings
  - Any configured settings for the console port and Telnet
- For security reasons, user passwords are only displayed in encrypted format.

Example

```
Console#show running-config
!<stackingDB>00</stackingDB>
!<stackingMac>01_00-e0-0c-00-00-fd_03</stackingMac>
!
snmp-server community public ro
snmp-server community private rw
!
enable password 7 1b3231655cebb7a1f783eddf27d254ca
!
vlan database
 VLAN 1 name DefaultVlan media ethernet
!
spanning-tree mst configuration
!
interface ethernet 1/1
 no negotiation
```

```
...
interface ethernet 1/18
 no negotiation
!
interface vlan 1
 ip address dhcp
!
interface vlan 1
!
line console
!
line vty
!
end
!
Console#
```

show startup-config

This command displays the configuration file stored in non-volatile memory that is used to start up the system.

Command Mode

Privileged Exec

Command Usage

- Use this command in conjunction with the **show running-config** command to compare the information in running memory to the information stored in non-volatile memory.

- This command displays settings for key command modes. Each mode group is separated by "!" symbols, and includes the configuration mode command, and corresponding commands. This command displays the following information:
  - MAC address
  - SNMP community strings
  - SNMP trap authentication
  - Users (names and access levels)
  - VLAN database (VLAN ID, name and state)
  - Multiple spanning tree instances (name and interfaces)
  - Interface settings and VLAN configuration settings for each interface
  - IP address for VLANs
  - Any configured settings for the console port and Telnet

Example
Refer to the example for the running configuration file.

show system
This command displays system information.

Default Setting
None

Command Mode
Normal Exec, Privileged Exec

Example

```
Console#show system
System Description : ECS5550-54X
System OID String  : 1.3.6.1.4.1.259.10.1.62.101
System Information
 System Up Time         : 0 days, 0 hours, 32 minutes, and 45.80 seconds
 System Name            :
 System Location        :
 System Contact         :
 MAC Address (Unit 1)   : B4-6A-D4-B2-EE-69
 Web Server             : Enabled
 Web Server Port        : 80
 HTTP/HTTPS Timeout     : 300(second)
 Web Secure Server      : Enabled
 Web Secure Server Port : 443
 Telnet Server          : Enabled
 Telnet Server Port     : 23
 Jumbo Frame            : Disabled

System Fan:
 Force Fan Speed Full   : Disabled
Unit 1
 Fan 1: Ok                    Fan 2: Ok                    Fan 3: Ok
 Fan 1 speed:  8301 rpm     Fan 2 speed:  8015 rpm     Fan 3 speed:  8015 rpm
 Fan 4: Ok
 Fan 4 speed:  8015 rpm


System Temperature:
Unit 1
 Temperature 1      :  23 degrees
 Rising Threshold   :  50 degrees
 Falling Threshold  :  30 degrees
 Temperature 2      :  28 degrees
 Rising Threshold   :  50 degrees
 Falling Threshold  :  30 degrees
 Temperature 3      :  28 degrees
 Rising Threshold   :  50 degrees
 Falling Threshold  :  30 degrees

Unit 1

 Main Power Status      : Up
 Redundant Power Status : Not present
Console#
```

show tech-support

This command displays a detailed list of system settings designed to help technical support resolve configuration or functional problems.

Command Mode

Normal Exec, Privileged Exec

Command Usage

This command generates a long list of information including detailed system and interface settings. It is therefore advisable to direct the output to a file using any suitable output capture function provided with your terminal emulation program.

Example

```
User Access Verification

Username: admin
Password:

      CLI session with the ECS5550-54X is opened.
      To end the CLI session, enter [Exit].

Vty-2#show tech-support

dir:
File Name                     Type    Startup Modified Time       Size (bytes)
----------------------------- ------- ------- ------------------- ------------
 Unit 1:
ECS5550_V1.1.2.243.bix        OpCode  N       2024-07-16 07:33:47   39,400,747
ECS5550_V1.1.3.243.bix        OpCode  Y       2024-07-15 13:21:27   39,401,799
Factory_Default_Config.cfg    Config  N       2024-07-11 08:22:53          390
startup1.cfg                  Config  Y       2024-07-15 13:23:22        2,212
test.cfg                      Config  N       2024-07-11 08:45:36        2,684
------------------------------------------------------------------------------
                   Free space for compressed user config files: 2,543,143,936
                                                 Total space: 3,082,760,192

show arp:
ARP Cache Timeout: 1200 (seconds)

IP Address      MAC Address       Type      Interface
--------------- ----------------- --------- -----------
192.168.2.99    F0-79-59-8F-2B-FE dynamic   VLAN 1

Total entry : 1

show interfaces brief:
Interface Name              Status    PVID  Pri Speed/Duplex  Type        Trunk
--------- ----------------- --------- ----- --- ------------- ----------- -----
Eth 1/ 1                      Down        1   0   10Gfull       10GBASE SFP+
  None
Eth 1/ 2                      Down        1   0   10Gfull       10GBASE SFP+
  None
Eth 1/ 3                      Down        1   0   10Gfull       10GBASE SFP+
  None
Eth 1/ 4                      Down        1   0   10Gfull       10GBASE SFP+
  None
Eth 1/ 5                      Down        1   0   10Gfull       10GBASE SFP+
  None

...
```

show users

Shows all active console and Telnet sessions, including user name, idle time, and IP address of Telnet client.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

The session used to execute this command is indicated by a "*" symbol next to the Line (i.e., session) index number.

Example

```
Console#show users
User Name Accounts:
User Name            Privilege  Public-Key
-------------------- ---------- ---------------
admin                        15 None
guest                         0 None

Online Users:
Line      Session ID User Name            Idle Time (h:m:s) Remote IP Addr
--------- ---------- -------------------- ----------------- -----------------
*Console           0 admin                          0:00:01

Web Online Users:
Line       User Name            Idle Time (h:m:s)    Remote IP Addr
---------- -------------------- -------------------- --------------------

Console#
```

show version

This command displays hardware and software version information for the system.

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show version
Unit 1
 Serial Number          : EC2349002346
 Hardware Version       : R0B
 Number of Ports        : 54
 Main Power Status      : Down
 Redundant Power Status : Up
 Role                   : Master
 Loader Version         : 1.0.1
 Linux Kernel Version   : 4.14.207-10.23.01
 Operation Code Version : 1.1.6.243

Console#
```

show watchdog

This command shows if watchdog debugging is enabled.

Command Mode

Privileged Exec

Example

```
Console#show watchdog
Software Watchdog Information
 Status :    Enabled
 AutoReload :    Enabled
Console#
```

watchdog software

This command monitors key processes, and automatically reboots the system if any of these processes are not responding correctly.

Syntax

watchdog software {disable | enable}

Default Setting

Disabled

Command Mode

Privileged Exec

Example

```
Console#watchdog software disable
Console#
```

Fan Control

This section describes the command used to force fan speed.

Table 12: Fan Control Commands

Command	Function	Mode
fan-speed force-full	Forces fans to full speed	GC
show system	Shows if full fan speed is enabled	NE, PE

fan-speed force-full

This command sets all fans to full speed. Use the no form to reset the fans to normal operating speed. Use the **no** form to restore the default setting.

Syntax

[no] **fan-speed force-full**

Default Setting

Normal speed

Command Mode

Global Configuration

Example

```
Console(config)#fan-speed force-full
Console(config)#
```

Thermal Thresholds

This section describes the command used to set thermal threshold alarms.

Table 13: Fan Control Commands

Command	Function	Mode
thermal	Sets thermal alarm thresholds	GC
show system	Shows thermal threshold settings	NE, PE

thermal

This command sets system rising and falling temperature thresholds. Use the **no** form to reset the thresholds to default values.

Syntax

thermal unit *unit* **index** *thermal-index* {**falling** *temp* | **rising** *temp*}

no thermal unit *unit* **index** *thermal-index* {**falling** | **rising**}

unit - Unit identifier. (Range: 1)

thermal-index - The thermal index. (Range: 1-3)

temp - Sets the rising or falling temperature threshold. (Range: 20-55 degrees Celsius)

Default Setting

Falling Threshold: 30 °C
Rising Threshold: 50 °C

Command Mode
Global Configuration

Command Usage
When the system temperature exceeds the rising threshold, a trap message is sent and the event is logged as a high temperature alarm. When the system temperature falls back below the falling threshold, a trap message is sent and the event is logged as a recovery alarm.

Example

```
Console(config)#thermal unit 1 index 1 rising 55
Console(config)#
```

Frame Size

This section describes commands used to configure the Ethernet frame size on the switch.

Table 14: Frame Size Commands

Command	Function	Mode
jumbo frame	Enables support for jumbo frames	GC

jumbo frame

This command enables support for layer 2 jumbo frames for Gigabit and 10 Gigabit Ethernet ports. Use the **no** form to disable it.

Syntax

[no] jumbo frame

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
- This switch provides more efficient throughput for large sequential data transfers by supporting layer 2 jumbo frames on Gigabit and 10 Gigabit Ethernet ports or trunks up to 10240 bytes. Compared to standard Ethernet frames that run only up to 1.5 KB, using jumbo frames significantly reduces the per-packet overhead required to process protocol encapsulation fields.

- To use jumbo frames, both the source and destination end nodes (such as a computer or server) must support this feature. Also, when the connection is operating at full duplex, all switches in the network between the two end nodes

must be able to accept the extended frame size. And for half-duplex connections, all devices in the collision domain would need to support jumbo frames.

- The current setting for jumbo frames can be displayed with the show system command.

Example

```
Console(config)#jumbo frame
Console(config)#
```

File Management

Managing Firmware

Firmware can be uploaded and downloaded to or from an FTP/SCP/TFTP server. By saving runtime code to a file on an FTP/FTPS/SCP/SFTP/TFTP server, that file can later be downloaded to the switch to restore operation. The switch can also be set to use new firmware without overwriting the previous version.

When downloading runtime code, the destination file name can be specified to replace the current image, or the file can be first downloaded using a different name from the current runtime code file, and then the new file set as the startup file.

Saving or Restoring Configuration Settings

Configuration settings can be uploaded and downloaded to and from an FTP/FTPS/SCP/SFTP/TFTP server. The configuration file can be later downloaded to restore switch settings.

The configuration file can be downloaded under a new file name and then set as the startup file, or the current startup configuration file can be specified as the destination file to directly replace it. Note that the file "Factory_Default_Config.cfg" can be copied to the FTP/FTPS/SCP/SFTP/TFTP server, but cannot be used as the destination on the switch.

Table 15: Flash/File Commands

Command	Function	Mode
General Commands		
boot system	Specifies the file or image used to start up the system	GC
copy	Copies a code image or a switch configuration to or from flash memory or an FTP/SFTP/TFTP server	PE
copy remote-license	Copies license files from a remote server to the switch	PE
delete	Deletes a file or code image	PE

Table 15: Flash/File Commands (Continued)

Command	Function	Mode
dir	Displays a list of files in flash memory	PE
umount	Unmount a removable USB device.	PE
whichboot	Displays the files booted	PE
Automatic Code Upgrade Commands		
upgrade opcode auto	Automatically upgrades the current image when a new version is detected on the indicated server	GC
upgrade opcode path	Specifies an FTP/SFTP/TFTP server and directory in which the new opcode is stored	GC
upgrade opcode reload	Reloads the switch automatically after the opcode upgrade is completed	GC
show upgrade	Shows the opcode upgrade configuration settings.	PE
TFTP Configuration Commands		
ip tftp retry	Specifies the number of times the switch can retry transmitting a request to a TFTP server	GC
ip tftp timeout	Specifies the time the switch can wait for a response from a TFTP server before retransmitting a request or timing out for the last retry	GC
show ip tftp	Displays information about TFTP settings	PE

General Commands

boot system

This command specifies the file or image used to start up the system.

Syntax

boot system {boot-rom | config | opcode}: *filename*

boot-rom* - Boot ROM.

config* - Configuration file.

opcode* - Run-time operation code.

filename - Name of configuration file or code image.

* The colon (:) is required.

Default Setting

None

Command Mode

Global Configuration

Command Usage

- A colon (:) is required after the specified file type.

- If the file contains an error, it cannot be set as the default file.

Example

```
Console(config)#boot system config: startup
Console(config)#
```

copy This command moves (upload/download) a code image or configuration file between the switch's flash memory and an FTP/FTPS/SCP/SFTP/TFTP server. When you save the system code or configuration settings to a file on an FTP/FTPS/SCP/SFTP/TFTP server, that file can later be downloaded to the switch to restore system operation. The success of the file transfer depends on the accessibility of the FTP/FTPS/SCP/SFTP/TFTP server and the quality of the network connection.

Syntax

copy file {file | ftp | ftps | running-config | scp | sftp | startup-config | tftp | unit | usbdisk}

copy ftp {add-to-running-config | file | https-certificate | public-key | radsec-certificate | running-config | startup-config}

copy ftps {add-to-running-config | file | public-key | radsec-certificate | running-config | startup-config}

copy sftp {add-to-running-config | file | https-certificate | public-key | radsec-certificate | running-config | startup-config}

copy tftp {add-to-running-config | file | https-certificate | public-key | radsec-certificate | running-config | startup-config}

copy running-config {file | ftp | ftps | sftp |startup-config | tftp}

copy startup-config {file | ftp | ftps |running-config | sftp | tftp}

copy log {ftp | sftp | tftp}

copy scp file

copy unit file

copy usbdisk file

add-to-running-config - Keyword that adds the settings listed in the specified file to the running configuration.

file - Keyword that allows you to copy to/from a file.

ftp - Keyword that allows you to copy to/from an FTP server.

ftps - Keyword that allows you to copy to/from an FTPS server.

https-certificate - Keyword that allows you to copy the HTTPS secure site certificate.

public-key - Keyword that allows you to copy a SSH key from a TFTP server. (See "Secure Shell" on page 221.)

radsec-certificate - Copies a CA certificate for secure RADIUS from a server to the switch. (See "radius-server type radsec" on page 197.)

running-config - Keyword that allows you to copy to/from the current running configuration.

log - Keyword that copies a log file to an FTP/SFTP/TFTP server.

scp - Keyword that copies a file to or from an SCP server.

sftp - Keyword that copies a file to or from an SFTP server.

startup-config - The configuration used for system initialization.

tftp - Keyword that allows you to copy to/from a TFTP server.

unit - Keyword that copies a file to/from a device unit.

usbdisk - Keyword that copies a file to/from a USB device.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- The system prompts for data required to complete the copy command.
- The destination file name should not contain slashes (\ or /), and the maximum length for file names is 32 characters for files on the switch or 127 characters for files on the server. (Valid characters: A-Z, a-z, 0-9, ".", "-")
- The switch supports only two operation code files, but the maximum number of user-defined configuration files is 16.
- Downloaded operation code files may not be saved by the system if the code is not compatible with the hardware, or if there is an incompatibility with the function profile license.
- You can use "Factory_Default_Config.cfg" as the source to copy from the factory default configuration file, but you cannot use it as the destination.
- To replace the startup configuration, you must use **startup-config** as the destination.
- The Boot ROM and Loader cannot be uploaded or downloaded from the FTP/FTPS/SFTP/TFTP server. You must follow the instructions in the release notes for new firmware, or contact your distributor for help.
- For information on specifying an https-certificate, see "Replacing the Default Secure-site Certificate" in the *Web Management Guide*. For information on configuring the switch to use HTTPS for a secure connection, see the ip http secure-server command.

- When logging into an FTP server, the interface prompts for a user name and password configured on the remote server. Note that "anonymous" is set as the default user name.

- When logging into a remote SFTP/FTPS server, the interface prompts for a user name and password configured on the remote server. If this is a first time connection, the system checks to see if the public key offered by the server matches one stored locally. If not, the server's public key will be copied to the local system.

- Secure Shell FTP (SFTP) provides a method of transferring files between two network devices over an SSH2-secured connection. SFTP functions similar to Secure Copy (SCP), using SSH for user authentication and data encryption.

  Although the underlying premises of SFTP are similar to SCP, it requires some additional steps to verify the protocol versions and perform security checks. SFTP connection setup includes verification of the DSS signature, creation of session keys, creation of client-server and server-client ciphers, SSH key exchange, and user authentication. An SFTP channel is then opened, the SFTP protocol version compatibility verified, and SFTP finally initialized.

- The reload command will not be accepted during copy operations to flash memory.

Example

The following example shows how to download new firmware from a TFTP server:

```
Console#copy tftp file
TFTP server ip address: 10.1.0.19
Choose file type:
 1. config:  2. opcode: 2
Source file name: m360.bix
Destination file name: m360.bix
\Write to FLASH Programming.
-Write to FLASH finish.
Success.
Console#
```

The following example shows how to upload the configuration settings to a file on the TFTP server:

```
Console#copy file tftp
Choose file type:
 1. config:  2. opcode: 1
Source file name: startup
TFTP server ip address: 10.1.0.99
Destination file name: startup.01
TFTP completed.
Success.

Console#
```

The following example shows how to copy the running configuration to a startup file.

```
Console#copy running-config file
destination file name: startup
Write to FLASH Programming.
\Write to FLASH finish.
Success.

Console#
```

The following example shows how to download a configuration file:

```
Console#copy tftp startup-config
TFTP server ip address: 10.1.0.99
Source configuration file name: startup.01
Startup configuration file name [startup]:
Write to FLASH Programming.

\Write to FLASH finish.
Success.

Console#
```

This example shows how to copy a secure-site certificate from an TFTP server. It then reboots the switch to activate the certificate:

```
Console#copy tftp https-certificate
TFTP server ip address: 10.1.0.19
Source certificate file name: SS-certificate
Source private file name: SS-private
Private password: ********

Success.
Console#reload
System will be restarted, continue <y/n>? y
```

This example shows how to copy a public-key used by SSH from an TFTP server. Note that public key authentication via SSH is only supported for users configured locally on the switch.

```
Console#copy tftp public-key
TFTP server IP address: 192.168.1.19
Source public-key file name: steve.pub
Username: steve
TFTP Download
Success.
Write to FLASH Programming.
Success.

Console#
```

This example shows how to copy a file to an FTP server.

```
Console#copy ftp file
FTP server IP address: 169.254.1.11
User[anonymous]: admin
Password[]: *****
Choose file type:
 1. config:  2. opcode: 2
Source file name: BLANC.BIX
Destination file name: BLANC.BIX
Console#
```

This example shows how to copy a file from an SFTP server. Note that the public key offered by the server is not found on the local system, but is saved locally after the user selects to continue the copy operation.

```
Console#copy sftp file
SFTP server IP address: 192.168.0.110
Choose file type:
1. config: 2. opcode: 1
Source file name: startup2.cfg
Destination file name: startup2.cfg
Login User Name: admin
Login User Password:
Press 'y' to allow connect to new sftp server,
and 'N' to deny connect to new sftp server: y
Success.
Console#
```

copy remote-license

This command copies license files from the remote license server to the local switch system.

Syntax

copy remote-license

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- After you have purchased a license from Edgecore, it will be available on a remote server for download to the switch using this command.
- Before using remote license commands, make sure the switch has an Internet connection and an accurate UTC time is set.
- Before using the this command, it is recommended to first use the show remote-license command to get the IDs of the remote license files.

- Downloading a pure license file overwrites a pure license file already in the local system.
- When there is already a profile license file in the local system that has the same profile as a downloaded file, the profile license file is overwritten by the downloaded file.
- When the local system already has a function license file with the same content as a function license to be downloaded, the remote function license file is not downloaded.
- The maximum number of function license files permitted in a local system is 16. Use the delete function-license command to remove function license files from the system.
- The detailed functions for strings in a function list can be obtained by using the show license function-detail command.

Example

The following example shows how to display the IDs of the remote license files and then copy the license files from the remote license server to the switch.

```
Console#show remote-license
Pure License:
  Existent
Profile License:
  ID Profile Name
---- ---------------------------------------------------
  1 L2+, cloud-u
  2 L3
  3 inverse-vector
Function License:
  ID Function List
---- ---------------------------------------------------
  1 DHCPSnooping_option82,ERPS
  2 LLDP_tx-delay,ERPS,DHCPSnooping_option82

Console#copy remote-license
Choose license style:
1. pure; 2. profile; 3. function: 3
Choose ID (0 is all): 2

Console#copy remote-license
Choose license style:
1. pure; 2. profile; 3. function: 2
Choose ID (0 is all): 0

Console#copy remote-license
Choose license style:
1. pure; 2. profile; 3. function: 1

Console#
```

delete

This command deletes a file from the switch system.

Syntax

delete {**file name** *filename* | **function-license** | **https-certificate** | **public-key** *username* | **radsec-certificate name** *filename*}

file - Keyword that allows you to delete a file.

name - Keyword indicating a file.

filename - Name of the file to be deleted.

function-license - Deletes a function license file. The CLI prompts you to choose a function license file from a file list.

https-certificate - Keyword that allows you to delete the HTTPS secure site certificate. You must reboot the switch to load the default certificate.

public-key - Keyword that allows you to delete a SSH key on the switch. (See "Secure Shell" on page 221.)

username - Name of an SSH user. (Range: 1-8 characters)

radsec-certificate - Keyword that allows you to delete a RADIUS security certificate file from the switch.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- If the file type is used for system startup, then this file cannot be deleted.
- "Factory_Default_Config.cfg" cannot be deleted.

Example

This example shows how to delete the test2.cfg configuration file from flash memory.

```
Console#delete file name test2.cfg
Console#
```

This example shows how to delete a function license file with function list "LLDP_tx-delay, ERPS, DHCPSnooping_option82".

```
Console#delete function-license
ID Expired Date Function List
-- ------------ ------------------------------------------------
 1 Permanent    DHCPSnooping_option82,ERPS
 2 2024-01-10   LLDP_tx-delay,ERPS,DHCPSnooping_option82
```

```
Choose ID: 2
Console#
```

dir

This command displays a list of files in flash memory.

Syntax

dir [*unit*:] {**config** | **opcode** | **usbdisk**}: [*filename*]}

unit - Unit identifier. (Range: 1)

config - Switch configuration file.

opcode - Run-time operation code image file.

usbdisk - Installed USB device file.

filename - Name of configuration file or code image. If this file exists but contains errors, information on this file cannot be shown.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

If you enter the command **dir** without any parameters, the system displays all files.

File information is shown below:

Table 16: File Directory Information

Column Heading	Description
File Name	The name of the file.
File Type	File types: Operation Code, and Config file.
Startup	Shows if this file is used when the system is started.
Modify Time	The date and time the file was last modified.
Size	The length of the file in bytes.

Example

The following example shows how to display all file information:

```
Console#dir
File Name                      Type    Startup Modified Time       Size (bytes)
---------------------------- ------- ------- ------------------- ------------
 Unit 1:
ECS5550_V1.1.2.243.bix       OpCode  N       2024-07-16 07:33:47   39,400,747
ECS5550_V1.1.3.243.bix       OpCode  Y       2024-07-15 13:21:27   39,401,799
Factory_Default_Config.cfg   Config  N       2024-07-11 08:22:53          390
```

```
startup1.cfg                Config  Y       2024-07-15 13:23:22        2,212
test.cfg                    Config  N       2024-07-11 08:45:36        2,684
------------------------------------------------------------------------------
                    Free space for compressed user config files: 2,543,143,936
                                                      Total space: 3,082,760,192

Console#
```

umount

This command unmounts a removable USB device.

Syntax

umount usbdisk

Command Mode

Privileged Exec

Example

```
#umount usbdisk

Console#
```

whichboot

This command displays which files were booted when the system powered up.

Syntax

whichboot

Default Setting

None

Command Mode

Privileged Exec

Example

This example shows the information displayed by the **whichboot** command. See the table under the **dir** command for a description of the file information displayed by this command.

```
Console#whichboot
File Name                      Type    Startup Modified Time       Size (bytes)
------------------------------ ------- ------- ------------------- ------------
 Unit 1:
ECS5550_V1.1.3.243.bix         OpCode  Y       2024-07-15 13:21:27   39,401,799
startup1.cfg                   Config  Y       2024-07-15 13:23:22        2,212
Console#
```

Automatic Code Upgrade Commands

upgrade opcode auto

This command automatically upgrades the current operational code when a new version is detected on the server indicated by the upgrade opcode path command. Use the **no** form of this command to restore the default setting.

Syntax

[no] upgrade opcode auto

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- This command is used to enable or disable automatic upgrade of the operational code. When the switch starts up and automatic image upgrade is enabled by this command, the switch will follow these steps when it boots up:

  1. It will search for a new version of the image at the location specified by upgrade opcode path command. The name for the new image stored on the TFTP server must be ECS5550.bix. If the switch detects a code version newer than the one currently in use, it will download the new image. If two code images are already stored in the switch, the image not set to start up the system will be overwritten by the new version.

  2. After the image has been downloaded, the switch will send a trap message to log whether or not the upgrade operation was successful.

  3. It sets the new version as the startup image.

  4. It then restarts the system to start using the new image.

- Any changes made to the default setting can be displayed with the show running-config or show startup-config commands.

Example

```
Console(config)#upgrade opcode auto
Console(config)#upgrade opcode path tftp://192.168.0.1/sm24/
Console(config)#
```

If a new image is found at the specified location, the following type of messages will be displayed during bootup.

```
.
.
.
```

```
Automatic Upgrade is looking for a new image
New image detected: current version 1.1.1.0; new version 1.1.1.2
Image upgrade in progress
The switch will restart after upgrade succeeds
Downloading new image
Flash programming started
Flash programming completed
The switch will now restart
.
.
.
```

upgrade opcode path

This command specifies an TFTP/FTP server and directory in which the new opcode is stored. Use the **no** form of this command to clear the current setting.

Syntax

upgrade opcode path *opcode-dir-url*

no upgrade opcode path

opcode-dir-url - The location of the new code.

Default Setting

None

Command Mode

Global Configuration

Command Usage

- This command is used in conjunction with the upgrade opcode auto command to facilitate automatic upgrade of new operational code stored at the location indicated by this command.
- The name for the new image stored on the TFTP/FTP server must be ECS5550.bix. However, note that file name is not to be included in this command.
- FTP (port 21) and TFTP (port 69) are both supported. Note that the TCP/UDP port bindings cannot be modified to support servers listening on non-standard ports.
- When specifying a TFTP server, the following syntax must be used, where *filedir* indicates the path to the directory containing the new image:

  `tftp://192.168.0.1[/filedir]/`

- When specifying an FTP server, the following syntax must be used, where *filedir* indicates the path to the directory containing the new image:

  `ftp://[username[:password@]]192.168.0.1[/filedir]/`

If the user name is omitted, "anonymous" will be used for the connection. If the password is omitted a null string ("") will be used for the connection.

- The host portion of the upgrade file location URL must be a valid IPv4 IP address. DNS host names are not recognized. Valid IP addresses consist of four numbers, 0 to 255, separated by periods.
- The path to the directory must also be defined. If the file is stored in the root directory for the FTP/TFTP service, then use the "/" to indicate this (e.g., ftp://192.168.0.1/).
- The FTP connection is made with PASV mode enabled. PASV mode is needed to traverse some fire walls, even if FTP traffic is not blocked. PASV mode cannot be disabled.
- The file name must not be included in the upgrade file location URL. The file name of the code stored on the remote server must be ECS5550.bix (using lower case letters as indicated).
- The switch-based search function is case-insensitive in that it will accept a file name in upper or lower case. However, keep in mind that the file systems of many operating systems are case-sensitive, meaning that requested file names must match exactly. Check the documentation for your server's operating system if you are unsure of its file system's behavior.
- Note that the switch itself does not distinguish between upper and lower-case file names, and only checks to see if the file stored on the server is more recent than the current runtime image.
- If two operation code image files are already stored on the switch's file system, then the non-startup image is deleted before the upgrade image is transferred.
- The automatic upgrade process will take place in the background without impeding normal operations (data switching, etc.) of the switch.
- During the automatic search and transfer process, the administrator cannot transfer or update another operation code image, configuration file, public key, or HTTPS certificate (i.e., no other concurrent file management operations are possible).
- The upgrade operation code image is set as the startup image after it has been successfully written to the file system.
- The switch will send an SNMP trap and make a log entry upon all upgrade successes and failures.
- The switch will immediately restart after the upgrade file is successfully written to the file system and set as the startup image.

Example

This shows how to specify a TFTP server where new code is stored.

```
Console(config)#upgrade opcode path tftp://192.168.0.1/sm24/
Console(config)#
```

This shows how to specify an FTP server where new code is stored.

```
Console(config)#upgrade opcode path ftp://admin:billy@192.168.0.1/sm24/
Console(config)#
```

upgrade opcode reload

This command reloads the switch automatically after the opcode upgrade is completed. Use the **no** form to disable this feature.

Syntax

[no] upgrade opcode reload

Default Setting

Disabled

Command Mode

Global Configuration

Example

This shows how to specify a TFTP server where new code is stored.

```
Console(config)#upgrade opcode reload
Console(config)#
```

show upgrade

This command shows the opcode upgrade configuration settings.

Command Mode

Privileged Exec

Example

```
Console#show upgrade
Auto Image Upgrade Global Settings:
  Status    : Disabled
  Reload Status : Disabled
  Path      :
  File Name : ECS5550.bix
Console#
```

TFTP Configuration Commands

ip tftp retry

This command specifies the number of times the switch can retry transmitting a request to a TFTP server after waiting for the configured timeout period and receiving no response. Use the **no** form to restore the default setting.

Syntax

ip tftp retry *retries*

no ip tftp retry

retries - The number of times the switch can resend a request to a TFTP server before it aborts the connection. (Range: 1-16)

Default Setting

15

Command Mode

Global Configuration

Example

```
Console(config)#ip tftp retry 10
Console(config)#
```

ip tftp timeout

This command specifies the time the switch can wait for a response from a TFTP server before retransmitting a request or timing out for the last retry. Use the **no** form to restore the default setting.

Syntax

ip tftp timeout *seconds*

no ip tftp timeout

seconds - The the time the switch can wait for a response from a TFTP server before retransmitting a request or timing out. (Range: 1-65535 seconds)

Default Setting

5 seconds

Command Mode

Global Configuration

Example

```
Console(config)#ip tftp timeout 10
Console(config)#
```

show ip tftp

This command displays information about the TFTP settings configured on this switch.

Syntax

show ip tftp

Command Mode

Privileged Exec

Example

```
Console#show ip tftp
TFTP Settings:
  Retries : 15
  Timeout : 5 seconds
Console#
```

Line

You can access the onboard configuration program by attaching a VT100 compatible device to the server's serial port. These commands are used to set communication parameters for the serial port or Telnet (i.e., a virtual terminal).

Table 17: Line Commands

Command	Function	Mode
line	Identifies a specific line for configuration and starts the line configuration mode	GC
accounting commands	Applies an accounting method to commands entered at specific CLI privilege levels	LC
accounting exec	Applies an accounting method to local console, Telnet or SSH connections	LC
authorization commands	Applies an authorization method to commands entered at specific CLI privilege levels	LC
authorization exec	Applies an authorization method to local console, Telnet or SSH connections	LC
databits*	Sets the number of data bits per character that are interpreted and generated by hardware	LC
exec-timeout	Sets the interval that the command interpreter waits until user input is detected	LC
login	Enables password checking at login	LC
parity*	Defines the generation of a parity bit	LC
password	Specifies a password on a line	LC
password-thresh	Sets the password intrusion threshold, which limits the number of failed logon attempts	LC

Table 17: Line Commands (Continued)

Command	Function	Mode
silent-time*	Sets the amount of time the management console is inaccessible after the number of unsuccessful logon attempts exceeds the threshold set by the password-thresh command	LC
speed*	Sets the terminal baud rate	LC
stopbits*	Sets the number of the stop bits transmitted per byte	LC
timeout login response	Sets the interval that the system waits for a login attempt	LC
disconnect	Terminates a line connection	PE
terminal	Configures terminal settings, including escape-character, line length, terminal type, and width	PE
show line	Displays a terminal line's parameters	NE, PE

* These commands only apply to the serial port.

line

This command identifies a specific line for configuration, and to process subsequent line configuration commands.

Syntax

line {console | vty}

console - Console terminal line.

vty - Virtual terminal for remote console access (i.e., Telnet).

Default Setting

There is no default line.

Command Mode

Global Configuration

Command Usage

Telnet is considered a virtual terminal connection and will be shown as "VTY" in screen displays such as show users. However, the serial communication parameters (e.g., databits) do not affect Telnet connections.

Example

To enter console line mode, enter the following command:

```
Console(config)#line console
Console(config-line)#
```

databits

This command sets the number of data bits per character that are interpreted and generated by the console port. Use the **no** form to restore the default value.

Syntax

databits {7 | 8}

no databits

7 - Seven data bits per character.

8 - Eight data bits per character.

Default Setting

8 data bits per character

Command Mode

Line Configuration

Command Usage

The **databits** command can be used to mask the high bit on input from devices that generate 7 data bits with parity. If parity is being generated, specify 7 data bits per character. If no parity is required, specify 8 data bits per character.

Example

To specify 7 data bits, enter this command:

```
Console(config-line-console)#databits 7
Console(config-line-console)#
```

exec-timeout

This command sets the interval that the system waits until user input is detected. Use the **no** form to restore the default.

Syntax

exec-timeout [*seconds*]

no exec-timeout

seconds - Integer that specifies the timeout interval.
(Range: 60 - 65535 seconds; 0: no timeout)

Default Setting

10 minutes

Command Mode

Line Configuration

Command Usage

- If user input is detected within the timeout interval, the session is kept open; otherwise the session is terminated.
- This command applies to both the local console and Telnet connections.
- The timeout for Telnet cannot be disabled.
- Using the command without specifying a timeout restores the default setting.

Example

To set the timeout to two minutes, enter this command:

```
Console(config-line-console)#exec-timeout 120
Console(config-line-console)#
```

login

This command enables password checking at login. Use the **no** form to disable password checking and allow connections without a password.

Syntax

login [**local**]

no login

local - Selects local password checking. Authentication is based on the user name specified with the username command.

Default Setting

login local

Command Mode

Line Configuration

Command Usage

- There are three authentication modes provided by the switch itself at login:
  - **login** selects authentication by a single global password as specified by the password line configuration command. When using this method, the management interface starts in Normal Exec (NE) mode.
  - **login local** selects authentication via the user name and password specified by the username command (i.e., default setting). When using this method, the management interface starts in Normal Exec (NE) or Privileged Exec (PE) mode, depending on the user's privilege level (0 or 15 respectively).
  - **no login** selects no authentication. When using this method, the management interface starts in Normal Exec (NE) mode.

- This command controls login authentication via the switch itself. To configure user names and passwords for remote authentication servers, you must use the RADIUS or TACACS software installed on those servers.

Example

```
Console(config-line-console)#login local
Console(config-line-console)#
```

parity

This command defines the generation of a parity bit. Use the **no** form to restore the default setting.

Syntax

parity {**none** | **even** | **odd**}

no parity

none - No parity

even - Even parity

odd - Odd parity

Default Setting

No parity

Command Mode

Line Configuration

Command Usage

Communication protocols provided by devices such as terminals and modems often require a specific parity bit setting.

Example

To specify no parity, enter this command:

```
Console(config-line-console)#parity none
Console(config-line-console)#
```

password

This command specifies the password for a line. Use the **no** form to remove the password.

Syntax

password {**0** | **7**} *password*

no password

{0 | 7} - 0 means plain password, 7 means encrypted password

password - Character string that specifies the line password. (Maximum length: 32 characters plain text or encrypted, case sensitive)

Default Setting
No password is specified.

Command Mode
Line Configuration

Command Usage
- When a connection is started on a line with password protection, the system prompts for the password. If you enter the correct password, the system shows a prompt. You can use the password-thresh command to set the number of times a user can enter an incorrect password before the system terminates the line connection and returns the terminal to the idle state.

- The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file from an FTP/SFTP server during system bootup. There is no need for you to manually configure encrypted passwords.

Example
```
Console(config-line-console)#password 0 secret
Console(config-line-console)#
```

password-thresh
This command sets the password intrusion threshold which limits the number of failed logon attempts. Use the **no** form to remove the threshold value.

Syntax
password-thresh [*threshold*]

no password-thresh

threshold - The number of allowed password attempts. (Range: 1-120; 0: no threshold)

Default Setting
The default value is three attempts.

Command Mode
Line Configuration

Command Usage
When the logon attempt threshold is reached, the system interface becomes silent for a specified amount of time before allowing the next logon attempt. (Use the

silent-time command to set this interval.) When this threshold is reached for Telnet, the Telnet logon interface shuts down.

Example
To set the password threshold to five attempts, enter this command:

```
Console(config-line-console)#password-thresh 5
Console(config-line-console)#
```

silent-time
This command sets the amount of time the management console is inaccessible after the number of unsuccessful logon attempts exceeds the threshold set by the password-thresh command. Use the **no** form to remove the silent time value.

Syntax
silent-time [*seconds*]

no silent-time

seconds - The number of seconds to disable console response. (Range: 1-65535; 0 means disabled)

Default Setting
Disabled

Command Mode
Line Configuration

Example
To set the silent time to 60 seconds, enter this command:

```
Console(config-line-console)#silent-time 60
Console(config-line-console)#
```

speed
This command sets the terminal line's baud rate. This command sets both the transmit (to terminal) and receive (from terminal) speeds. Use the **no** form to restore the default setting.

Syntax
speed *bps*

no speed

bps - Baud rate in bits per second. (Options: 9600, 19200, 38400, 57600, 115200 bps)

Default Setting
115200 bps

Command Mode
Line Configuration

Command Usage
Set the speed to match the baud rate of the device connected to the serial port. Some baud rates available on devices connected to the port might not be supported. The system indicates if the speed you selected is not supported.

Example
To specify 57600 bps, enter this command:

```
Console(config-line-console)#speed 57600
Console(config-line-console)#
```

stopbits
This command sets the number of the stop bits transmitted per byte. Use the **no** form to restore the default setting.

Syntax
stopbits {1 | 2}

no stopbits

1 - One stop bit

2 - Two stop bits

Default Setting
1 stop bit

Command Mode
Line Configuration

Example
To specify 2 stop bits, enter this command:

```
Console(config-line-console)#stopbits 2
Console(config-line-console)#
```

timeout login response

This command sets the interval that the system waits for a user to log into the CLI. Use the **no** form to restore the default setting.

Syntax

timeout login response [*seconds*]

no timeout login response

seconds - Integer that specifies the timeout interval. (Range: 10 - 300 seconds)

Default Setting

300 seconds

Command Mode

Line Configuration

Command Usage

- If a login attempt is not detected within the timeout interval, the connection is terminated for the session.
- This command applies to both the local console and Telnet connections.
- The timeout for Telnet cannot be disabled.
- Using the command without specifying a timeout restores the default setting.

Example

To set the timeout to two minutes, enter this command:

```
Console(config-line)#timeout login response 120
Console(config-line)#
```

disconnect

This command terminates an SSH, Telnet, or console connection.

Syntax

disconnect *session-id*

session-id – The session identifier for an SSH, Telnet or console connection. (Range: 0-8)

Command Mode

Privileged Exec

Command Usage

Specifying session identifier "0" will disconnect the console connection. Specifying any other identifiers for an active session will disconnect an SSH or Telnet connection.

Example

```
Console#disconnect 1
Console#
```

terminal

This command configures terminal settings, including escape-character, lines displayed, terminal type, width, and command history. Use the **no** form with the appropriate keyword to restore the default setting.

Syntax

terminal {**escape-character** {**ASCII-number** | *character*} | **history** [**size** *size*] | **length** *length* | **terminal-type** {**ansi-bbs** | **vt-100** | **vt-102**} | **width** *width*}

escape-character - The keyboard character used to escape from current line input.

ASCII-number - ASCII decimal equivalent. (Range: 0-255)

character - Any valid keyboard character.

history - The number of lines stored in the command buffer, and recalled using the arrow keys. (Range: 0-256)

length - The number of lines displayed on the screen. (Range: 24-200, where 0 means not to pause)

terminal-type - The type of terminal emulation used.

ansi-bbs - ANSI-BBS

vt-100 - VT-100

vt-102 - VT-102

width - The number of character columns displayed on the terminal. (Range: 80-300)

Default Setting

Escape Character: 27 (ASCII-number)
History: 10
Length: 24
Terminal Type: VT100
Width: 80

Command Mode

Privileged Exec

Example

This example sets the number of lines displayed by commands with lengthy output such as show running-config to 48 lines.

```
Console#terminal length 48
Console#
```

show line

This command displays the terminal line's parameters.

Syntax

show line [console | vty]

console - Console terminal line.

vty - Virtual terminal for remote console access (i.e., Telnet).

Default Setting

Shows all lines

Command Mode

Normal Exec, Privileged Exec

Example

To show all lines, enter this command:

```
Console#show line
 Terminal Configuration for this session:
  Length                          : 24
  Width                           : 80
  History Size                    : 10
  Escape Character(ASCII-number)  : 27
  Terminal Type                   : VT100

 Console Configuration:
  Password Threshold : 3 times
  EXEC Timeout       : 600 seconds
  Login Timeout      : 300 seconds
  Silent Time        : Disabled
  Baud Rate          : 115200
  Data Bits          : 8
  Parity             : None
  Stop Bits          : 1

 VTY Configuration:
  Password Threshold : 3 times
  EXEC Timeout       : 600 seconds
  Login Timeout      : 300 sec.
  Silent Time        : Disabled
Console#
```

Event Logging

This section describes commands used to configure event logging on the switch.

Table 18: Event Logging Commands

Command	Function	Mode
logging command	Stores CLI command execution records in syslog RAM and flash	GC
logging facility	Sets the facility type for remote logging of syslog messages	GC
logging history	Limits syslog messages saved to switch memory based on severity	GC
logging host	Adds a syslog server host IP address that will receive logging messages	GC
logging level	Sets the logging level for user login and log out	GC
logging on	Controls logging of error messages	GC
logging trap	Limits syslog messages saved to a remote server based on severity	GC
logging print-screen	Sends all system log messages to the console	GC
clear log	Clears messages from the logging buffer	PE
show log	Displays log messages	PE
show logging	Displays the state of logging	PE
show logging command	Displays the logging command settings	PE

logging command

This command stores CLI command execution records in syslog RAM and flash. Use the **no** form to disable this feature.

Syntax

[no] logging command

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

The records stored include the commands executed from the CLI, command execution time and information about the CLI user including user name, user interface (console, Telnet, SSH) and user IP address. The severity level for this record type is 6 (see the logging facility command).

Example

```
Console(config)#logging command
Console(config)#
```

logging facility

This command sets the facility type for remote logging of syslog messages. Use the **no** form to return the type to the default.

Syntax

logging facility *type*

no logging facility

type - A number that indicates the facility used by the syslog server to dispatch log messages to an appropriate service. (Range: 16-23)

Default Setting

23

Command Mode

Global Configuration

Command Usage

The command specifies the facility type tag sent in syslog messages. (See RFC 3164.) This type has no effect on the kind of messages reported by the switch. However, it may be used by the syslog server to sort messages or to store messages in the corresponding database.

Example

```
Console(config)#logging facility 19
Console(config)#
```

logging history

This command limits syslog messages saved to switch memory based on severity. The **no** form returns the logging of syslog messages to the default level.

Syntax

logging history {**flash** | **ram**} *level*

no logging history {**flash** | **ram**}

flash - Event history stored in flash memory (i.e., permanent memory).

ram - Event history stored in temporary RAM (i.e., memory flushed on power reset).

level - One of the levels listed below. Messages sent include the selected level down to level 0. (Range: 0-7)

Table 19: Logging Levels

Level	Severity Name	Description
7	debugging	Debugging messages
6	informational	Informational messages only
5	notifications	Normal but significant condition, such as cold start
4	warnings	Warning conditions (e.g., return false, unexpected return)
3	errors	Error conditions (e.g., invalid input, default used)
2	critical	Critical conditions (e.g., memory allocation, or free memory error - resource exhausted)
1	alerts	Immediate action needed
0	emergencies	System unusable

Default Setting
Flash: errors (level 3 - 0)
RAM: debugging (level 7 - 0)

Command Mode
Global Configuration

Command Usage
The message level specified for flash memory must be a higher priority (i.e., numerically lower) than that specified for RAM.

Example

```
Console(config)#logging history ram 0
Console(config)#
```

logging host
This command adds a syslog server host IP address that will receive logging messages. Use the **no** form to remove a syslog server host.

Syntax

logging host *host-ip-address* [**port** *udp-port*]

no logging host *host-ip-address*

host-ip-address - The IPv4 or IPv6 address of a syslog server.

udp-port - UDP port number used by the remote server. (Range: 1-65535)

Default Setting
UPD Port: 514

Command Mode
Global Configuration

Command Usage
- Use this command more than once to build up a list of host IP addresses.
- The maximum number of host IP addresses allowed is five.

Example
```
Console(config)#logging host 10.1.0.3
Console(config)#
```

logging level
This command sets the syslog logging severity level for user login and log out. Use the **no** form to set the logging level to the default value.

Syntax
logging level {**user-login** *level* | **user-logout** *level*}

no logging level {**user-login** | **user-logout**}

user-login - Specifies the level to log when a user logs in.

user-logout - Specifies the level to log when a user logs out.

level - The syslog severity level to log (Range: 1-7)

Default Setting
6

Command Mode
Global Configuration

Command Usage
Logging severity levels are described in Table 19.

Example
```
Console(config)#logging level user-login 5
Console(config)#
```

logging on
This command controls logging of error messages, sending debug or error messages to a logging process. The **no** form disables the logging process.

Syntax
[no] **logging on**

Default Setting
None

Command Mode
Global Configuration

Command Usage
The logging process controls error messages saved to switch memory or sent to remote syslog servers. You can use the logging history command to control the type of error messages that are stored in memory. You can use the logging trap command to control the type of error messages that are sent to specified syslog servers.

Example

```
Console(config)#logging on
Console(config)#
```

logging trap

This command enables the logging of system messages to a remote server, or limits the syslog messages saved to a remote server based on severity. Use this command without a specified level to enable remote logging. Use the **no** form to disable remote logging.

Syntax

logging trap [**level** *level*]

no logging trap [**level**]

level - One of the syslog severity levels listed in the table on page 114. Messages sent include the selected level through level 0.

Default Setting
Disabled
Level 7

Command Mode
Global Configuration

Command Usage
- Using this command with a specified level enables remote logging and sets the minimum severity level to be saved.
- Using this command without a specified level also enables remote logging, but restores the minimum severity level to the default.

Example

```
Console(config)#logging trap level 4
Console(config)#
```

logging print-screen

This command enables the logging of all system messages to the console. Use the no form to disable the feature.

Syntax

[no] logging print-screen

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

Use this command to print all system log messages saved to RAM directly to the console screen (includes Telnet and SSH).

Example

```
Console(config)#logging print-screen
Console(config)#
```

clear log

This command clears messages from the log buffer.

Syntax

clear log [flash | ram]

flash - Event history stored in flash memory (i.e., permanent memory).

ram - Event history stored in temporary RAM (i.e., memory flushed on power reset).

Default Setting

Flash and RAM

Command Mode

Privileged Exec

Example

```
Console#clear log
Console#
```

show log

This command displays the log messages stored in local memory.

Syntax

show log {flash | ram} [login | *key-word*]

flash - Event history stored in flash memory (i.e., permanent memory).

ram - Event history stored in temporary RAM (i.e., memory flushed on power reset).

login - Shows the contents of login buffers.

key-word - A keyword that can match information in the log messages.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- All log messages are retained in RAM and Flash after a warm restart (i.e., power is reset through the command interface).
- All log messages are retained in Flash and purged from RAM after a cold restart (i.e., power is turned off and then on through the power source).

Example

The following example shows the event message stored in RAM.

```
Console#show log ram
[1] 00:01:30 2001-01-01
   "VLAN 1 link-up notification."
   level: 6, module: 5, function: 1, and event no.: 1
[0] 00:01:30 2001-01-01
   "Unit 1, Port  1 link-up notification."
   level: 6, module: 5, function: 1, and event no.: 1
Console#
Console#show log ram sys
[7] 22:35:25 2022-10-13
   "System warmStart notification."
   level : 6, module : 5, function : 1, and event no. : 1
[0] 22:26:30 2022-10-13
   "System coldStart notification."
   level : 6, module : 5, function : 1, and event no. : 1
Console#
```

show logging

This command displays the configuration settings for logging messages to local switch memory, to an SMTP event handler, or to a remote syslog server.

Syntax

show logging {level | flash | ram | sendmail | trap}

level - Displays logging levels for user login and log out.

flash - Displays settings for storing event messages in flash memory (i.e., permanent memory).

ram - Displays settings for storing event messages in temporary RAM (i.e., memory flushed on power reset).

sendmail - Displays settings for the SMTP event handler (page 124).

trap - Displays settings for the trap function.

Default Setting

None

Command Mode

Privileged Exec

Example

The following example shows that system logging is enabled, the message level for flash memory is "errors" (i.e., default level 3 - 0), and the message level for RAM is "debugging" (i.e., default level 7 - 0).

```
Console#show logging flash
Global Configuration:
  Syslog Logging           : Enabled
Flash Logging Configuration:
  History Logging in Flash : Level Errors (3)
Console#show logging ram
Global Configuration:
  Syslog Logging           : Enabled
Ram Logging Configuration:
  History Logging in RAM   : Level Debugging (7)
Console#
```

The following example displays settings for the trap function.

```
Console#show logging trap
Global Configuration:
  Syslog Logging           : Enabled
Remote Logging Configuration:
  Status                   : Disabled
  Facility Type            : Local use 7 (23)
  Level Type               : Debugging messages (7)
Console#
```

show logging command

This command displays the logging command settings.

Syntax

show logging command

Command Mode

Privileged Exec

Example

```
Console#show logging command
Global Configuration:
  Syslog Logging           : Enabled
  Command Log Status       : Disabled
Console#
```

SMTP Alerts

These commands configure SMTP event handling, and forwarding of alert messages to the specified SMTP servers and email recipients.

Table 20: Event Logging Commands

Command	Function	Mode
logging sendmail	Enables SMTP event handling	GC
logging sendmail destination-email	Email recipients of alert messages	GC
logging sendmail host	SMTP servers to receive alert messages	GC
logging sendmail level	Severity threshold used to trigger alert messages	GC
logging sendmail source-email	Email address used for "From" field of alert messages	GC
show logging sendmail	Displays SMTP event handler settings	PE

logging sendmail

This command enables SMTP event handling. Use the no form to disable this function.

Syntax

[no] logging sendmail

Default Setting

Enabled

Command Mode

Global Configuration

Example

```
Console(config)#logging sendmail
Console(config)#
```

logging sendmail destination-email

This command specifies the email recipients of alert messages. Use the **no** form to remove a recipient.

Syntax

[no] **logging sendmail destination-email** *email-address*

email-address - The source email address used in alert messages. (Range: 1-41 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

You can specify up to five recipients for alert messages. However, you must enter a separate command to specify each recipient.

Example

```
Console(config)#logging sendmail destination-email ted@this-company.com
Console(config)#
```

logging sendmail host

This command specifies SMTP servers that will be sent alert messages. Use the **no** form to remove an SMTP server.

Syntax

[no] **logging sendmail host** *ip-address*

ip-address - IPv4 address of an SMTP server that will be sent alert messages for event handling.

Default Setting

None

Command Mode

Global Configuration

Command Usage

- You can specify up to three SMTP servers for event handing. However, you must enter a separate command to specify each server.
- To send email alerts, the switch first opens a connection, sends all the email alerts waiting in the queue one by one, and finally closes the connection.
- To open a connection, the switch first selects the server that successfully sent mail during the last connection, or the first server configured by this command. If it fails to send mail, the switch selects the next server in the list and tries to send mail again. If it still fails, the system will repeat the process at a periodic interval. (A trap will be triggered if the switch cannot successfully open a connection.)

Example

```
Console(config)#logging sendmail host 192.168.1.19
Console(config)#
```

logging sendmail level

This command sets the severity threshold used to trigger alert messages. Use the **no** form to restore the default setting.

Syntax

logging sendmail level *level*

no logging sendmail level

level - One of the system message levels (page 114). Messages sent include the selected level down to level 0. (Range: 0-7; Default: 7)

Default Setting

Level 7

Command Mode

Global Configuration

Command Usage

The specified level indicates an event threshold. All events at this level or higher will be sent to the configured email recipients. (For example, using Level 7 will report all events from level 7 to level 0.)

Example

This example will send email alerts for system errors from level 3 through 0.

```
Console(config)#logging sendmail level 3
Console(config)#
```

logging sendmail source-email

This command sets the email address used for the "From" field in alert messages. Use the **no** form to restore the default value.

Syntax

logging sendmail source-email *email-address*

no logging sendmail source-email

email-address - The source email address used in alert messages. (Range: 1-41 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

You may use an symbolic email address that identifies the switch, or the address of an administrator responsible for the switch.

Example

```
Console(config)#logging sendmail source-email bill@this-company.com
Console(config)#
```

show logging sendmail

This command displays the settings for the SMTP event handler.

Command Mode

Privileged Exec

Example

```
Console#show logging sendmail
SMTP Servers
-------------------------------------------------
192.168.1.19

SMTP Minimum Severity Level: 7

SMTP Destination E-mail Addresses
-------------------------------------------------
ted@this-company.com

SMTP Source E-mail Address: bill@this-company.com

SMTP Status: Enabled
Console#
```

Time

The system clock can be dynamically set by polling a set of specified time servers (NTP or SNTP). Maintaining an accurate time on the switch enables the system log to record meaningful dates and times for event entries. If the clock is not set, the switch will only record the time from the factory default set at the last bootup.

Table 21: Time Commands

Command	Function	Mode
SNTP Commands		
sntp client	Accepts time from specified time servers	GC
sntp poll	Sets the interval at which the client polls for time	GC
sntp server	Specifies one or more time servers	GC
show sntp	Shows current SNTP configuration settings	NE, PE
NTP Commands		
ntp authenticate	Enables authentication for NTP traffic	GC
ntp authentication-key	Configures authentication keys	GC
ntp client	Enables the NTP client for time updates from specified servers	GC
ntp server	Specifies NTP servers to poll for time updates	GC
show ntp	Shows current NTP configuration settings	NE, PE
show ntp status	Shows the status of time updates	PE
show ntp statistics peer	Shows statistics from an NTP peer	PE
show ntp peer-status	Shows the status of connections to NTP peers	PE
Manual Configuration Commands		
clock summer-time (date)	Configures summer time* for the switch's internal clock	GC
clock summer-time (predefined)	Configures summer time* for the switch's internal clock	GC
clock summer-time (recurring)	Configures summer time* for the switch's internal clock	GC
clock timezone	Sets the time zone for the switch's internal clock	GC
calendar set	Sets the system date and time	PE
show calendar	Displays the current date and time setting	NE, PE

* Daylight savings time.

SNTP Commands

sntp client

This command enables SNTP client requests for time synchronization from NTP or SNTP time servers specified with the sntp server command. Use the **no** form to disable SNTP client requests.

Syntax

[no] sntp client

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- The time acquired from time servers is used to record accurate dates and times for log events. Without SNTP, the switch only records the time starting from the factory default set at the last bootup (e.g., Dec 31 07:32:04 2014).
- This command enables client time requests to time servers specified via the sntp server command. It issues time synchronization requests based on the interval set via the sntp poll command.

Example

```
Console(config)#sntp server 10.1.0.19
Console(config)#sntp poll 60
Console(config)#sntp client
Console(config)#end
Console#show sntp
Current Time:  Dec 23 02:52:44 2015
Poll Interval: 60
Current Mode: Unicast
SNTP Status : Enabled
SNTP Server 137.92.140.80 0.0.0.0 0.0.0.0
Current Server: 137.92.140.80
Console#
```

sntp poll

This command sets the interval between sending time requests when the switch is set to SNTP client mode. Use the **no** form to restore to the default.

Syntax

sntp poll *seconds*

no sntp poll

seconds - Interval between time requests. (Range: 16-16384 seconds)

Default Setting
16 seconds

Command Mode
Global Configuration

Example

```
Console(config)#sntp poll 60
Console#
```

sntp server

This command sets the IP address of the servers to which SNTP time requests are issued. Use the this command with no arguments to clear all time servers from the current list. Use the **no** form to clear all time servers from the current list, or to clear a specific server.

Syntax

sntp server [*ip1* [*ip2* [*ip3*]]]

no sntp server [*ip1* [*ip2* [*ip3*]]]

ip - IPv4 or IPv6 address of a time server (NTP or SNTP).
(Range: 1 - 3 addresses)

Default Setting
None

Command Mode
Global Configuration

Command Usage
This command specifies time servers from which the switch will poll for time updates when set to SNTP client mode. The client will poll the time servers in the order specified until a response is received. It issues time synchronization requests based on the interval set via the sntp poll command.

Example

```
Console(config)#sntp server 10.1.0.19
Console#
```

show sntp

This command displays the current time and configuration settings for the SNTP client, and indicates whether or not the local time has been properly updated.

Command Mode
Normal Exec, Privileged Exec

Command Usage
This command displays the current time, the poll interval used for sending time synchronization requests, and the current SNTP mode (i.e., unicast).

Example

```
Console#show sntp
Current Time   : Nov  5 18:51:22 2015
Poll Interval  : 16 seconds
Current Mode   : Unicast
SNTP Status    : Enabled
SNTP Server    : 137.92.140.80
               : 137.92.140.90
               : 137.92.140.99
Current Server : 137.92.140.80
Console#
```

NTP Commands

ntp authenticate

This command enables authentication for NTP client-server communications. Use the **no** form to disable authentication.

Syntax

[no] ntp authenticate

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
You can enable NTP authentication to ensure that reliable updates are received from only authorized NTP servers. The authentication keys and their associated key number must be centrally managed and manually distributed to NTP servers and clients. The key numbers and key values must match on both the server and client.

Example

```
Console(config)#ntp authenticate
Console(config)#
```

ntp authentication-key

This command configures authentication keys and key numbers to use when NTP authentication is enabled. Use the **no** form of the command to clear a specific authentication key or all keys from the current list.

Syntax

ntp authentication-key *number* **md5** *key*

no ntp authentication-key [*number*]

number - The NTP authentication key ID number. (Range: 1-65533)

md5 - Specifies that authentication is provided by using the message digest algorithm 5.

key - An MD5 authentication key string. The key string can be up to 32 case-sensitive printable ASCII characters (no spaces).

Default Setting

None

Command Mode

Global Configuration

Command Usage

- The key number specifies a key value in the NTP authentication key list. Up to 255 keys can be configured on the switch. Re-enter this command for each server you want to configure.
- Note that NTP authentication key numbers and values must match on both the server and client.
- NTP authentication is optional. When enabled with the **ntp authenticate** command, you must also configure at least one key number using this command.
- Use the **no** form of this command without an argument to clear all authentication keys in the list.

Example

```
Console(config)#ntp authentication-key 45 md5 thisiskey45
Console(config)#
```

ntp client

This command enables NTP client requests for time synchronization from NTP time servers specified with the **ntp servers** command. Use the **no** form to disable NTP client requests.

Syntax

[**no**] **ntp client**

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
- The SNTP and NTP clients cannot be enabled at the same time. First disable the SNTP client before using this command.
- The time acquired from time servers is used to record accurate dates and times for log events. Without NTP, the switch only records the time starting from the factory default set at the last bootup (e.g., Dec 10 16:04:43 2014).
- This command enables client time requests to time servers specified via the **ntp servers** command. Once enabled the switch will issue time synchronization requests periodically.

Example
```
Console(config)#ntp client
Console(config)#
```

ntp server
This command sets the IP addresses of the servers to which NTP time requests are sent to. Use the **no** form of the command to clear a specific time server or all servers from the current list.

Syntax
ntp server *ip-address* [**key** *key-number*]

no ntp server [*ip-address*]

ip-address - IPv4 or IPv6 address of an NTP time server (Range: a.b.c.d or xx:xx:xx:xx::xx).

key-number - The number of an authentication key to use in communications with the server. (Range: 1-65533)

Default Setting
No address configured - when an IP address and key is configured with this command, NTPv4 is the default.

Command Mode
Global Configuration

Command Usage
- This command specifies time servers that the switch will poll for time updates when set to NTP client mode. The client will poll all the time servers configured,

the responses received are filtered and compared to determine the most reliable and accurate time update for the switch.

- You can configure up to 3 NTP servers on the switch. Re-enter this command for each server you want to configure.
- NTP authentication is optional. If enabled with the **ntp authenticate** command, you must also configure at least one key number using the **ntp authentication-key** command.
- Use the **no** form of this command without an argument to clear all configured servers in the list.

Example

```
Console(config)#ntp server 192.168.3.20
Console(config)#ntp server 192.168.3.21
Console(config)#ntp server 192.168.5.23 key 19
Console(config)#
```

show ntp

This command displays the current time and configuration settings for the NTP client, and indicates whether or not the local time has been properly updated from an NTP server.

Command Mode

Normal Exec, Privileged Exec

Command Usage

This command displays the current time, the poll interval used for sending time synchronization requests, and the current NTP mode (i.e., unicast).

Example

```
Console#show ntp
Current Time             : Apr 29 13:57:32 2015
Polling Interval         : 1024 seconds
Current Mode             : unicast
NTP Status               : Disabled
NTP Authenticate Status  : Enabled
Last Update NTP Server   : 0.0.0.0        Port: 0
Last Update Time         : Jan  1 00:00:00 1970 UTC
NTP Server 192.168.3.20 version 3
NTP Server 192.168.3.21 version 3
NTP Server 192.168.4.22 version 3 key 19
NTP Authentication Key 19 md5 42V68751663T6K11P2J307210R885
Console#
```

show ntp status

This command displays the current status of received time updates from an NTP peer.

Command Mode

Privileged Exec

Example

```
Console#show ntp status
System Peer     : 192.168.125.88
Leap Indicator  : 11
Stratum         : 14
Precision       : 0.000001907349 seconds
Root Distance   : 0.001160 seconds
Root Dispersion : 0.948900 seconds
Reference ID    : 192.168.125.88
Reference Time  : e0c697a3.6b04c19f  Wed, Jul  3 2019  2:55:31.418
Console#
```

show ntp statistics peer

This command displays the statistics from an NTP peer.

Syntax

show ntp statistics peer {*ip-address* | *ipv6-address* | *hostname*}

ip-address - IP address of an NTP peer.

ipv6-address - IPv6 address of an NTP peer.

hostname - Host name of an NTP peer.

Command Mode

Privileged Exec

Example

```
Console#show ntp statistics Peer 192.168.125.88
Remote Host          : 192.168.125.88
Local Interface      : 192.168.125.138
Time Last Received   : 223 seconds
Time Until Next Send : 772 seconds
Reachability Change  : 229 seconds
Packets Sent         : 8
Packets Received     : 8
Bad Authentication   : 0
Bogus Origin         : 0
Duplicate            : 0
Bad Dispersion       : 0
Bad Reference Time   : 0
Candidate Order      : 6
Console#
```

show ntp peer-status

This command displays the status of connections to NTP peers.

Syntax

show ntp peer-status [*ip-address* | *ipv6-address* | *hostname*]

ip-address - IP address of an NTP time server.

ipv6-address - IPv6 address of an NTP time server.

hostname - Host name of an NTP time server.

Command Mode

Privileged Exec

Example

```
Console#show ntp peer-status
* : system peer
Remote Host      Local Interface St Poll   Reach Delay    Offset   Dispersion
---------------- --------------- -- ------ ----- -------- -------- ----------
 1.1.1.1         0.0.0.0         16   1024     0 0.000000  0.00000 3.99217010
 192.168.1.10    0.0.0.0         16   1024     0 0.000000  0.00000 3.99217010
*192.168.125.88  192.168.125.138 13   1024     1 0.001160 -0.00011 0.96824998
Console#
```

Manual Configuration Commands

clock summer-time (date)

This command sets the start, end, and offset times of summer time (daylight savings time) for the switch on a one-time basis. Use the **no** form to disable summer time.

Syntax

clock summer-time *name* **date** *b-date b-month b-year b-hour b-minute e-date e-month e-year e-hour e-minute* [*offset*]

no clock summer-time

name - Name of the time zone while summer time is in effect, usually an acronym. (Range: 1-30 characters)

b-date - Day of the month when summer time will begin. (Range: 1-31)

b-month - The month when summer time will begin. (Options: **january** | **february** | **march** | **april** | **may** | **june** | **july** | **august** | **september** | **october** | **november** | **december**)

b-year- The year summer time will begin.

b-hour - The hour summer time will begin. (Range: 0-23 hours)

b-minute - The minute summer time will begin. (Range: 0-59 minutes)

e-date - Day of the month when summer time will end. (Range: 1-31)

e-month - The month when summer time will end. (Options: **january** | **february** | **march** | **april** | **may** | **june** | **july** | **august** | **september** | **october** | **november** | **december**)

e-year - The year summer time will end.

e-hour - The hour summer time will end. (Range: 0-23 hours)

e-minute - The minute summer time will end. (Range: 0-59 minutes)

offset - Summer time offset from the regular time zone, in minutes. (Range: 1-120 minutes)

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
- In some countries or regions, clocks are adjusted through the summer months so that afternoons have more daylight and mornings have less. This is known as Summer Time, or Daylight Savings Time (DST). Typically, clocks are adjusted forward one hour at the start of spring and then adjusted backward in autumn.

- This command sets the summer-time time zone relative to the currently configured time zone. To specify a time corresponding to your local time when summer time is in effect, you must indicate the number of minutes your summer-time time zone deviates from your regular time zone (that is, the offset).

Example
The following example sets the 2014 Summer Time ahead by 60 minutes on March 9th and returns to normal time on November 2nd.

```
Console(config)#clock summer-time DEST date march 9 2014 01 59 november 2
  2014 01 59 60
Console(config)#
```

clock summer-time (predefined)

This command configures the summer time (daylight savings time) status and settings for the switch using predefined configurations for several major regions in the world. Use the **no** form to disable summer time.

Syntax

clock summer-time *name* **predefined** [**australia** | **europe** | **new-zealand** | **usa**]

no clock summer-time

name - Name of the timezone while summer time is in effect, usually an acronym. (Range: 1-30 characters)

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
- In some countries or regions, clocks are adjusted through the summer months so that afternoons have more daylight and mornings have less. This is known as Summer Time, or Daylight Savings Time (DST). Typically, clocks are adjusted forward one hour at the start of spring and then adjusted backward in autumn.

- This command sets the summer-time time relative to the configured time zone. To specify the time corresponding to your local time when summer time is in effect, select the predefined summer-time time zone appropriate for your location, or manually configure summer time if these predefined configurations do not apply to your location (see clock summer-time (date) or clock summer-time (recurring).

Table 22: Predefined Summer-Time Parameters

Region	Start Time, Day, Week, & Month	End Time, Day, Week, & Month	Rel. Offset
Australia	00:00:00, Sunday, Week 5 of October	23:59:59, Sunday, Week 5 of March	60 min
Europe	00:00:00, Sunday, Week 5 of March	23:59:59, Sunday, Week 5 of October	60 min
New Zealand	00:00:00, Sunday, Week 1 of October	23:59:59, Sunday, Week 3 of March	60 min
USA	00:00:00, Sunday, Week 2 of March	23:59:59, Sunday, Week 1 of November	60 min

Example
The following example sets the Summer Time setting to use the predefined settings for the European region.

```
Console(config)#clock summer-time MESZ predefined europe
Console(config)#
```

clock summer-time (recurring)

This command allows the user to manually configure the start, end, and offset times of summer time (daylight savings time) for the switch on a recurring basis. Use the **no** form to disable summer-time.

Syntax

clock summer-time *name* **recurring** *b-week b-day b-month b-hour b-minute e-week e-day e-month e-hour e-minute* [*offset*]

no clock summer-time

name - Name of the timezone while summer time is in effect, usually an acronym. (Range: 1-30 characters)

b-week - The week of the month when summer time will begin. (Range: 1-5)

b-day - The day of the week when summer time will begin. (Options: **sunday** | **monday** | **tuesday** | **wednesday** | **thursday** | **friday** | **saturday**)

b-month - The month when summer time will begin. (Options: **january** | **february** | **march** | **april** | **may** | **june** | **july** | **august** | **september** | **october** | **november** | **december**)

b-hour - The hour when summer time will begin. (Range: 0-23 hours)

b-minute - The minute when summer time will begin. (Range: 0-59 minutes)

e-week - The week of the month when summer time will end. (Range: 1-5)

e-day - The day of the week summer time will end. (Options: **sunday** | **monday** | **tuesday** | **wednesday** | **thursday** | **friday** | **saturday**)

e-month - The month when summer time will end. (Options: **january** | **february** | **march** | **april** | **may** | **june** | **july** | **august** | **september** | **october** | **november** | **december**)

e-hour - The hour when summer time will end. (Range: 0-23 hours)

e-minute - The minute when summer time will end. (Range: 0-59 minutes)

offset - Summer-time offset from the regular time zone, in minutes. (Range: 1-120 minutes)

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
- In some countries or regions, clocks are adjusted through the summer months so that afternoons have more daylight and mornings have less. This is known as Summer Time, or Daylight Savings Time (DST). Typically, clocks are adjusted forward one hour at the start of spring and then adjusted backward in autumn.

- This command sets the summer-time time zone relative to the currently configured time zone. To display a time corresponding to your local time when summer time is in effect, you must indicate the number of minutes your summer-time time zone deviates from your regular time zone (that is, the offset).

Example

The following example sets a recurring 60 minute offset summer-time to begin on the Friday of the 1st week of March at 01:59 hours and summer time to end on the Saturday of the 2nd week of November at 01:59 hours.

```
Console(config)#clock summer-time MESZ recurring 1 friday march 01 59 3
  saturday november 1 59 60
Console(config)#
```

clock timezone

This command sets the time zone for the switch's internal clock.

Syntax

clock timezone *name* **hour** *hours* **minute** *minutes*
{**before-utc** | **after-utc**}

name - Name of timezone, usually an acronym. (Range: 1-30 characters)

hours - Number of hours before/after UTC. (Range: 0-12 hours before UTC, 0-13 hours after UTC)

minutes - Number of minutes before/after UTC. (Range: 0-59 minutes)

before-utc - Sets the local time zone before (east) of UTC.

after-utc - Sets the local time zone after (west) of UTC.

Default Setting

None

Command Mode

Global Configuration

Command Usage

This command sets the local time zone relative to the Coordinated Universal Time (UTC, formerly Greenwich Mean Time or GMT), based on the earth's prime meridian, zero degrees longitude. To display a time corresponding to your local time, you must indicate the number of hours and minutes your time zone is east (before) or west (after) of UTC.

Example

```
Console(config)#clock timezone Japan hours 8 minute 0 after-UTC
Console(config)#
```

calendar set

This command sets the system clock. It may be used if there is no time server on your network, or if you have not configured the switch to receive signals from a time server.

Syntax

calendar set *hour min sec {day month year | month day year}*

hour - Hour in 24-hour format. (Range: 0 - 23)

min - Minute. (Range: 0 - 59)

sec - Second. (Range: 0 - 59)

day - Day of month. (Range: 1 - 31)

month - **january** | **february** | **march** | **april** | **may** | **june** | **july** | **august** | **september** | **october** | **november** | **december**

year - Year (4-digit). (Range: 1970 - 2037)

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Note that when SNTP is enabled, the system clock cannot be manually configured.

Example

This example shows how to set the system clock to 15:12:34, February 1st, 2015.

```
Console#calendar set 15 12 34 1 February 2015
Console#
```

show calendar

This command displays the system clock.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show calendar
 Current Time          : May 13 14:08:18 2014
 Time Zone             : UTC, 08:00
 Summer Time           : Not configured
```

```
 Summer Time in Effect : No
Console#
```

Time Range

This section describes the commands used to sets a time range for use by other functions, such as Access Control Lists.

Table 23: Time Range Commands

Command	Function	Mode
time-range	Specifies the name of a time range, and enters time range configuration mode	GC
absolute	Sets the absolute time range for the execution of a command	TR
periodic	Sets the time range for the periodic execution of a command	TR
show time-range	Shows configured time ranges.	PE

time-range

This command specifies the name of a time range, and enters time range configuration mode. Use the **no** form to remove a previously specified time range.

Syntax

[no] **time-range** *name*

name - Name of the time range. (Range: 1-32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- This command sets a time range for use by other functions, such as Access Control Lists.
- A maximum of eight rules can be configured for a time range.

Example

```
Console(config)#time-range r&d
Console(config-time-range)#
```

absolute

This command sets the absolute time range for the execution of a command. Use the **no** form to remove a previously specified time.

Syntax

absolute start *hour minute day month year*
[**end** *hour minutes day month year*]

absolute end *hour minutes day month year*

no absolute

hour - Hour in 24-hour format. (Range: 0-23)

minute - Minute. (Range: 0-59)

day - Day of month. (Range: 1-31)

month - **january** | **february** | **march** | **april** | **may** | **june** | **july** | **august** | **september** | **october** | **november** | **december**

year - Year (4-digit). (Range: 2013-2037)

Default Setting

None

Command Mode

Time Range Configuration

Command Usage

- If a time range is already configured, you must use the **no** form of this command to remove the current entry prior to configuring a new time range.
- If both an absolute rule and one or more periodic rules are configured for the same time range (i.e., named entry), that entry will only take effect if the current time is within the absolute time range and one of the periodic time ranges.

Example

This example configures the time for the single occurrence of an event.

```
Console(config)#time-range r&d
Console(config-time-range)#absolute start 1 1 1 april 2009 end 2 1 1 april
  2009
Console(config-time-range)#
```

periodic

This command sets the time range for the periodic execution of a command. Use the **no** form to remove a previously specified time range.

Syntax

[no] **periodic** {**daily** | **friday** | **monday** | **saturday** | **sunday** | **thursday** | **tuesday** | **wednesday** | **weekdays** | **weekend**} *hour minute* **to** {**daily** | **friday** | **monday** | **saturday** | **sunday** | **thursday** | **tuesday** | **wednesday** | **weekdays** | **weekend** | *hour minute*}

daily - Daily

friday - Friday

monday - Monday

saturday - Saturday

sunday - Sunday

thursday - Thursday

tuesday - Tuesday

wednesday - Wednesday

weekdays - Weekdays

weekend - Weekends

hour - Hour in 24-hour format. (Range: 0-23)

minute - Minute. (Range: 0-59)

Default Setting

None

Command Mode

Time Range Configuration

Command Usage

- If a time range is already configured, you must use the **no** form of this command to remove the current entry prior to configuring a new time range.
- If both an absolute rule and one or more periodic rules are configured for the same time range (i.e., named entry), that entry will only take effect if the current time is within the absolute time range and one of the periodic time ranges.

Example

This example configures a time range for the periodic occurrence of an event.

```
Console(config)#time-range sales
Console(config-time-range)#periodic daily 1 1 to 2 1
Console(config-time-range)#
```

show time-range

This command shows configured time ranges.

Syntax

show time-range [*name*]

name - Name of the time range. (Range: 1-32 characters)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show time-range r&d
 Time-range r&d:
   status: inactive
   absolute start 01:01 01 April 2015
   periodic    Daily 01:01 to    Daily 02:01
   periodic    Daily 02:01 to    Daily 03:01
Console#
```

Switch Clustering

Switch Clustering is a method of grouping switches together to enable centralized management through a single unit. Switches that support clustering can be grouped together regardless of physical location or switch type, as long as they are connected to the same local network.

Table 24: Switch Cluster Commands

Command	Function	Mode
cluster	Configures clustering on the switch	GC
cluster commander	Configures the switch as a cluster Commander	GC
cluster ip-pool	Sets the cluster IP address pool for Members	GC
cluster member	Sets Candidate switches as cluster members	GC
rcommand	Provides configuration access to Member switches	GC
show cluster	Displays the switch clustering status	PE
show cluster members	Displays current cluster Members	PE
show cluster candidates	Displays current cluster Candidates in the network	PE

Using Switch Clustering

- A switch cluster has a primary unit called the "Commander" which is used to manage all other "Member" switches in the cluster. The management station can use either Telnet or the web interface to communicate directly with the Commander through its IP address, and then use the Commander to manage the Member switches through the cluster's "internal" IP addresses.
- Clustered switches must be in the same Ethernet broadcast domain. In other words, clustering only functions for switches which can pass information between the Commander and potential Candidates or active Members through VLAN 4093.
- Once a switch has been configured to be a cluster Commander, it automatically discovers other cluster-enabled switches in the network. These "Candidate" switches only become cluster Members when manually selected by the administrator through the management station.
- The cluster VLAN 4093 is not configured by default. Before using clustering, take the following actions to set up this VLAN:
  1. Create VLAN 4093 (see "Editing VLAN Groups" on page 597).
  2. Add the participating ports to this VLAN (see "Configuring VLAN Interfaces" on page 599), and set them to hybrid mode, tagged members, PVID = 1, and acceptable frame type = all.

Note: Cluster Member switches can be managed either through a Telnet connection to the Commander, or through a web management connection to the Commander. When using a console connection, from the Commander CLI prompt, use the rcommand to connect to the Member switch.

cluster

This command enables clustering on the switch. Use the **no** form to disable clustering.

Syntax

[no] cluster

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- To create a switch cluster, first be sure that clustering is enabled on the switch (the default is enabled), then set the switch as a Cluster Commander. Set a

Cluster IP Pool that does not conflict with any other IP subnets in the network. Cluster IP addresses are assigned to switches when they become Members and are used for communication between Member switches and the Commander.

- Switch clusters are limited to the same Ethernet broadcast domain.
- There can be up to 100 candidates and 36 member switches in one cluster.
- A switch can only be a Member of one cluster.
- Configured switch clusters are maintained across power resets and network changes.

Example

```
Console(config)#cluster
Console(config)#
```

cluster commander

This command enables the switch as a cluster Commander. Use the **no** form to disable the switch as cluster Commander.

Syntax

[no] cluster commander

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- Once a switch has been configured to be a cluster Commander, it automatically discovers other cluster-enabled switches in the network. These "Candidate" switches only become cluster Members when manually selected by the administrator through the management station.
- Cluster Member switches can be managed through a Telnet connection to the Commander. From the Commander CLI prompt, use the rcommand id command to connect to the Member switch.

Example

```
Console(config)#cluster commander
Console(config)#
```

cluster ip-pool

This command sets the cluster IP address pool. Use the **no** form to reset to the default address.

Syntax

cluster ip-pool *ip-address*

no cluster ip-pool

ip-address - The base IP address for IP addresses assigned to cluster Members. The IP address must start 10.x.x.x.

Default Setting

10.254.254.1

Command Mode

Global Configuration

Command Usage

- An "internal" IP address pool is used to assign IP addresses to Member switches in the cluster. Internal cluster IP addresses are in the form 10.*x.x.member-ID*. Only the base IP address of the pool needs to be set since Member IDs can only be between 1 and 36.
- Set a Cluster IP Pool that does not conflict with addresses in the network IP subnet. Cluster IP addresses are assigned to switches when they become Members and are used for communication between Member switches and the Commander.
- You cannot change the cluster IP pool when the switch is currently in Commander mode. Commander mode must first be disabled.

Example

```
Console(config)#cluster ip-pool 10.2.3.4
Console(config)#
```

cluster member

This command configures a Candidate switch as a cluster Member. Use the **no** form to remove a Member switch from the cluster.

Syntax

cluster member mac-address *mac-address* **id** *member-id*

no cluster member id *member-id*

mac-address - The MAC address of the Candidate switch.

member-id - The ID number to assign to the Member switch. (Range: 1-36)

Default Setting

No Members

Command Mode
Global Configuration

Command Usage
- The maximum number of cluster Members is 36.
- The maximum number of cluster Candidates is 100.

Example
```
Console(config)#cluster member mac-address 00-12-34-56-78-9a id 5
Console(config)#
```

rcommand
This command provides access to a cluster Member CLI for configuration.

Syntax
rcommand id *member-id*

member-id - The ID number of the Member switch. (Range: 1-36)

Command Mode
Privileged Exec

Command Usage
- This command only operates through a Telnet connection to the Commander switch. Managing cluster Members using the local console CLI on the Commander is not supported.
- There is no need to enter the username and password for access to the Member switch CLI.

Example
```
Console#rcommand id 1

      CLI session with the ECS5550-54X is opened.
      To end the CLI session, enter [Exit].

Vty-0#
```

show cluster

This command shows the switch clustering configuration.

Command Mode

Privileged Exec

Example

```
Console#show cluster
Role                 : commander
Interval Heartbeat   : 30
Heartbeat Loss Count : 3 seconds
Number of Members    : 1
Number of Candidates : 2
Console#
```

show cluster members

This command shows the current switch cluster members.

Command Mode

Privileged Exec

Example

```
Console#show cluster members
Cluster Members:
ID          : 1
Role        : Active member
IP Address  : 10.254.254.2
MAC Address : 00-E0-0C-00-00-FE
Description : ECS5550-54X
Console#
```

show cluster candidates

This command shows the discovered Candidate switches in the network.

Command Mode

Privileged Exec

Example

```
Console#show cluster candidates
Cluster Candidates:
Role            MAC Address       Description
--------------- ----------------- ---------------------------------------
Candidate join  00-E0-0C-00-00-FE ECS5550-54X
Candidate       00-12-CF-0B-47-A0 ECS5550-54X
Console#
```

Dying Gasp

When the switch enters an unrecoverable condition, such as a power failure, it can be configured to send "dying-gasp" notification messages to other devices.

Table 25: Dying-Gasp Commands

Command	Function	Mode
dying-gasp	Configures the sending of dying-gasp messages	GC
show dying-gasp status	Shows the dying-gasp configuration and status	PE
show dying-gasp packets	Shows the contents of the stored dying-gasp packet	PE

dying-gasp

This command specifies the type of dying-gasp message to send when the switch encounters an abrupt loss of power. Use the **no** form to restore the default setting.

Syntax

dying-gasp {**none** | **snmp-trap** *ip-address* | **syslog** *ip-address*}

no dying-gasp

none - Disables sending a dying-gasp message.

snmp-trap - Send an SNMP trap packet to a specified receiver.

syslog - Send a Syslog dying-gasp packet to a specified server.

ip-address - The IPv4 or IPv6 receiver address.

Default Setting

None

Command Mode

Global Configuration

Command Usage

- The switch only sends dying-gasp messages on the Craft (management) port and not other switch ports.
- A SNMP trap receiver or Syslog server IP address must first be configured when using these message types. Using this command makes the switch send a dying-gasp message to the receiver on a switch power failure.

Example

```
Console(config)#dying-gasp snmp-trap 10.2.3.4
Console(config)#
```

show dying-gasp status

This command shows the dying-gasp configuration and status.

Command Mode

Privileged Exec

Example

```
Console#show dying-gasp status
Dying Gasp Configuration:
 Notification Type : Syslog
 Server IP Address : 192.168.1.1
Status:
 Update Timer  : 30 seconds
 Packet        : Ready
Console#
```

show dying-gasp packets

This command shows the contents of the stored dying-gasp packet.

Command Mode

Privileged Exec

Example

```
Console#show dying-gasp packets
Interface               : CRAFT
Source MAC Address      : 00-10-80-CC-22-01
Source IP Address       : 192.168.1.1
Source Port Number      : 1042
Destination MAC Address : 00-10-80-CC-22-02
Destination IP Address  : 192.168.1.10
Destination Port Number : 162
Console#
```

6 SNMP Commands

SNMP commands control access to this switch from management stations using the Simple Network Management Protocol (SNMP), as well as the error types sent to trap managers.

SNMP Version 3 also provides security features that cover message integrity, authentication, and encryption; as well as controlling user access to specific areas of the MIB tree. To use SNMPv3, first set an SNMP engine ID (or accept the default), specify read and write access views for the MIB tree, configure SNMP user groups with the required security model (i.e., SNMP v1, v2c or v3) and security level (i.e., authentication and privacy), and then assign SNMP users to these groups, along with their specific authentication and privacy passwords.

Table 26: SNMP Commands

Command	Function	Mode
General SNMP Commands		
snmp-server	Enables the SNMP agent	GC
snmp-server community	Sets up the community access string to permit access to SNMP commands	GC
snmp-server contact	Sets the system contact string	GC
snmp-server location	Sets the system location string	GC
show snmp	Displays the status of SNMP communications	NE, PE
SNMP Target Host Commands		
snmp-server enable traps	Enables the device to send SNMP traps (i.e., SNMP notifications)	GC
snmp-server host	Specifies the recipient of an SNMP notification operation	GC
snmp-server enable port-traps link-up-down	Enables the device to send SNMP traps (i.e., SNMP notifications) when a link-up or link-down state change occurs	IC
snmp-server enable port-traps mac-notification	Enables the device to send SNMP traps (i.e., SNMP notifications) when a dynamic MAC address is added or removed	IC
show snmp-server enable port-traps	Shows if SNMP traps are enabled or disabled for the specified interfaces	PE
SNMPv3 Engine Commands		
snmp-server engine-id	Sets the SNMP engine ID	GC
snmp-server group	Adds an SNMP group, mapping users to views	GC
snmp-server user	Adds a user to an SNMP group	GC
snmp-server view	Adds an SNMP view	GC

Table 26: SNMP Commands (Continued)

Command	Function	Mode
show snmp engine-id	Shows the SNMP engine ID	PE
show snmp group	Shows the SNMP groups	PE
show snmp user	Shows the SNMP users	PE
show snmp view	Shows the SNMP views	PE
Notification Log Commands		
nlm	Enables the specified notification log	GC
snmp-server notify-filter	Creates a notification log and specifies the target host	GC
show nlm oper-status	Shows operation status of configured notification logs	PE
show snmp notify-filter	Displays the configured notification logs	PE
ATC Trap Commands		
snmp-server enable port-traps atc broadcast-alarm-clear	Sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered	IC (Port)
snmp-server enable port-traps atc broadcast-alarm-fire	Sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control	IC (Port)
snmp-server enable port-traps atc broadcast-control-apply	Sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control and the apply timer expires	IC (Port)
snmp-server enable port-traps atc broadcast-control-release	Sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires	IC (Port)
snmp-server enable port-traps atc multicast-alarm-clear	Sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered	IC (Port)
snmp-server enable port-traps atc multicast-alarm-fire	Sends a trap when multicast traffic exceeds the upper threshold for automatic storm control	IC (Port)
snmp-server enable port-traps atc multicast-control-apply	Sends a trap when multicast traffic exceeds the upper threshold for automatic storm control and the apply timer expires	IC (Port)
snmp-server enable port-traps atc multicast-control-release	Sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires	IC (Port)
Transceiver Power Threshold Trap Commands		
transceiver-threshold current	Sends a trap when the transceiver current falls outside the specified thresholds	IC (Port)
transceiver-threshold rx-power	Sends a trap when the power level of the received signal falls outside the specified thresholds	IC (Port)
transceiver-threshold temperature	Sends a trap when the transceiver temperature falls outside the specified thresholds	IC (Port)
transceiver-threshold tx-power	Sends a trap when the power level of the transmitted signal power outside the specified thresholds	IC (Port)
transceiver-threshold voltage	Sends a trap when the transceiver voltage falls outside the specified thresholds	IC (Port)

Table 26: SNMP Commands (Continued)

Command	Function	Mode
Additional Trap Commands		
memory	Sets the rising and falling threshold for the memory utilization alarm	GC
process cpu	Sets the rising and falling threshold for the CPU utilization alarm	GC
process cpu guard	Sets the CPU utilization watermark and threshold	GC

General SNMP Commands

snmp-server

This command enables the SNMPv3 engine and services for all management clients (i.e., versions 1, 2c, 3). Use the **no** form to disable the server.

Syntax

[no] snmp-server

Default Setting

Enabled

Command Mode

Global Configuration

Example

```
Console(config)#snmp-server
Console(config)#
```

snmp-server community

This command defines community access strings used to authorize management access by clients using SNMP v1 or v2c. Use the **no** form to remove the specified community string.

Syntax

snmp-server community *string* [**ro** | **rw**]

no snmp-server community *string*

string - Community string that acts like a password and permits access to the SNMP protocol. (Maximum length: 32 characters, case sensitive; Maximum number of strings: 5)

ro - Specifies read-only access. Authorized management stations are only able to retrieve MIB objects.

rw - Specifies read/write access. Authorized management stations are able to both retrieve and modify MIB objects.

Default Setting
None

Command Mode
Global Configuration

Example

```
Console(config)#snmp-server community alpha rw
Console(config)#
```

snmp-server contact

This command sets the system contact string. Use the **no** form to remove the system contact information.

Syntax

snmp-server contact *string*

no snmp-server contact

string - String that describes the system contact information. (Maximum length: 255 characters)

Default Setting
None

Command Mode
Global Configuration

Example

```
Console(config)#snmp-server contact Paul
Console(config)#
```

snmp-server location

This command sets the system location string. Use the **no** form to remove the location string.

Syntax

snmp-server location *text*

no snmp-server location

text - String that describes the system location. (Maximum length: 255 characters)

Default Setting
None

Command Mode
Global Configuration

Example

```
Console(config)#snmp-server location WC-19
Console(config)#
```

show snmp

This command can be used to check the status of SNMP communications.

Default Setting
None

Command Mode
Normal Exec, Privileged Exec

Command Usage
This command provides information on the community access strings, counters for SNMP input and output protocol data units, and whether or not SNMP logging has been enabled with the **snmp-server enable traps** command.

Example

```
Console#show snmp

SNMP Agent : Enabled

SNMP Traps :
 Authentication : Enabled
 MAC-notification : Disabled
 MAC-notification interval : 1 second(s)

SNMP Communities :
   1. public, and the access level is read-only
   2. private, and the access level is read/write

0 SNMP packets input
    0 Bad SNMP version errors
    0 Unknown community name
    0 Illegal operation for community name supplied
    0 Encoding errors
    0 Number of requested variables
    0 Number of altered variables
    0 Get-request PDUs
    0 Get-next PDUs
    0 Set-request PDUs
0 SNMP packets output
    0 Too big errors
    0 No such name errors
    0 Bad values errors
    0 General errors
    0 Response PDUs
    0 Trap PDUs
```

```
SNMP Logging: Disabled
Console#
```

SNMP Target Host Commands

snmp-server enable traps

This command enables this device to send Simple Network Management Protocol traps or informs (i.e., SNMP notifications). Use the **no** form to disable SNMP notifications.

Syntax

[no] **snmp-server enable traps** [**authentication** | **mac-notification** [**interval** *seconds*]]

authentication - Keyword to issue authentication failure notifications.

mac-notification - Keyword to issue trap when a dynamic MAC address is added or removed.

interval - Specifies the interval between issuing two consecutive traps. (Range: 1-3600 seconds; Default: 1 second)

Default Setting

Issue authentication traps
Other traps are disabled

Command Mode

Global Configuration

Command Usage

- If you do not enter an **snmp-server enable traps** command, no notifications controlled by this command are sent. In order to configure this device to send SNMP notifications, you must enter at least one **snmp-server enable traps** command. If you enter the command with no keywords, both authentication notifications are enabled. If you enter the command with a keyword, only the notification type related to that keyword is enabled.

- The **snmp-server enable traps** command is used in conjunction with the snmp-server host command. Use the snmp-server host command to specify which host or hosts receive SNMP notifications. In order to send notifications, you must configure at least one snmp-server host command.

- The authentication traps are legacy notifications, and therefore when used for SNMP Version 3 hosts, they must be enabled in conjunction with the corresponding entries in the Notify View assigned by the snmp-server group command.

- Interface link-up and link-down traps can be configured using the snmp-server enable port-traps link-up-down command.

Example

```
Console(config)#snmp-server enable traps authentication
Console(config)#
```

snmp-server host

This command specifies the recipient of a Simple Network Management Protocol notification operation. Use the **no** form to remove the specified host.

Syntax

snmp-server host *host-addr* [**inform** [**retry** *retries* | **timeout** *seconds*]] *community-string* [**version** {**1** | **2c** | **3** {**auth** | **noauth** | **priv**} [**udp-port** *port*]}

no snmp-server host *host-addr*

host-addr - IPv4 or IPv6 address of the host (the targeted recipient). (Maximum host addresses: 5 trap destination IP address entries)

inform - Notifications are sent as inform messages. Note that this option is only available for version 2c and 3 hosts. (Default: traps are used)

retries - The maximum number of times to resend an inform message if the recipient does not acknowledge receipt. (Range: 0-255; Default: 3)

seconds - The number of seconds to wait for an acknowledgment before resending an inform message. (Range: 0-2147483647 centiseconds; Default: 1500 centiseconds)

community-string - Password-like community string sent with the notification operation to SNMP V1 and V2c hosts. Although you can set this string using the **snmp-server host** command by itself, we recommend defining it with the snmp-server community command prior to using the **snmp-server host** command. (Maximum length: 32 characters)

version - Specifies whether to send notifications as SNMP Version 1, 2c or 3 traps. (Range: 1, 2c, 3; Default: 1)

auth | **noauth** | **priv** - This group uses SNMPv3 with authentication, no authentication, or with authentication and privacy. See "Simple Network Management Protocol" in the *Web Management Guide* for further information about these authentication and encryption options.

port - Host UDP port to use. (Range: 1-65535; Default: 162)

Default Setting

Host Address: None
Notification Type: Traps
SNMP Version: 1
UDP Port: 162

Command Mode

Global Configuration

Command Usage

- If you do not enter an **snmp-server host** command, no notifications are sent. In order to configure the switch to send SNMP notifications, you must enter at least one **snmp-server host** command. In order to enable multiple hosts, you must issue a separate **snmp-server host** command for each host.

- The **snmp-server host** command is used in conjunction with the snmp-server enable traps command. Use the snmp-server enable traps command to enable the sending of traps or informs and to specify which SNMP notifications are sent globally. For a host to receive notifications, at least one snmp-server enable traps command and the **snmp-server host** command for that host must be enabled.

- Some notification types cannot be controlled with the snmp-server enable traps command. For example, some notification types are always enabled.

- Notifications are issued by the switch as trap messages by default. The recipient of a trap message does not send a response to the switch. Traps are therefore not as reliable as inform messages, which include a request for acknowledgement of receipt. Informs can be used to ensure that critical information is received by the host. However, note that informs consume more system resources because they must be kept in memory until a response is received. Informs also add to network traffic. You should consider these effects when deciding whether to issue notifications as traps or informs.

  To send an inform to a SNMPv2c host, complete these steps:

  1. Enable the SNMP agent (page 152).
  2. Create a view with the required notification messages (page 163).
  3. Create a group that includes the required notify view (page 161).
  4. Allow the switch to send SNMP traps; i.e., notifications (page 155).
  5. Specify the target host that will receive inform messages with the **snmp-server host** command as described in this section.

  To send an inform to a SNMPv3 host, complete these steps:

  1. Enable the SNMP agent (page 152).
  2. Create a remote SNMPv3 user to use in the message exchange process (page 162).
  3. Create a view with the required notification messages (page 163).
  4. Create a group that includes the required notify view (page 161).
  5. Allow the switch to send SNMP traps; i.e., notifications (page 155).
  6. Specify the target host that will receive inform messages with the **snmp-server host** command as described in this section.

- The switch can send SNMP Version 1, 2c or 3 notifications to a host IP address, depending on the SNMP version that the management station supports. If the **snmp-server host** command does not specify the SNMP version, the default is to send SNMP version 1 notifications.

- If you specify an SNMP Version 3 host, then the community string is interpreted as an SNMP user name. The user name must first be defined with the snmp-server user command. Otherwise, an SNMPv3 group will be automatically created by the **snmp-server host** command using the name of the specified community string, and default settings for the read, write, and notify view.

Example

```
Console(config)#snmp-server host 10.1.19.23 batman
Console(config)#
```

snmp-server enable port-traps link-up-down

This command enables the device to send SNMP traps (i.e., SNMP notifications) when a link-up or link-down state change occurs. Use the **no** form to restore the default setting.

Syntax

[no] **snmp-server enable port-traps link-up-down**

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps link-up-down
Console(config)#
```

snmp-server enable port-traps mac-notification

This command enables the device to send SNMP traps (i.e., SNMP notifications) when a dynamic MAC address is added or removed. Use the no form to restore the default setting.

Syntax

[no] **snmp-server enable port-traps mac-notification**

mac-notification - Keyword to issue trap when a dynamic MAC address is added or removed.

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This command can enable MAC authentication traps on the current interface only if they are also enabled at the global level with the snmp-server enable traps mac-authentication command.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps mac-notification
Console(config)#
```

show snmp-server enable port-traps

This command shows if SNMP traps are enabled or disabled for the specified interfaces.

Syntax

show snmp-server enable port-traps interface [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode

Privileged Exec

Example

```
Console#show snmp-server enable port-traps interface
Interface MAC Notification Trap
--------- ----------------------
Eth 1/1                      No
Eth 1/2                      No
Eth 1/3                      No
⋮
```

SNMPv3 Commands

snmp-server engine-id

This command configures an identification string for the SNMPv3 engine. Use the **no** form to restore the default.

Syntax

snmp-server engine-id {**local** | **remote** {*ip-address*}} *engineid-string*

no snmp-server engine-id {**local** | **remote** {*ip-address*}}

local - Specifies the SNMP engine on this switch.

remote - Specifies an SNMP engine on a remote device.

ip-address - IPv4 or IPv6 address of the remote device.

engineid-string - String identifying the engine ID. (Range: 9-64 hexadecimal characters)

Default Setting

A unique engine ID is automatically generated by the switch based on its MAC address.

Command Mode

Global Configuration

Command Usage

- An SNMP engine is an independent SNMP agent that resides either on this switch or on a remote device. This engine protects against message replay, delay, and redirection. The engine ID is also used in combination with user passwords to generate the security keys for authenticating and encrypting SNMPv3 packets.

- A remote engine ID is required when using SNMPv3 informs. (See the snmp-server host command.) The remote engine ID is used to compute the security digest for authentication and encryption of packets passed between the switch and a user on the remote host. SNMP passwords are localized using the engine ID of the authoritative agent. For informs, the authoritative SNMP agent is the remote agent. You therefore need to configure the remote agent's SNMP engine ID before you can send proxy requests or informs to it.

- Trailing zeroes need not be entered to uniquely specify a engine ID. In other words, the value "0123456789" is equivalent to "0123456789" followed by 16 zeroes for a local engine ID.

- A local engine ID is automatically generated that is unique to the switch. This is referred to as the default engine ID. If the local engine ID is deleted or changed, all SNMP users will be cleared. You will need to reconfigure all existing users (page 162).

Example

```
Console(config)#snmp-server engine-id local 1234567890
Console(config)#snmp-server engine-id remote 192.168.1.19 9876543210
Console(config)#
```

snmp-server group

This command adds an SNMP group, mapping SNMP users to SNMP views. Use the **no** form to remove an SNMP group.

Syntax

snmp-server group *groupname*
{**v1** | **v2c** | **v3** {**auth** | **noauth** | **priv**}}
[**read** *readview*] [**write** *writeview*] [**notify** *notifyview*]

no snmp-server group *groupname*

groupname - Name of an SNMP group. A maximum of 22 groups can be configured. (Range: 1-32 characters)

v1 | **v2c** | **v3** - Use SNMP version 1, 2c or 3.

auth | **noauth** | **priv** - This group uses SNMPv3 with authentication, no authentication, or with authentication and privacy. See "Simple Network Management Protocol" in the *Web Management Guide* for further information about these authentication and encryption options.

readview - Defines the view for read access. (1-32 characters)

writeview - Defines the view for write access. (1-32 characters)

notifyview - Defines the view for notifications. (1-32 characters)

Default Setting

Default groups: None
readview - Every object belonging to the Internet OID space (1).
writeview - Nothing is defined.
notifyview - Nothing is defined.

Command Mode

Global Configuration

Command Usage

- A group sets the access policy for the assigned users.
- When authentication is selected, the MD5 or SHA algorithm is used as specified in the snmp-server user command.
- When privacy is selected, the DES 56-bit algorithm is used for data encryption.
- For additional information on the notification messages supported by this switch, see the table for "Supported Notification Messages" in the *Web Management Guide*. Also, note that the authentication, link-up and link-down messages are legacy traps and must therefore be enabled in conjunction with the snmp-server enable traps command.

Example

```
Console(config)#snmp-server group r&d v3 auth write daily
Console(config)#
```

snmp-server user

This command adds a user to an SNMP group, restricting the user to a specific SNMP Read, Write, or Notify View. Use the **no** form to remove a user from an SNMP group.

Syntax

snmp-server user *username groupname*
{**v1** | **v2c** | **v3** [**encrypted**] [**auth** {**md5** | **sha**} *auth-password* [**priv** {**3des** | **aes128** | **aes192** | **aes256** | **des56**} *priv-password*]]

snmp-server user *username groupname* **remote** *ip-address*
{**v3** [**encrypted**] [**auth** {**md5** | **sha**} *auth-password* [**priv** {**3des** | **aes128** | **aes192** | **aes256** | **des56**} *priv-password*]]

no snmp-server user *username* {**v1** | **v2c** | **v3** | **remote** *ip-address* **v3**}

username - Name of user connecting to the SNMP agent. A maximum of 22 groups can be configured. (Range: 1-32 characters)

groupname - Name of an SNMP group to which the user is assigned. (Range: 1-32 characters)

remote - Specifies an SNMP engine on a remote device.

ip-address - IPv4 address of the remote device.

v1 | **v2c** | **v3** - Use SNMP version 1, 2c or 3.

encrypted - Accepts the password as encrypted input.

auth - Uses SNMPv3 with authentication.

md5 | **sha** - Uses MD5 or SHA authentication.

auth-password - Authentication password. Enter as plain text if the **encrypted** option is not used. Otherwise, enter an encrypted password. (Range: 8-32 characters for unencrypted password.)

If the **encrypted** option is selected, enter an encrypted password. (Range: 32 characters for MD5 encrypted password, 40 characters for SHA encrypted password)

priv - Uses SNMPv3 with privacy.

3des - Uses SNMPv3 with privacy with 3DES (168-bit) encryption.

aes128 - Uses SNMPv3 with privacy with AES128 encryption.

aes192 - Uses SNMPv3 with privacy with AES192 encryption.

aes256 - Uses SNMPv3 with privacy with AES256 encryption.

des56 - Uses SNMPv3 with privacy with DES56 encryption.

priv-password - Privacy password. Enter as plain text if the **encrypted** option is not used. Otherwise, enter an encrypted password. (Range: 8-32 characters)

Default Setting

None

Command Mode
Global Configuration

Command Usage
- Local users (i.e., the command does not specify a remote engine identifier) must be configured to authorize management access for SNMPv3 clients, or to identify the source of SNMPv3 trap messages sent from the local switch.
- Remote users (i.e., the command specifies a remote engine identifier) must be configured to identify the source of SNMPv3 inform messages sent from the local switch.
- The SNMP engine ID is used to compute the authentication/privacy digests from the password. You should therefore configure the engine ID with the snmp-server engine-id command before using this configuration command.
- Before you configure a remote user, use the snmp-server engine-id command to specify the engine ID for the remote device where the user resides. Then use the **snmp-server user** command to specify the user and the IP address for the remote device where the user resides. The remote agent's SNMP engine ID is used to compute authentication/privacy digests from the user's password. If the remote engine ID is not first configured, the **snmp-server user** command specifying a remote user will fail.
- SNMP passwords are localized using the engine ID of the authoritative agent. For informs, the authoritative SNMP agent is the remote agent. You therefore need to configure the remote agent's SNMP engine ID before you can send proxy requests or informs to it.

Example
```
Console(config)#snmp-server user steve r&d v3 auth md5 greenpeace priv des56
  einstien
Console(config)#snmp-server engine-id remote 192.168.1.19 9876543210
Console(config)#snmp-server user mark r&d remote 192.168.1.19 v3 auth md5
  greenpeace priv des56 einstien
Console(config)#
```

snmp-server view
This command adds an SNMP view which controls user access to the MIB. Use the **no** form to remove an SNMP view.

Syntax
snmp-server view *view-name oid-tree* {**included** | **excluded**}

no snmp-server view *view-name*

view-name - Name of an SNMP view. A maximum of 32 views can be configured. (Range: 1-32 characters)

oid-tree - Object identifier of a branch within the MIB tree. Wild cards can be used to mask a specific portion of the OID string. (Refer to the examples.)

included - Defines an included view.

excluded - Defines an excluded view.

Default Setting
defaultview (includes access to the entire MIB tree)

Command Mode
Global Configuration

Command Usage
- Views are used in the snmp-server group command to restrict user access to specified portions of the MIB tree.
- The predefined view "defaultview" includes access to the entire MIB tree.

Examples
This view includes MIB-2.

```
Console(config)#snmp-server view mib-2 1.3.6.1.2.1 included
Console(config)#
```

This view includes the MIB-2 interfaces table, ifDescr. The wild card is used to select all the index values in the following table.

```
Console(config)#snmp-server view ifEntry.2 1.3.6.1.2.1.2.2.1.*.2 included
Console(config)#
```

This view includes the MIB-2 interfaces table, and the mask selects all index entries.

```
Console(config)#snmp-server view ifEntry.a 1.3.6.1.2.1.2.2.1.1.* included
Console(config)#
```

show snmp engine-id

This command shows the SNMP engine ID.

Command Mode
Privileged Exec

Example
This example shows the default engine ID.

```
Console#show snmp engine-id
```

```
Local SNMP EngineID: 8000002a8000000000e8666672
Local SNMP EngineBoots: 1

Remote SNMP Engine ID                                    IP address
80000000030004e2b316c54321                               192.168.1.19
Console#
```

show snmp group

This command shows information on SNMP groups.

Command Mode

Privileged Exec

Example

```
Console#show snmp group
Group Name     : r&d
Security Model : v3
Security Level : Authentication and privacy
Read View      : No readview specified
Write View     : No writeview specified
Notify View    : No notifyview specified
Storage Type   : Nonvolatile
Row Status     : Active
Console#
```

show snmp user

This command shows information on SNMP users.

Command Mode

Privileged Exec

Example

```
Console#show snmp user
Engine ID               : 800001030300e00c0000fd0000
User Name               : steve
Group Name              : rd
Security Model          : v1
Security Level          : None
Authentication Protocol : None
Privacy Protocol        : None
Storage Type            : Nonvolatile
Row Status              : Active

SNMP remote user
Engine ID               : 0000937564846450000
User Name               : mark
Group Name              : public
Security Model          : v3
Security Level          : Anthentication and privacy
Authentication Protocol : MD5
Privacy Protocol        : DES56
Storage Type            : Nonvolatile
Row Status              : Active
Console#
```

show snmp view

This command shows information on the SNMP views.

Command Mode

Privileged Exec

Example

```
Console#show snmp view
View Name: mib-2
Subtree OID: 1.2.2.3.6.2.1
View Type: included
Storage Type: permanent
Row Status: active

View Name    : defaultview
Subtree OID  : 1
View Type    : included
Storage Type : volatile
Row Status   : active
Console#
```

Notification Log Commands

nlm

This command enables or disables the specified notification log.

Syntax

[no] **nlm** *filter-name*

filter-name - Notification log name. (Range: 1-32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Notification logging is enabled by default, but will not start recording information until a logging profile specified by the snmp-server notify-filter command is enabled by the **nlm** command.
- Disabling logging with this command does not delete the entries stored in the notification log.

Example

This example enables the notification log A1.

```
Console(config)#nlm A1
Console(config)#
```

snmp-server notify-filter

This command creates an SNMP notification log. Use the **no** form to remove this log.

Syntax

[no] **snmp-server notify-filter** *profile-name* **remote** *ip-address*

profile-name - Notification log profile name. (Range: 1-32 characters)

ip-address - IPv4 or IPv6 address of a remote device. The specified target host must already have been configured using the snmp-server host command.

Note: The notification log is stored locally. It is not sent to a remote device. This remote host parameter is only required to complete mandatory fields in the SNMP Notification MIB.

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Systems that support SNMP often need a mechanism for recording Notification information as a hedge against lost notifications, whether there are Traps or Informs that may exceed retransmission limits. The Notification Log MIB (NLM, RFC 3014) provides an infrastructure in which information from other MIBs may be logged.
- Given the service provided by the NLM, individual MIBs can now bear less responsibility to record transient information associated with an event against the possibility that the Notification message is lost, and applications can poll the log to verify that they have not missed any important Notifications.
- If notification logging is not configured and enabled, when the switch reboots, some SNMP traps (such as warm start) cannot be logged.
- To avoid this problem, notification logging should be configured and enabled using the **snmp-server notify-filter** command and nlm command, and these commands stored in the startup configuration file. Then when the switch reboots, SNMP traps (such as warm start) can now be logged.
- When this command is executed, a notification log is created (with the default parameters defined in RFC 3014). Notification logging is enabled by default (see the nlm command), but will not start recording information until a logging profile specified with this command is enabled with the nlm command.
- Based on the default settings used in RFC 3014, a notification log can contain up to 256 entries, and the entry aging time is 1440 minutes. Information

recorded in a notification log, and the entry aging time can only be configured using SNMP from a network management station.

- When a trap host is created with the snmp-server host command, a default notify filter will be created as shown in the example under the show snmp notify-filter command.

Example

This example first creates an entry for a remote host, and then instructs the switch to record this device as the remote host for the specified notification log.

```
Console(config)#snmp-server host 10.1.19.23 batman
Console(config)#snmp-server notify-filter A1 remote 10.1.19.23
Console#
```

show nlm oper-status

This command shows the operational status of configured notification logs.

Command Mode

Privileged Exec

Example

```
Console#show nlm oper-status
Filter Name: A1
Oper-Status: Operational
Console#
```

show snmp notify-filter

This command displays the configured notification logs.

Command Mode

Privileged Exec

Example

This example displays the configured notification logs and associated target hosts.

```
Console#show snmp notify-filter
Filter profile name            IP address
-----------------------------  ----------------
A1                             10.1.19.23
Console#
```

Additional Trap Commands

memory

This command sets an SNMP trap based on configured thresholds for memory utilization. Use the **no** form to restore the default setting.

Syntax

memory {**rising** *rising-threshold* | **falling** *falling-threshold*}

no memory {**rising** | **falling**}

rising-threshold - Rising threshold for memory utilization alarm expressed in percentage. (Range: 1-100)

falling-threshold - Falling threshold for memory utilization alarm expressed in percentage. (Range: 1-100)

Default Setting

Rising Threshold: 90%
Falling Threshold: 70%

Command Mode

Global Configuration

Command Usage

Once the rising alarm threshold is exceeded, utilization must drop beneath the falling threshold before the alarm is terminated, and then exceed the rising threshold again before another alarm is triggered.

Example

```
Console(config)#memory rising 80
Console(config)#memory falling 60
Console#
```

process cpu

This command sets an SNMP trap based on configured thresholds for CPU utilization. Use the no form to restore the default setting.

Syntax

process cpu {**rising** *rising-threshold* | **falling** *falling-threshold*}

no process cpu {**rising** | **falling**}

rising-threshold - Rising threshold for CPU utilization alarm expressed in percentage. (Range: 1-100)

falling-threshold - Falling threshold for CPU utilization alarm expressed in percentage. (Range: 1-100)

Default Setting
Rising Threshold: 90%
Falling Threshold: 70%

Command Mode
Global Configuration

Command Usage
Once the rising alarm threshold is exceeded, utilization must drop beneath the falling threshold before the alarm is terminated, and then exceed the rising threshold again before another alarm is triggered.

Example

```
Console(config)#process cpu rising 80
Console(config)#process cpu falling 60
Console#
```

process cpu guard

This command sets the CPU utilization high and low watermarks in percentage of CPU time utilized and the CPU high and low thresholds in the number of packets being processed per second. Use the **no** form of this command without any parameters to restore all of the default settings, or with a specific parameter to restore the default setting for that item.

Syntax

process cpu guard [**high-watermark** *high-watermark* | **low-watermark** *low-watermark* | **max-threshold** *max-threshold* | **min-threshold** *min-threshold* | **trap**]

high-watermark - If the percentage of CPU usage time is higher than the high-watermark, the switch stops packet flow to the CPU (allowing it to catch up with packets already in the buffer) until usage time falls below the low watermark. (Range: 40-100%)

low-watermark - If packet flow has been stopped after exceeding the high watermark, normal flow will be restored after usage falls beneath the low watermark. (Range: 40-100%)

max-threshold - If the number of packets being processed per second by the CPU is higher than the maximum threshold, the switch stops packet flow to the CPU (allowing it to catch up with packets already in the buffer) until the number of packets being processed falls below the minimum threshold. (Range: 50-500 pps)

min-threshold - If packet flow has been stopped after exceeding the maximum threshold, normal flow will be restored after usage falls beneath the minimum threshold. (Range: 50-500 pps)

trap - If traps are enabled, the switch will send an alarm message if CPU utilization exceeds the high watermark in percentage of CPU usage time or

exceeds the maximum threshold in the number of packets being processed by the CPU.

Default Setting

Guard Status: Disabled
High Watermark: 90%
Low Watermark: 70%
Maximum Threshold: 500 packets per second
Minimum Threshold: 50 packets per second
Trap Status: Disabled

Command Mode

Global Configuration

Command Usage

- Once the high watermark is exceeded, utilization must drop beneath the low watermark before the alarm is terminated, and then exceed the high watermark again before another alarm is triggered.

- Once the maximum threshold is exceeded, utilization must drop beneath the minimum threshold before the alarm is terminated, and then exceed the maximum threshold again before another alarm is triggered.

Example

```
Console(config)#process cpu guard high-watermark 80
Console(config)#process cpu guard low-watermark 60
Console(config)#
```

7 Remote Monitoring Commands

Remote Monitoring allows a remote device to collect information or respond to specified events on an independent basis. This switch is an RMON-capable device which can independently perform a wide range of tasks, significantly reducing network management traffic. It can continuously run diagnostics and log information on network performance. If an event is triggered, it can automatically notify the network administrator of a failure and provide historical information about the event. If it cannot connect to the management agent, it will continue to perform any specified tasks and pass data back to the management station the next time it is contacted.

This switch supports mini-RMON, which consists of the Statistics, History, Event and Alarm groups. When RMON is enabled, the system gradually builds up information about its physical interfaces, storing this information in the relevant RMON database group. A management agent then periodically communicates with the switch using the SNMP protocol. However, if the switch encounters a critical event, it can automatically send a trap message to the management agent which can then respond to the event if so configured.

Table 27: RMON Commands

Command	Function	Mode
rmon alarm	Sets threshold bounds for a monitored variable	GC
rmon event	Creates a response event for an alarm	GC
rmon collection history	Periodically samples statistics	IC
rmon collection rmon1	Enables statistics collection	IC
show rmon alarms	Shows the settings for all configured alarms	PE
show rmon events	Shows the settings for all configured events	PE
show rmon history	Shows the sampling parameters for each entry	PE
show rmon statistics	Shows the collected statistics	PE

rmon alarm

This command sets threshold bounds for a monitored variable. Use the **no** form to remove an alarm.

Syntax

rmon alarm *index variable interval* {**absolute** | **delta**}
rising-threshold *threshold* [*event-index*] **falling-threshold** *threshold* [*event-index*]
[**owner** *name*]

no rmon alarm *index*

index – Index to this entry. (Range: 1-65535)

variable – The object identifier of the MIB variable to be sampled. Only variables of the type etherStatsEntry.n.n may be sampled. Note that etherStatsEntry.n uniquely defines the MIB variable, and etherStatsEntry.n.n defines the MIB variable, plus the etherStatsIndex. For example, 1.3.6.1.2.1.16.1.1.1.6.1 denotes etherStatsBroadcastPkts, plus the etherStatsIndex of 1.

interval – The polling interval. (Range: 1-31622400 seconds)

absolute – The variable is compared directly to the thresholds at the end of the sampling period.

delta – The last sample is subtracted from the current value and the difference is then compared to the thresholds.

threshold – An alarm threshold for the sampled variable. (Range: 0-2147483647)

event-index – The index of the event to use if an alarm is triggered. If there is no corresponding entry in the event control table, then no event will be generated. (Range: 1-65535)

name – Name of the person who created this entry. (Range: 1-127 characters)

Default Setting

1.3.6.1.2.1.16.1.1.1.6.1 - 1.3.6.1.2.1.16.1.1.1.6.18
Taking delta samples every 30 seconds, last value was 0
Rising threshold is 892800, assigned to event 0
Falling threshold is 446400, assigned to event 0

Command Mode

Global Configuration

Command Usage

- If an event is already defined for an index, the entry must be deleted before any changes can be made with this command.

- If the current value is greater than or equal to the rising threshold, and the last sample value was less than this threshold, then an alarm will be generated. After a rising event has been generated, another such event will not be

generated until the sampled value has fallen below the rising threshold, reaches the falling threshold, and again moves back up to the rising threshold.

- If the current value is less than or equal to the falling threshold, and the last sample value was greater than this threshold, then an alarm will be generated. After a falling event has been generated, another such event will not be generated until the sampled value has risen above the falling threshold, reaches the rising threshold, and again moves back down to the failing threshold.

Example

```
Console(config)#rmon alarm 1 1.3.6.1.2.1.16.1.1.1.6.1 15 delta
  rising-threshold 100 1 falling-threshold 30 1 owner mike
Console(config)#
```

rmon event

This command creates a response event for an alarm. Use the **no** form to remove an event.

Syntax

rmon event *index* [**log**] | [**trap** *community*] | [**description** *string*] | [**owner** *name*]

no rmon event *index*

index – Index to this entry. (Range: 1-65535)

log – Generates an RMON log entry when the event is triggered. Log messages are processed based on the current configuration settings for event logging (see "Event Logging" on page 113).

trap – Sends a trap message to all configured trap managers (see the snmp-server host command).

community – A password-like community string sent with the trap operation to SNMP v1 and v2c hosts. Although this string can be set using the **rmon event** command by itself, it is recommended that the string be defined using the snmp-server community command prior to using the rmon event command. (Range: 1-32 characters)

string – A comment that describes this event. (Range: 1-127 characters)

name – Name of the person who created this entry. (Range: 1-32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- If an event is already defined for an index, the entry must be deleted before any changes can be made with this command.
- The specified events determine the action to take when an alarm triggers this event. The response to an alarm can include logging the alarm or sending a message to a trap manager.

Example

```
Console(config)#rmon event 2 log description urgent owner mike
Console(config)#
```

rmon collection history

This command periodically samples statistics on a physical interface. Use the no form to disable periodic sampling.

Syntax

rmon collection history controlEntry *index*
[**buckets** *number* [**interval** *seconds*]] |
[**interval** *seconds*] |
[**owner** *name* [**buckets** *number* [**interval** *seconds*]]

no rmon collection history controlEntry *index*

index – Index to this entry. (Range: 1-65535)

number – The number of buckets requested for this entry. (Range: 1-65535)

seconds – The polling interval. (Range: 1-3600 seconds)

name – Name of the person who created this entry. (Range: 1-32 characters)

Default Setting

1.3.6.1.2.1.16.1.1.1.6.1 - 1.3.6.1.2.1.16.1.1.1.6.18
Buckets: 50
Interval: 30 seconds for even numbered entries,
1800 seconds for odd numbered entries

Command Mode

Interface Configuration (Ethernet)

Command Usage

- By default, each index number equates to a port on the switch, but can be changed to any number not currently in use.
- If periodic sampling is already enabled on an interface, the entry must be deleted before any changes can be made with this command.

- The information collected for each sample includes:

  input octets, packets, broadcast packets, multicast packets, undersize packets, oversize packets, fragments, jabbers, CRC alignment errors, collisions, drop events, and network utilization.

- The switch reserves two controlEntry index entries for each port. If a default index entry is re-assigned to another port by this command, the show running-config command will display a message indicating that this index is not available for the port to which is normally assigned.

  For example, if control entry 15 is assigned to port 5 as shown below, the **show running-config** command will indicate that this entry is not available for port 8.

```
Console(config)#interface ethernet 1/5
Console(config-if)#rmon collection history controlEntry 15
Console(config-if)#end
Console#show running-config
!
interface ethernet 1/5
 rmon collection history controlEntry 15 buckets 50 interval 1800
...
interface ethernet 1/8
 no rmon collection history controlEntry 15
```

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#rmon collection history controlentry 21 owner mike buckets
  24 interval 60
Console(config-if)#
```

rmon collection rmon1

This command enables the collection of statistics on a physical interface. Use the no form to disable statistics collection.

Syntax

rmon collection rmon1 controlEntry *index* [**owner** *name*]

no rmon collection rmon1 controlEntry *index*

index – Index to this entry. (Range: 1-65535)

name – Name of the person who created this entry. (Range: 1-32 characters)

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet)

Command Usage

- By default, each index number equates to a port on the switch, but can be changed to any number not currently in use.
- If statistics collection is already enabled on an interface, the entry must be deleted before any changes can be made with this command.
- The information collected for each entry includes:

  input octets, packets, broadcast packets, multicast packets, undersize packets, oversize packets, fragments, jabbers, CRC alignment errors, collisions, drop events, and packets of specified lengths

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#rmon collection rmon1 controlentry 1 owner mike
Console(config-if)#
```

show rmon alarms

This command shows the settings for all configured alarms.

Command Mode

Privileged Exec

Example

```
Console#show rmon alarms
Alarm 1 is valid, owned by
 Monitors 1.3.6.1.2.1.16.1.1.1.6.1 every 30 seconds
 Taking delta samples, last value was 0
 Rising threshold is 892800, assigned to event 0
 Falling threshold is 446400, assigned to event 0
:
```

show rmon events

This command shows the settings for all configured events.

Command Mode

Privileged Exec

Example

```
Console#show rmon events
Event 2 is valid, owned by mike
 Description is urgent
 Event firing causes log and trap to community , last fired  00:00:00
Console#
```

show rmon history

This command shows the sampling parameters configured for each entry in the history group.

Command Mode

Privileged Exec

Example

```
Console#show rmon history
Entry 1 is valid, and owned by
 Monitors 1.3.6.1.2.1.2.2.1.1.1 every 1800 seconds
 Requested # of time intervals, ie buckets, is 8
 Granted # of time intervals, ie buckets, is 8
  Sample # 1 began measuring at 00:00:01
  Received 77671 octets, 1077 packets,
  61 broadcast and 978 multicast packets,
  0 undersized and 0 oversized packets,
  0 fragments and 0 jabbers packets,
  0 CRC alignment errors and 0 collisions.
  # of dropped packet events is 0
  Network utilization is estimated at 0
⋮
```

show rmon statistics

This command shows the information collected for all configured entries in the statistics group.

Command Mode

Privileged Exec

Example

```
Console#show rmon statistics
Interface 1 is valid, and owned by
 Monitors 1.3.6.1.2.1.2.2.1.1.1 which has
 Received 164289 octets, 2372 packets,
 120 broadcast and 2211 multicast packets,
 0 undersized and 0 oversized packets,
 0 fragments and 0 jabbers,
 0 CRC alignment errors and 0 collisions.
 # of dropped packet events (due to lack of resources): 0
 # of packets received of length (in octets):
  64: 2245, 65-127: 87, 128-255: 31,
  256-511: 5, 512-1023: 2, 1024-1518: 2
⋮
```

8 Flow Sampling Commands

Flow sampling (sFlow) can be used with a remote sFlow Collector to provide an accurate, detailed and real-time overview of the types and levels of traffic present on the network. The sFlow Agent samples 1 out of *n* packets from all data traversing the switch, re-encapsulates the samples as sFlow datagrams and transmits them to the sFlow Collector. This sampling occurs at the internal hardware level where all traffic is seen, whereas traditional probes only have a partial view of traffic as it is sampled at the monitored interface. Moreover, the processor and memory load imposed by the sFlow agent is minimal since local analysis does not take place.

Note: The terms "collector", "receiver" and "owner", in the context of this chapter, all refer to a remote server capable of receiving the sFlow datagrams generated by the sFlow agent of the switch.

Table 28: sFlow Commands

Command	Function	Mode
sflow owner	Creates an sFlow collector which the switch uses to send samples to.	PE
sflow polling instance	Configures an sFlow polling data source that takes samples periodically based on time.	PE
sflow sampling instance	Configures an sFlow sampling data source that samples periodically based on a packet count.	PE
show sflow	Shows the global and interface settings for the sFlow process	PE

sflow owner

This command creates an sFlow collector on the switch. Use the **no** form to remove the sFlow receiver.

Syntax

sflow owner *owner-name* **timeout** *timeout-value*
[**destination** {*ipv4-address* | *ipv6-address*}
[**max-datagram-size** *max-datagram-size*] [**version** {**v4** | **v5**}]
[**port** *destination-udp-port*] [**max-datagram-size** *max-datagram-size*] [**version** {**v4** | **v5**}]]
[**port** *destination-udp-port*]

no sflow owner *owner-name*

owner-name - Name of the collector. (Range: 1-30 alphanumeric characters)

timeout-value - The length of time the sFlow interface is available to send samples to a receiver, after which the owner and associated polling and sampling data source instances are removed from the configuration. (Range: 30-10000000 seconds)

ipv4-address - IPv4 address of the sFlow collector. Valid IPv4 addresses consist of four decimal numbers, 0 to 255, separated by periods.

ipv6-address - IPv6 address of the sFlow collector. A full IPv6 address including the network prefix and host address bits. An IPv6 address consists of 8 colon-separated 16-bit hexadecimal values. One double colon may be used to indicate the appropriate number of zeros required to fill the undefined fields.

destination-udp-port - The UDP port on which the collector is listening for sFlow streams. (Range: 1-65535)

max-datagram-size - The maximum size of the sFlow datagram payload. (Range: 200-1500 bytes)

version {**v4** | **v5**} - Sends either v4 or v5 sFlow datagrams to the receiver.

Default Setting

No owner is configured
UDP Port: 6343
Version: v5
Maximum Datagram Size: 1400 bytes

Command Mode

Privileged Exec

Command Usage

- Use the **sflow owner** command to create an owner instance of an sFlow collector. If the socket port, maximum datagram size, and datagram version are not specified, then the default values are used.

- Once an owner is created, the **sflow owner** command can again be used to modify the owner's port number. All other parameter values for the owner will be retained if the port is modified.
- Use the **no sflow owner** command to remove the collector.
- When the **sflow owner** command is issued, it's associated timeout value will immediately begin to count down. Once the timeout value has reached zero seconds, the sFlow owner and it's associated sampling sources will be deleted from the configuration.

Example

This example shows an sflow collector being created on the switch.

```
Console#sflow owner stat_server1 timeout 100 destination 192.168.220.225 port
  22500 max-datagram-size 512 version v5
Console#
```

This example shows how to modify the sFlow port number for an already configured collector.

```
Console#sflow owner stat_server1 timeout 100 port 35100
Console#
```

sflow polling instance

This command enables an sFlow polling data source, for a specified interface, that polls periodically based on a specified time interval. Use the **no** form to remove the polling data source instance from the switch's sFlow configuration.

Syntax

sflow polling {**interface** *interface*} **instance** *instance-id* **receiver** *owner-name* **polling-interval** *seconds*

no sflow polling {**interface** *interface*} **instance** *instance-id*

interface - The source from which the samples will be taken at specified intervals and sent to a collector.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

instance-id - An instance ID used to identify the sampling source. (Range: 1)

owner-name - The associated receiver, to which the samples will be sent. (Range: 1-30 alphanumeric characters)

polling-interval - The time interval at which the sFlow process adds counter values to the sample datagram. (Range: 1-10000000 seconds, 0 disables this feature)

Default Setting
No sFlow polling instance is configured.

Command Mode
Privileged Exec

Command Usage
This command enables a polling data source and configures the interval at which counter values are added to the sample datagram.

Example
This example sets the polling interval to 10 seconds.

```
Console#sflow polling interface ethernet 1/9 instance 1 receiver owner1
  polling-interval 10
Console#
```

sflow sampling instance

This command enables an sFlow data source instance for a specific interface that takes samples periodically based on the number of packets processed. Use the **no** form to remove the sampling data source instance from the switch's sFlow configuration.

Syntax

sflow sampling {**interface** *interface*} **instance** *instance-id* **receiver** *owner-name* **sampling-rate** *sample-rate*
[**max-header-size** *max-header-size*]

no sflow sample {**interface** *interface*} **instance** *instance-id*

interface - The source from which the samples will be taken and sent to a collector.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

instance-id - An instance ID used to identify the sampling source. (Range: 1)

owner-name - The associated receiver, to which the samples will be sent. (Range: 1-30 alphanumeric characters)

sample-rate - The packet sampling rate, or the number of packets out of which one sample will be taken. (Range: 256-16777215 packets)

max-header-size - The maximum size of the sFlow datagram header. (Range: 64-256 bytes)

Default Setting

No sFlow sampling instance id configured.
Maximum Header Size: 128 bytes

Command Mode

Privileged Exec

Example

This example enables a sampling data source on Ethernet interface 1/1, an associated receiver named "owner1", and a sampling rate of one out of 100. The maximum header size is also set to 200 bytes.

```
Console# sflow sampling interface ethernet 1/1 instance 1 receiver owner1
  sampling-rate 100 max-header-size 200
Console#
```

The following command removes a sampling data source from Ethernet interface 1/1.

```
Console# no sflow sampling interface ethernet 1/1 instance 1
Console#
```

show sflow

This command shows the global and interface settings for the sFlow process.

Syntax

show sflow [**owner** *owner-name* | **interface** *interface*]

owner-name - The associated receiver, to which the samples are sent. (Range: 1-30 alphanumeric characters)

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode

Privileged Exec

Example

```
Console#show sflow interface ethernet 1/2

  Receiver Owner Name   : stat1
  Receiver Timeout      : 99633 sec
```

```
  Receiver Destination  : 192.168.32.32
  Receiver Socket Port  : 6343
  Maximum Datagram Size : 1400 bytes
  Datagram Version      : 4

  Data Source           : Eth 1/2
  Sampling Instance ID  : 1
  Sampling Rate         : 512
  Maximum Header Size   : 128 bytes

Console#
```

9 Authentication Commands

You can configure this switch to authenticate users logging into the system for management access using local or remote authentication methods. Port-based authentication using IEEE 802.1X can also be configured to control either management access to the uplink ports or client access[1] to the data ports.

Table 29: Authentication Commands

Command Group	Function
User Accounts and Privilege Levels	Configures the basic user names and passwords for management access, and assigns a privilege level to specified command groups or individual commands
Authentication Sequence	Defines logon authentication method and precedence
RADIUS Client	Configures settings for authentication via a RADIUS server
TACACS+ Client	Configures settings for authentication via a TACACS+ server
AAA	Configures authentication, authorization, and accounting for network access
Web Server	Enables management access via a web browser
Telnet Server	Enables management access via Telnet
Secure Shell	Provides secure replacement for Telnet
802.1X Port Authentication	Configures host authentication on specific ports using 802.1X
Management IP Filter	Configures IP addresses that are allowed management access
PPPoE Intermediate Agent	Configures relay parameters required for sending authentication messages between a client and broadband remote access servers

1. For other methods of controlling client access, see "General Security Measures" on page 255.

User Accounts and Privilege Levels

The basic commands required for management access and assigning command privilege levels are listed in this section. This switch also includes other options for password checking via the console or a Telnet connection (page 102), user authentication via a remote authentication server (page 185), and host access authentication for specific ports (page 229).

Table 30: User Access Commands

Command	Function	Mode
enable password	Sets a password to control access to the Privileged Exec level	GC
username	Establishes a user name-based authentication system at login	GC
privilege	Assigns a privilege level to specified command groups or individual commands	GC
show privilege	Shows the privilege level for the current user, or the privilege level for commands modified by the privilege command	PE

enable password

After initially logging onto the system, you should set the Privileged Exec password. Remember to record it in a safe place. This command controls access to the Privileged Exec level from the Normal Exec level. Use the **no** form to reset the default password.

Syntax

enable password [**level** *level*] {**0** | **7**} *password*

no enable password [**level** *level*]

level *level* - Sets the command access privileges. (Range: 0-15)

Level 0, 8 and 15 are designed for users (guest), managers (network maintenance), and administrators (top-level access). The other levels can be used to configured specialized access profiles.

Level 0-7 provide the same default access privileges, all within Normal Exec mode under the "Console>" command prompt.

Level 8-14 provide the same default access privileges, including additional commands in Normal Exec mode, and a subset of commands in Privileged Exec mode under the "Console#" command prompt.

Level 15 provides full access to all commands.

The privilege level associated with any command can be changed using the privilege command.

{**0** | **7**} - 0 means plain password, 7 means encrypted password.

password - Password for this privilege level.
(Maximum length: 32 characters plain text or encrypted, case sensitive)

Default Setting

The default is level 15.
The default password is "super"

Command Mode

Global Configuration

Command Usage

- You cannot set a null password. You will have to enter a password to change the command mode from Normal Exec to Privileged Exec with the enable command.

- The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from an FTP server. There is no need for you to manually configure encrypted passwords.

Example

```
Console(config)#enable password level 15 0 admin
Console(config)#
```

username

This command adds named users, requires authentication at login, specifies or changes a user's password (or specify that no password is required), or specifies or changes a user's access level. Use the **no** form to remove a user name.

Syntax

username *name* {**access-level** *level* | **nopassword** |
password {**0** | **7**} *password*}

no username *name*

name - The name of the user. (Maximum length: 32 characters, case sensitive. Maximum users: 16)

The device has two predefined users, **guest** which is assigned privilege level **0** (Normal Exec) and has access to a limited number of commands, and **admin** which is assigned privilege level 15 and has full access to all commands.

access-level *level* - Specifies command access privileges. (Range: 0-15)

Level 0, 8 and 15 are designed for users (guest), managers (network maintenance), and administrators (top-level access). The other levels can be used to configured specialized access profiles.

Level 0-7 provide the same default access privileges, all within Normal Exec mode under the "Console>" command prompt.

Level 8-14 provide the same default access privileges, including additional commands in Normal Exec mode, and a subset of commands in Privileged Exec mode under the "Console#" command prompt.

Level 15 provides full access to all commands.

The privilege level associated with any command can be changed using the privilege command.

Any privilege level can access all of the commands assigned to lower privilege levels. For example, privilege level 8 can access all commands assigned to privilege levels 7-0 according to default settings, and to any other commands assigned to levels 7-0 using the privilege command.

nopassword - No password is required for this user to log in.

{**0** | **7**} - 0 means plain password, 7 means encrypted password.

password *password* - The authentication password for the user. (Maximum length: 32 characters plain text or encrypted, case sensitive)

Default Setting

The default access level is 0 (Normal Exec).
The factory defaults for the user names and passwords are:

Table 31: Default Login Settings

username	access-level	password
guest	0	guest
admin	15	admin

Command Mode

Global Configuration

Command Usage

The encrypted password is required for compatibility with legacy password settings (i.e., plain text or encrypted) when reading the configuration file during system bootup or when downloading the configuration file from an FTP server. There is no need for you to manually configure encrypted passwords.

Example

This example shows how the set the access level and password for a user.

```
Console(config)#username bob access-level 15
Console(config)#username bob password 0 smith
Console(config)#
```

privilege

This command assigns a privilege level to specified command groups or individual commands. Use the **no** form to restore the default setting.

Syntax

privilege *mode* [**all**] **level** *level command*

no privilege *mode* [**all**] *command*

mode - The configuration mode containing the specified *command*. (See "Understanding Command Modes" on page 38 and "Configuration Commands" on page 39.)

all - Modifies the privilege level for all subcommands under the specified *command*.

level *level* - Specifies the privilege level for the specified *command*. Refer to the default settings described for the access level parameter under the username command. (Range: 0-15)

command - Specifies any command contained within the specified *mode*.

Default Setting

Privilege level 0 provides access to a limited number of the commands which display the current status of the switch, as well as several database clear and reset functions. Level 8 provides access to all display status and configuration commands, except for those controlling various authentication and security features. Level 15 provides full access to all commands.

Command Mode

Global Configuration

Example

This example sets the privilege level for the ping command to Privileged Exec.

```
Console(config)#privilege exec level 15 ping
Console(config)#
```

show privilege

This command shows the privilege level for the current user, or the privilege level for commands modified by the privilege command.

Syntax

show privilege [**command**]

command - Displays the privilege level for all commands modified by the privilege command.

Command Mode

Privileged Exec

Example

This example shows the privilege level for any command modified by the privilege command.

```
Console#show privilege command
privilege line all level 0 accounting
privilege exec level 15 ping
Console(config)#
```

Authentication Sequence

Three authentication methods can be specified to authenticate users logging into the system for management access. The commands in this section can be used to define the authentication method and sequence.

Table 32: Authentication Sequence Commands

Command	Function	Mode
authentication enable	Defines the authentication method and precedence for command mode change	GC
authentication login	Defines logon authentication method and precedence	GC

authentication enable

This command defines the authentication method and precedence to use when changing from Exec command mode to Privileged Exec command mode with the enable command. Use the **no** form to restore the default.

Syntax

authentication enable {[**local**] [**radius**] [**tacacs**]}

no authentication enable

local - Use local password only.

radius - Use RADIUS server password only.

tacacs - Use TACACS server password.

Default Setting

Local

Command Mode

Global Configuration

Command Usage

- RADIUS uses UDP while TACACS+ uses TCP. UDP only offers best effort delivery, while TCP offers a connection-oriented transport. Also, note that

RADIUS encrypts only the password in the access-request packet from the client to the server, while TACACS+ encrypts the entire body of the packet.

- RADIUS and TACACS+ logon authentication assigns a specific privilege level for each user name and password pair. The user name, password, and privilege level must be configured on the authentication server.
- You can specify three authentication methods in a single command to indicate the authentication sequence. For example, if you enter "**authentication enable radius tacacs local**," the user name and password on the RADIUS server is verified first. If the RADIUS server is not available, then authentication is attempted on the TACACS+ server. If the TACACS+ server is not available, the local user name and password is checked.
- Use the enable password command to set the password for changing command modes.

Example

```
Console(config)#authentication enable radius
Console(config)#
```

authentication login

This command defines the login authentication method and precedence. Use the **no** form to restore the default.

Syntax

authentication login {[**local**] [**radius**] [**tacacs**]}

no authentication login

local - Use local password.

radius - Use RADIUS server password.

tacacs - Use TACACS server password.

Default Setting

Local

Command Mode

Global Configuration

Command Usage

- RADIUS uses UDP while TACACS+ uses TCP. UDP only offers best effort delivery, while TCP offers a connection-oriented transport. Also, note that RADIUS encrypts only the password in the access-request packet from the client to the server, while TACACS+ encrypts the entire body of the packet.

- RADIUS and TACACS+ logon authentication assigns a specific privilege level for each user name and password pair. The user name, password, and privilege level must be configured on the authentication server.

- You can specify three authentication methods in a single command to indicate the authentication sequence. For example, if you enter "**authentication login radius tacacs local**," the user name and password on the RADIUS server is verified first. If the RADIUS server is not available, then authentication is attempted on the TACACS+ server. If the TACACS+ server is not available, the local user name and password is checked.

Example

```
Console(config)#authentication login radius
Console(config)#
```

RADIUS Client

Remote Authentication Dial-in User Service (RADIUS) is a logon authentication protocol that uses software running on a central server to control access to RADIUS-aware devices on the network. An authentication server contains a database of multiple user name/password pairs with associated privilege levels for each user or group that require management access to a switch.

Table 33: RADIUS Client Commands

Command	Function	Mode
radius-server acct-port	Sets the RADIUS server network port	GC
radius-server auth-port	Sets the RADIUS server network port	GC
radius-server host	Specifies the RADIUS server	GC
radius-server key	Sets the RADIUS encryption key	GC
radius-server encrypted-key	Sets the RADIUS encryption key sent in encrypted text	GC
radius-server retransmit	Sets the number of retries	GC
radius-server timeout	Sets the interval between sending authentication requests	GC
radius-server type radsec	Enables RADIUS using Transport Layer Security (TLS) over TCP for additional security	GC
show radius-server	Shows the current RADIUS settings	PE

radius-server acct-port

This command sets the RADIUS server network port for accounting messages. Use the **no** form to restore the default.

Syntax

radius-server acct-port *port-number*

no radius-server acct-port

port-number - RADIUS server UDP port used for accounting messages. (Range: 1-65535)

Default Setting

1813

Command Mode

Global Configuration

Example

```
Console(config)#radius-server acct-port 181
Console(config)#
```

radius-server auth-port

This command sets the RADIUS server network port. Use the **no** form to restore the default.

Syntax

radius-server auth-port *port-number*

no radius-server auth-port

port-number - RADIUS server UDP port used for authentication messages. (Range: 1-65535)

Default Setting

1812

Command Mode

Global Configuration

Example

```
Console(config)#radius-server auth-port 181
Console(config)#
```

radius-server host

This command specifies primary and backup RADIUS servers, and authentication and accounting parameters that apply to each server. Use the **no** form to remove a specified server, or to restore the default values.

Syntax

[**no**] **radius-server** *index* **host** *host-ip-address* [**acct-port** *acct-port*] [**auth-port** *auth-port*] [**key** *key*] [**retransmit** *retransmit*] [**timeout** *timeout*]

index - Allows you to specify up to five servers. These servers are queried in sequence until a server responds or the retransmit period expires.

host-ip-address - IP address of server.

acct-port - RADIUS server UDP port used for accounting messages. (Range: 1-65535)

auth-port - RADIUS server UDP port used for authentication messages. (Range: 1-65535)

key - Encryption key used to authenticate logon access for client. Enclose any string containing blank spaces in double quotes. (Maximum length: 48 characters)

retransmit - Number of times the switch will try to authenticate logon access via the RADIUS server. (Range: 1-30)

timeout - Number of seconds the switch waits for a reply before resending a request. (Range: 1-65535)

Default Setting

auth-port - 1812
acct-port - 1813
timeout - 5 seconds
retransmit - 2

Command Mode

Global Configuration

Example

```
Console(config)#radius-server 1 host 192.168.1.20 auth-port 181 timeout 10
  retransmit 5 key green
Console(config)#
```

radius-server key

This command sets the RADIUS encryption key. Use the **no** form to restore the default.

Syntax

radius-server key *key-string*

no radius-server key

key-string - Encryption key used to authenticate logon access for client. Enclose any string containing blank spaces in double quotes. (Maximum length: 48 characters)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#radius-server key green
Console(config)#
```

radius-server encrypted-key

This command sets the RADIUS encryption key to be sent in encrypted text. Use the **no** form to restore the default.

Syntax

radius-server key *key-string*

no radius-server key

key-string - Encryption key sent in encrypted text and used to authenticate logon access for client. Enclose any character string using ASCII characters "A-Z" or "a-z". (Maximum length: 48 characters)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#radius-server encrypted-key green
Console(config)#
```

radius-server retransmit

This command sets the number of retries. Use the **no** form to restore the default.

Syntax

radius-server retransmit *number-of-retries*

no radius-server retransmit

number-of-retries - Number of times the switch will try to authenticate logon access via the RADIUS server. (Range: 1 - 30)

Default Setting

2

Command Mode

Global Configuration

Example

```
Console(config)#radius-server retransmit 5
Console(config)#
```

radius-server timeout

This command sets the interval between transmitting authentication requests to the RADIUS server. Use the **no** form to restore the default.

Syntax

radius-server timeout *number-of-seconds*

no radius-server timeout

number-of-seconds - Number of seconds the switch waits for a reply before resending a request. (Range: 1-65535)

Default Setting

5

Command Mode

Global Configuration

Example

```
Console(config)#radius-server timeout 10
Console(config)#
```

radius-server type radsec

This command enables RADIUS using Transport Layer Security (TLS) over TCP for additional security. Use the **no** form to disable the feature.

Syntax

radius-server type radsec [**certificate** *string*]

no radius-server type radsec

certificate - Key word for specifying the CA certificate.

string - The file name of the CA certificate.

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- This command changes communications to a secure RADIUS message exchange (RFC 6614). The switch uses Transport Layer Security (TLS) over TCP as the transport protocol for RADIUS messages, and will dynamically trust relationships between RADIUS servers. A RADIUS client and RADIUS server exchange public keys through CA certificates.

- An X.509 CA certificate file can be user generated and the switch must match the server-side. When setting up a TLS connection, the server certificate is verified by the client's CA certificate, including checking that the configured CN/ Validity period matches what is in the certificate. The client has to verify the one-way TLS authentication of the server, so the server's private key must be used to create the CA certificate file for the client. Use the copy command to copy a CA certificate to the switch and the delete command to remove a certificate from the switch.

Example

```
Console(config)#radius-server type radsec
Console(config)#
```

show radius-server

This command displays the current settings for the RADIUS server.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show radius-server

Remote RADIUS Server Configuration:

Global Settings:
 Authentication Port Number : 1812
 Accounting Port Number     : 1813
 Retransmit Times           : 2
 Request Timeout            : 5
 Radsec                     : No

Server 1:
 Server IP Address          : 192.168.1.1
 Authentication Port Number : 1812
 Accounting Port Number     : 1813
 Retransmit Times           : 2
 Request Timeout            : 5
 Radsec                     : No

RADIUS Server Group:
Group Name                Member Index
------------------------- -------------
radius                    1
Console#
```

TACACS+ Client

Terminal Access Controller Access Control System (TACACS+) is a logon authentication protocol that uses software running on a central server to control access to TACACS-aware devices on the network. An authentication server contains a database of multiple user name/password pairs with associated privilege levels for each user or group that require management access to a switch.

Table 34: TACACS+ Client Commands

Command	Function	Mode
tacacs-server host	Specifies the TACACS+ server and optional parameters	GC
tacacs-server key	Sets the TACACS+ encryption key	GC
tacacs-server encrypted-key	Sets the TACACS+ encryption key sent in encrypted text	GC
tacacs-server port	Specifies the TACACS+ server network port	GC
tacacs-server retransmit	Sets the number of retries	GC
tacacs-server timeout	Sets the interval between sending authentication requests	GC
show tacacs-server	Shows the current TACACS+ settings	GC

tacacs-server host

This command specifies the TACACS+ server and other optional parameters. Use the **no** form to remove the server, or to restore the default values.

Syntax

tacacs-server *index* **host** *host-ip-address* [**key** *key*] [**port** *port-number*] [**retransmit** *retransmit*] [**timeout** *timeout*]

no tacacs-server *index*

index - The index for this server. (Range: 1-5)

host-ip-address - IP address of a TACACS+ server.

key - Encryption key used to authenticate logon access for the client. Enclose any string containing blank spaces in double quotes. (Maximum length: 48 characters)

port-number - TACACS+ server TCP port used for authentication messages. (Range: 1-65535)

retransmit - Number of times the switch will try to authenticate logon access via the TACACS+ server. (Range: 1-30)

timeout - Number of seconds the switch waits for a reply before resending a request. (Range: 1-540)

Default Setting

authentication port - 49
timeout - 5 seconds
retransmit - 2

Command Mode

Global Configuration

Example

```
Console(config)#tacacs-server 1 host 192.168.1.25 port 181 timeout 10
  retransmit 5 key green
Console(config)#
```

tacacs-server key

This command sets the TACACS+ encryption key. Use the **no** form to restore the default.

Syntax

tacacs-server key *key-string*

no tacacs-server key

key-string - Encryption key used to authenticate logon access for the client. Enclose any string containing blank spaces in double quotes. (Maximum length: 48 characters)

Default Setting
None

Command Mode
Global Configuration

Example

```
Console(config)#tacacs-server key green
Console(config)#
```

tacacs-server encrypted-key

This command sets the TACACS+ encryption key to be sent in encrypted text. Use the **no** form to restore the default.

Syntax

tacacs-server encrypted-key *key-string*

no tacacs-server encrypted-key

key-string - Encryption key sent in encrypted text and used to authenticate logon access for client. Enclose any character string using ASCII characters "A-Z" or "a-z". (Maximum length: 48 characters)

Default Setting
None

Command Mode
Global Configuration

Example

```
Console(config)#tacacs-server encrypted-key green
Console(config)#
```

tacacs-server port

This command specifies the TACACS+ server network port. Use the **no** form to restore the default.

Syntax

tacacs-server port *port-number*

no tacacs-server port

port-number - TACACS+ server TCP port used for authentication messages. (Range: 1-65535)

Default Setting
49

Command Mode
Global Configuration

Example

```
Console(config)#tacacs-server port 181
Console(config)#
```

tacacs-server retransmit

This command sets the number of retries. Use the **no** form to restore the default.

Syntax

tacacs-server retransmit *number-of-retries*

no tacacs-server retransmit

number-of-retries - Number of times the switch will try to authenticate logon access via the TACACS+ server. (Range: 1 - 30)

Default Setting
2

Command Mode
Global Configuration

Example

```
Console(config)#tacacs-server retransmit 5
Console(config)#
```

tacacs-server timeout

This command sets the interval between transmitting authentication requests to the TACACS+ server. Use the **no** form to restore the default.

Syntax

tacacs-server timeout *number-of-seconds*

no tacacs-server timeout

number-of-seconds - Number of seconds the switch waits for a reply before resending a request. (Range: 1-540)

Default Setting
5

Command Mode
Global Configuration

Example

```
Console(config)#tacacs-server timeout 10
Console(config)#
```

show tacacs-server

This command displays the current settings for the TACACS+ server.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show tacacs-server

Remote TACACS+ Server Configuration:

Global Settings:
 Server Port Number : 49
 Retransmit Times   : 2
 Timeout            : 5

Server 1:
 Server IP Address  : 10.11.12.13
 Server Port Number : 49
 Retransmit Times   : 2
 Timeout            : 4

TACACS+ Server Group:
Group Name                Member Index
------------------------- -------------
tacacs+                   1
Console#
```

AAA

The Authentication, Authorization, and Accounting (AAA) feature provides the main framework for configuring access control on the switch. The AAA functions require the use of configured RADIUS or TACACS+ servers in the network.

Table 35: AAA Commands

Command	Function	Mode
aaa accounting commands	Enables accounting of Exec mode commands	GC
aaa accounting dot1x	Enables accounting of 802.1X services	GC
aaa accounting exec	Enables accounting of Exec services	GC

Table 35: AAA Commands (Continued)

Command	Function	Mode
aaa accounting update	Enables periodoc updates to be sent to the accounting server	GC
aaa authorization commands	Enables authorization of Exec mode commands	GC
aaa authorization without-server	Allows Exec mode commands when the TACACS+ server is disconnected	GC
aaa authorization exec	Enables authorization of Exec sessions	GC
aaa group server	Groups security servers in to defined lists	GC
server	Configures the IP address of a server in a group list	SG
accounting dot1x	Applies an accounting method to an interface for 802.1X service requests	IC
accounting commands	Applies an accounting method to CLI commands entered by a user	Line
accounting exec	Applies an accounting method to local console, Telnet or SSH connections	Line
authorization commands	Applies an authorization method to CLI commands entered by a user	Line
authorization exec	Applies an authorization method to local console, Telnet or SSH connections	Line
show accounting	Displays all accounting information	PE
show authorization	Displays all authorization information	PE

aaa accounting commands

This command enables the accounting of Exec mode commands. Use the **no** form to disable the accounting service.

Syntax

aaa accounting commands *level* {**default** | *method-name*} **start-stop group** {**tacacs+** | *server-group*}

no aaa accounting commands *level* {**default** | *method-name*}

level - The privilege level for executing commands. (Range: 0-15)

default - Specifies the default accounting method for service requests.

method-name - Specifies an accounting method for service requests. (Range: 1-64 characters)

start-stop - Records accounting from starting point and stopping point.

group - Specifies the server group to use.

tacacs+ - Specifies all TACACS+ hosts configured with the tacacs-server host command.

server-group - Specifies the name of a server group configured with the aaa group server command. (Range: 1-64 characters)

Default Setting
Accounting is not enabled
No servers are specified

Command Mode
Global Configuration

Command Usage
- The accounting of Exec mode commands is only supported by TACACS+ servers.
- Note that the **default** and *method-name* fields are only used to describe the accounting method(s) configured on the specified TACACS+ server, and do not actually send any information to the server about the methods to use.

Example
```
Console(config)#aaa accounting commands 15 default start-stop group tacacs+
Console(config)#
```

aaa accounting dot1x

This command enables the accounting of requested 802.1X services for network access. Use the **no** form to disable the accounting service.

Syntax
aaa accounting dot1x {**default** | *method-name*}
start-stop group {**radius** | **tacacs+** |*server-group*}

no aaa accounting dot1x {**default** | *method-name*}

default - Specifies the default accounting method for service requests.

method-name - Specifies an accounting method for service requests. (Range: 1-64 characters)

start-stop - Records accounting from starting point and stopping point.

group - Specifies the server group to use.

radius - Specifies all RADIUS hosts configure with the radius-server host command.

tacacs+ - Specifies all TACACS+ hosts configure with the tacacs-server host command.

server-group - Specifies the name of a server group configured with the aaa group server command. (Range: 1-64 characters)

Default Setting
Accounting is not enabled
No servers are specified

Command Mode
Global Configuration

Command Usage
Note that the **default** and *method-name* fields are only used to describe the accounting method(s) configured on the specified RADIUS or TACACS+ servers, and do not actually send any information to the servers about the methods to use.

Example

```
Console(config)#aaa accounting dot1x default start-stop group radius
Console(config)#
```

aaa accounting exec

This command enables the accounting of requested Exec services for network access. Use the **no** form to disable the accounting service.

Syntax

aaa accounting exec {**default** | *method-name*}
start-stop group {**radius** | **tacacs+** |*server-group*}

no aaa accounting exec {**default** | *method-name*}

default - Specifies the default accounting method for service requests.

method-name - Specifies an accounting method for service requests. (Range: 1-64 characters)

start-stop - Records accounting from starting point and stopping point.

group - Specifies the server group to use.

radius - Specifies all RADIUS hosts configure with the radius-server host command.

tacacs+ - Specifies all TACACS+ hosts configure with the tacacs-server host command.

server-group - Specifies the name of a server group configured with the aaa group server command. (Range: 1-64 characters)

Default Setting
Accounting is not enabled
No servers are specified

Command Mode
Global Configuration

Command Usage
- This command runs accounting for Exec service requests for the local console and Telnet connections.

- Note that the **default** and *method-name* fields are only used to describe the accounting method(s) configured on the specified RADIUS or TACACS+ servers, and do not actually send any information to the servers about the methods to use.

Example

```
Console(config)#aaa accounting exec default start-stop group tacacs+
Console(config)#
```

aaa accounting update

This command enables the sending of periodic updates to the accounting server. Use the **no** form to disable accounting updates.

Syntax

aaa accounting update [**periodic** *interval*]

no aaa accounting update

interval - Sends an interim accounting record to the server at this interval. (Range: 1-2147483647 minutes)

Default Setting

1 minute

Command Mode

Global Configuration

Command Usage

- When accounting updates are enabled, the switch issues periodic interim accounting records for all users on the system.
- Using the command without specifying an interim interval enables updates, but does not change the current interval setting.

Example

```
Console(config)#aaa accounting update periodic 30
Console(config)#
```

aaa authorization commands

This command enables the authorization of Exec mode commands. Use the **no** form to disable the authorization service.

Syntax

aaa authorization commands *level* {**default** | *method-name*} **group** {**tacacs+** | *server-group*}

no aaa authorization commands *level* {**default** | *method-name*}

level - The privilege level for executing commands. (Range: 0-15)

default - Specifies the default authorization method for service requests.

method-name - Specifies an authorization method for service requests. (Range: 1-64 characters)

group - Specifies the server group to use.

tacacs+ - Specifies all TACACS+ hosts configured with the tacacs-server host command.

server-group - Specifies the name of a server group configured with the aaa group server command. (Range: 1-64 characters)

Default Setting
Authorization is not enabled
No servers are specified

Command Mode
Global Configuration

Command Usage
- The authorization of Exec mode commands is only supported by TACACS+ servers.
- Note that the **default** and *method-name* fields are only used to describe the authorization method(s) configured on the specified TACACS+ server, and do not actually send any information to the server about the methods to use.

Example
```
Console(config)#aaa authorization commands 15 default group tacacs+
Console(config)#
```

aaa authorization without-server

This command enables commands to be executed when the TACACS+ server is disconnected. Use the **no** form to disable the feature.

Syntax
[no] **aaa authorization without-server**

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
When this feature is enabled, users can continue to execute commands when the TACACS+ server is unreachable and no authorization is required.

Example

```
Console(config)#aaa authorization without-server
Console(config)#
```

aaa authorization exec

This command enables the authorization for Exec access. Use the **no** form to disable the authorization service.

Syntax

aaa authorization exec {**default** | *method-name*}
group {**tacacs+** | *server-group*}

no aaa authorization exec {**default** | *method-name*}

default - Specifies the default authorization method for Exec access.

method-name - Specifies an authorization method for Exec access. (Range: 1-64 characters)

group - Specifies the server group to use.

tacacs+ - Specifies all TACACS+ hosts configured with the tacacs-server host command.

server-group - Specifies the name of a server group configured with the aaa group server command. (Range: 1-64 characters)

Default Setting

Authorization is not enabled
No servers are specified

Command Mode

Global Configuration

Command Usage

- This command performs authorization to determine if a user is allowed to run an Exec shell for local console, Telnet, or SSH connections.
- AAA authentication must be enabled before authorization is enabled.
- If this command is issued without a specified named method, the default method list is applied to all interfaces or lines (where this authorization type applies), except those that have a named method explicitly defined.

Example

```
Console(config)#aaa authorization exec default group tacacs+
Console(config)#
```

aaa group server

Use this command to name a group of security server hosts. To remove a server group from the configuration list, enter the **no** form of this command.

Syntax

[no] **aaa group server** {**radius** | **tacacs+**} *group-name*

radius - Defines a RADIUS server group.

tacacs+ - Defines a TACACS+ server group.

group-name - A text string that names a security server group. (Range: 1-64 characters)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#aaa group server radius tps
Console(config-sg-radius)#
```

server

This command adds a security server to an AAA server group. Use the **no** form to remove the associated server from the group.

Syntax

[no] **server** {*index* | *ip-address*}

index - Specifies the server index. (Range: RADIUS 1-5, TACACS+ 1)

ip-address - Specifies the host IP address of a server.

Default Setting

None

Command Mode

Server Group Configuration

Command Usage

- When specifying the index for a RADIUS server, that server index must already be defined by the radius-server host command.
- When specifying the index for a TACACS+ server, that server index must already be defined by the tacacs-server host command.

Example

```
Console(config)#aaa group server radius tps
Console(config-sg-radius)#server 10.2.68.120
Console(config-sg-radius)#
```

accounting dot1x

This command applies an accounting method for 802.1X service requests on an interface. Use the **no** form to disable accounting on the interface.

Syntax

accounting dot1x {**default** | *list-name*}

no accounting dot1x

default - Specifies the default method list created with the aaa accounting dot1x command.

list-name - Specifies a method list created with the aaa accounting dot1x command.

Default Setting

None

Command Mode

Interface Configuration

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#accounting dot1x tps
Console(config-if)#
```

accounting commands

This command applies an accounting method to entered CLI commands. Use the **no** form to disable accounting for entered CLI commands.

Syntax

accounting commands *level* {**default** | *list-name*}

no accounting commands *level*

level - The privilege level for executing commands. (Range: 0-15)

default - Specifies the default method list created with the aaa accounting commands command.

list-name - Specifies a method list created with the aaa accounting commands command.

Default Setting

None

Command Mode
Line Configuration

Example

```
Console(config)#line console
Console(config-line)#accounting commands 15 default
Console(config-line)#
```

accounting exec

This command applies an accounting method to local console, Telnet or SSH connections. Use the **no** form to disable accounting on the line.

Syntax

accounting exec {**default** | *list-name*}

no accounting exec

default - Specifies the default method list created with the aaa accounting exec command.

list-name - Specifies a method list created with the aaa accounting exec command.

Default Setting
None

Command Mode
Line Configuration

Example

```
Console(config)#line console
Console(config-line)#accounting exec tps
Console(config-line)#exit
Console(config)#line vty
Console(config-line)#accounting exec default
Console(config-line)#
```

authorization commands

This command applies an authorization method to entered CLI commands. Use the **no** form to disable authorization for entered CLI commands.

Syntax

authorization commands *level* {**default** | *list-name*}

no authorization commands *level*

level - The privilege level for executing commands. (Range: 0-15)

default - Specifies the default method list created with the aaa authorization commands command.

list-name - Specifies a method list created with the aaa authorization commands command.

Default Setting
None

Command Mode
Line Configuration

Example
```
Console(config)#line console
Console(config-line)#authorization commands 15 default
Console(config-line)#
```

authorization exec
This command applies an authorization method to local console, Telnet or SSH connections. Use the **no** form to disable authorization on the line.

Syntax
authorization exec {**default** | *list-name*}

no authorization exec

default - Specifies the default method list created with the aaa authorization exec command.

list-name - Specifies a method list created with the aaa authorization exec command.

Default Setting
None

Command Mode
Line Configuration

Example
```
Console(config)#line console
Console(config-line)#authorization exec tps
Console(config-line)#exit
Console(config)#line vty
Console(config-line)#authorization exec default
Console(config-line)#
```

show accounting

This command displays the current accounting settings per function and per port.

Syntax

show accounting [**commands** [*level*]] |
[[**dot1x** [**statistics** [**username** *user-name* | **interface** *interface*]] | **exec** [**statistics**] | **statistics**]

commands - Displays command accounting information.

level - Displays command accounting information for a specifiable command level.

dot1x - Displays dot1x accounting information.

exec - Displays Exec accounting records.

statistics - Displays accounting records.

user-name - Displays accounting records for a specifiable username.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show accounting
Accounting Type : dot1x
  Method List   : default
  Group List    : radius
  Interface     : Eth 1/1

  Method List   : tps
  Group List    : radius
  Interface     : Eth 1/2

Accounting Type : EXEC
  Method List   : default
  Group List    : tacacs+
  Interface     : vty

Accounting Type : Commands 0
  Method List   : default
  Group List    : tacacs+
  Interface     :
⋮
Accounting Type : Commands 15
  Method List   : default
  Group List    : tacacs+
  Interface     :
```

```
Console#
```

show authorization

This command displays the current authorization settings per function and per port.

Syntax

show authorization

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show authorization
Authorization Type : EXEC
  Method List   : default
  Group List    : tacacs+
  Interface     : vty

Authorization Type : Commands 0
  Method List   : default
  Group List    : tacacs+
  Interface     :
⋮
Authorization Type : Commands 15
  Method List   : default
  Group List    : tacacs+
  Interface     :

without-server : Disable
Console#
```

Web Server

This section describes commands used to configure web browser management access to the switch.

Table 36: Web Server Commands

Command	Function	Mode
ip http authentication	Sets the method list for EXEC authorization of an EXEC session	GC
ip http port	Specifies the port to be used by the web browser interface	GC
ip http server	Allows the switch to be monitored or configured from a browser	GC

Table 36: Web Server Commands

Command	Function	Mode
ip http secure-port	Specifies the TCP port number for HTTPS	GC
ip http secure-server	Enables HTTPS (HTTP/SSL) for encrypted communications	GC
ip http timeout	Specifies the HTTP/HTTPS web session timeout	GC
show authorization	Displays all authorization information	PE
show system	Displays system information	NE, PE

Note: Users are automatically logged off of the HTTP server or HTTPS server if no input is detected for 300 seconds.

ip http authentication

This command specifies the method list for EXEC authorization for starting an EXEC session used by the web browser interface. Use the **no** form to use the default port.

Syntax

ip http authentication aaa exec-authorization {**default** | *list-name*}

no ip http authentication aaa exec-authorization

default - Specifies the default method list used for authorization requests.

list-name - Specifies a method list created with the aaa authorization commands command.

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#ip http authentication aaa exec-authorization default
Console(config)#
```

ip http port

This command specifies the TCP port number used by the web browser interface. Use the **no** form to use the default port.

Syntax

ip http port *port-number*

no ip http port

port-number - The TCP port to be used by the browser interface. (Range: 1-65535)

Default Setting

80

Command Mode

Global Configuration

Example

```
Console(config)#ip http port 769
Console(config)#
```

ip http server

This command allows this device to be monitored or configured from a browser. Use the **no** form to disable this function.

Syntax

[no] **ip http server**

Default Setting

Enabled

Command Mode

Global Configuration

Example

```
Console(config)#ip http server
Console(config)#
```

ip http secure-port

This command specifies the TCP port number used for HTTPS connection to the switch's web interface. Use the **no** form to restore the default port.

Syntax

ip http secure-port *port_number*

no ip http secure-port

port_number – The TCP port used for HTTPS. (Range: 1-65535, except for the following reserved ports: 1 and 25 - Linux kernel, 23 - Telnet, 80 - HTTP)

Default Setting

443

Command Mode

Global Configuration

Command Usage

- You cannot configure the HTTP and HTTPS servers to use the same port.
- If you change the HTTPS port number, clients attempting to connect to the HTTPS server must specify the port number in the URL, in this format: **https://** *device*:*port_number*

Example

```
Console(config)#ip http secure-port 1000
Console(config)#
```

ip http secure-server

This command enables the secure hypertext transfer protocol (HTTPS) over the Secure Socket Layer (SSL), providing secure access (i.e., an encrypted connection) to the switch's web interface. Use the **no** form to disable this function.

Syntax

[**no**] **ip http secure-server**

Default Setting

Enabled

Command Mode

Global Configuration

Command Usage

- Both HTTP and HTTPS service can be enabled independently on the switch. However, you cannot configure the HTTP and HTTPS servers to use the same UDP port.

- If you enable HTTPS, you must indicate this in the URL that you specify in your browser: **https**://*device*[:*port_number*]
- When you start HTTPS, the connection is established in this way:
  - The client authenticates the server using the server's digital certificate.
  - The client and server negotiate a set of security protocols to use for the connection.
  - The client and server generate session keys for encrypting and decrypting data.
- The client and server establish a secure encrypted connection.

  A padlock icon should appear in the status bar for more recent browser versions.
- To specify a secure-site certificate, see "Replacing the Default Secure-site Certificate" in the *Web Management Guide*. Also refer to the copy tftp https-certificate command.
- Connection to the web interface is not supported for HTTPS using an IPv6 link local address.

Example

```
Console(config)#ip http secure-server
Console(config)#
```

ip http timeout

This command specifies the HTTP/HTTPS connection timeout for web interface sessions. Use the **no** form to restore the default setting.

Syntax

ip http timeout *seconds*

no ip http timeout

seconds – The timeout setting in seconds. (Range: 300-3600 seconds)

Default Setting

300 seconds

Command Mode

Global Configuration

Example

```
Console(config)#ip http timeout 600
Console(config)#
```

Telnet Server

This section describes commands used to configure Telnet management access to the switch.

Table 37: Telnet Server Commands

Command	Function	Mode
ip telnet max-sessions	Specifies the maximum number of Telnet sessions that can simultaneously connect to this system	GC
ip telnet port	Specifies the port to be used by the Telnet interface	GC
ip telnet server	Allows the switch to be monitored or configured from Telnet	GC
telnet (client)	Accesses a remote device using a Telnet connection	PE
show ip telnet	Displays configuration settings for the Telnet server	PE

Note: This switch also supports a Telnet client function. A Telnet connection can be made from this switch to another device by entering the **telnet** command at the Privileged Exec configuration level.

ip telnet max-sessions

This command specifies the maximum number of Telnet sessions that can simultaneously connect to this system. Use the **no** from to restore the default setting.

Syntax

ip telnet max-sessions *session-count*

no ip telnet max-sessions

session-count - The maximum number of allowed Telnet session. (Range: 0-8)

Default Setting

8 sessions

Command Mode

Global Configuration

Command Usage

A maximum of eight sessions can be concurrently opened for Telnet and Secure Shell (i.e., both Telnet and SSH share a maximum number of eight sessions).

Example

```
Console(config)#ip telnet max-sessions 1
Console(config)#
```

ip telnet port

This command specifies the TCP port number used by the Telnet interface. Use the **no** form to use the default port.

Syntax

ip telnet port *port-number*

no telnet port

port-number - The TCP port number to be used by the browser interface. (Range: 1-65535)

Default Setting

23

Command Mode

Global Configuration

Example

```
Console(config)#ip telnet port 123
Console(config)#
```

ip telnet server

This command allows this device to be monitored or configured from Telnet. Use the **no** form to disable this function.

Syntax

[**no**] **ip telnet server**

Default Setting

Enabled

Command Mode

Global Configuration

Example

```
Console(config)#ip telnet server
Console(config)#
```

telnet (client)

This command accesses a remote device using a Telnet connection.

Syntax

telnet *host*

host - IP address or alias of a remote device.

Command Mode
Privileged Exec

Example

```
Console#telnet 192.168.2.254
Connect To 192.168.2.254...

************************************************************

WARNING - MONITORED ACTIONS AND ACCESSES

User Access Verification

Username:

Console(config)#
```

show ip telnet This command displays the configuration settings for the Telnet server.

Command Mode
Normal Exec, Privileged Exec

Example

```
Console#show ip telnet
IP Telnet Configuration:

Telnet Status: Enabled
Telnet Service Port: 23
Telnet Max Session: 8
Console#
```

Secure Shell

This section describes the commands used to configure the SSH server. Note that you also need to install a SSH client on the management station when using this protocol to configure the switch.

Note: The switch supports only SSH Version 2.0 clients.

Table 38: Secure Shell Commands

Command	Function	Mode
ip ssh authentication-retries	Specifies the number of retries allowed by a client	GC
ip ssh server	Enables the SSH server on the switch	GC
ip ssh timeout	Specifies the authentication timeout for the SSH server	GC

Table 38: Secure Shell Commands (Continued)

Command	Function	Mode
copy tftp public-key	Copies the user's public key from a TFTP server to the switch	PE
delete public-key	Deletes the public key for the specified user	PE
disconnect	Terminates a line connection	PE
ip ssh crypto host-key generate	Generates the host key	PE
ip ssh crypto zeroize	Clears the host key from RAM	PE
ip ssh save host-key	Saves the host key from RAM to flash memory	PE
show ip ssh	Displays the status of the SSH server and the configured values for authentication timeout and retries	PE
show public-key	Shows the public key for the specified user or for the host	PE
show ssh	Displays the status of current SSH sessions	PE
show users	Shows SSH users, including privilege level and public key type	PE

Configuration Guidelines

The SSH server on this switch supports both password and public key authentication. If password authentication is specified by the SSH client, then the password can be authenticated either locally or via a RADIUS or TACACS+ remote authentication server, as specified by the authentication login command. If public key authentication is specified by the client, then you must configure authentication keys on both the client and the switch as described in the following section. Note that regardless of whether you use public key or password authentication, you still have to generate authentication keys on the switch and enable the SSH server.

To use the SSH server, complete these steps:

1. Generate a Host Key Pair – Use the ip ssh crypto host-key generate command to create a host public/private key pair.

2. Provide Host Public Key to Clients – Many SSH client programs automatically import the host public key during the initial connection setup with the switch. Otherwise, you need to manually create a known hosts file on the management station and place the host public key in it. An entry for a public key in the known hosts file would appear similar to the following example:

```
10.1.0.54 1024 35
156849954018676692593339467750546173253136748908365472541502024559319986854435836165199992332978176606583095610825913212890233765468017262725714134287629413011961955667825956641048695742788814620651941746772984865468615717739390164779355942303577413098022737087794545240839717526463580581767167095748047761171
```

3. Import Client's Public Key to the Switch – Use the copy tftp public-key command to copy a file containing the public key for all the SSH client's granted management access to the switch. (Note that these clients must be configured locally on the switch with the username command.) The clients are subsequently authenticated using these keys. The current firmware only accepts public key files based on standard UNIX format as shown in the following example for an RSA key:

   1024 35
   134108168560989392104094492015542534763164192187295892114317388005553
   616163105177594083868631109291232226828519254374603100937187721199696
   317813662774141689851320491172048303392543241016379975923714490119380
   060902539484084827178194372288402533115952134861022902978982721353267
   131629432532818915045306393916643 steve@192.168.1.19

4. Set the Optional Parameters – Set other optional parameters, including the authentication timeout and the number of retries.

5. Enable SSH Service – Use the ip ssh server command to enable the SSH server on the switch.

6. *Authentication* – One of the following authentication methods is employed:

   Password Authentication (for SSH V2 Clients)

   a. The client sends its password to the server.
   b. The switch compares the client's password to those stored in memory.
   c. If a match is found, the connection is allowed.

Note: To use SSH with only password authentication, the host public key must still be given to the client, either during initial connection or manually entered into the known host file. However, you do not need to configure the client's keys.

   Public Key Authentication – When an SSH client attempts to contact the switch, the SSH server uses the host key pair to negotiate a session key and encryption method. Only clients that have a private key corresponding to the public keys stored on the switch can access it. The following exchanges take place during this process:

   Authenticating SSH v2 Clients

   a. The client first queries the switch to determine if public key authentication using a preferred algorithm is acceptable.
   b. If the specified algorithm is supported by the switch, it notifies the client to proceed with the authentication process. Otherwise, it rejects the request.
   c. The client sends a signature generated using the private key to the switch.
   d. When the server receives this message, it checks whether the supplied key is acceptable for authentication, and if so, it then checks whether the signature is correct. If both checks succeed, the client is authenticated.

Note: The SSH server supports up to eight client sessions. The maximum number of client sessions includes both current Telnet sessions and SSH sessions.

Note: The SSH server can be accessed using any configured IPv4 or IPv6 interface address on the switch.

ip ssh authentication-retries

This command configures the number of times the SSH server attempts to reauthenticate a user. Use the **no** form to restore the default setting.

Syntax

ip ssh authentication-retries *count*

no ip ssh authentication-retries

count – The number of authentication attempts permitted after which the interface is reset. (Range: 1-5)

Default Setting

3

Command Mode

Global Configuration

Example

```
Console(config)#ip ssh authentication-retires 2
Console(config)#
```

ip ssh server

This command enables the Secure Shell (SSH) server on this switch. Use the **no** form to disable this service.

Syntax

[no] **ip ssh server**

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- The SSH server supports up to eight client sessions. The maximum number of client sessions includes both current Telnet sessions and SSH sessions.

- The SSH server uses RSA for key exchange when the client first establishes a connection with the switch, and then negotiates with the client to select either DES (56-bit) or 3DES (168-bit) for data encryption.
- You must generate RSA host keys before enabling the SSH server.

Example

```
Console#ip ssh crypto host-key generate
Console#configure
Console(config)#ip ssh server
Console(config)#
```

ip ssh timeout

This command configures the timeout for the SSH server. Use the **no** form to restore the default setting.

Syntax

ip ssh timeout *seconds*

no ip ssh timeout

seconds – The timeout for client response during SSH negotiation. (Range: 1-120)

Default Setting

120 seconds

Command Mode

Global Configuration

Command Usage

The **timeout** specifies the interval the switch will wait for a response from the client during the SSH negotiation phase. Once an SSH session has been established, the timeout for user input is controlled by the exec-timeout command for vty sessions.

Example

```
Console(config)#ip ssh timeout 60
Console(config)#
```

delete public-key

This command deletes the specified user's public key.

Syntax

delete public-key *username*

username – Name of an SSH user. (Range: 1-8 characters)

Default Setting
Deletes the RSA key.

Command Mode
Privileged Exec

Example
```
Console#delete public-key admin
Console#
```

ip ssh crypto host-key generate

This command generates the host key pair (i.e., public and private).

Syntax
ip ssh crypto host-key generate

Default Setting
Generates the RSA key pairs.

Command Mode
Privileged Exec

Command Usage
- The switch uses RSA for SSHv2 clients.
- This command stores the host key pair in memory (i.e., RAM). Use the ip ssh save host-key command to save the host key pair to flash memory.
- Some SSH client programs automatically add the public key to the known hosts file as part of the configuration process. Otherwise, you must manually create a known hosts file and place the host public key in it.
- The SSH server uses this host key to negotiate a session key and encryption method with the client trying to connect to it.

Example
```
Console#ip ssh crypto host-key generate
Console#
```

ip ssh crypto zeroize

This command clears the host key from memory (i.e. RAM).

Syntax

ip ssh crypto zeroize

Default Setting

Clears the RSA key.

Command Mode

Privileged Exec

Command Usage

- This command clears the host key from volatile memory (RAM). Use the **no** ip ssh save host-key command to clear the host key from flash memory.
- The SSH server must be disabled before you can execute this command.

Example

```
Console#ip ssh crypto zeroize
Console#
```

ip ssh save host-key

This command saves the host key from RAM to flash memory.

Syntax

ip ssh save host-key

Default Setting

Saves the RSA key.

Command Mode

Privileged Exec

Example

```
Console#ip ssh save host-key
Console#
```

show ip ssh

This command displays the connection settings used when authenticating client access to the SSH server.

Command Mode

Privileged Exec

Example

```
Console#show ip ssh
SSH Enabled - Version 2.0
Negotiation Timeout : 120 seconds; Authentication Retries : 3
Console#
```

show public-key

This command shows the public key for the specified user or for the host.

Syntax

show public-key [**user** [*username*] | **host**]

username – Name of an SSH user. (Range: 1-32 characters)

Default Setting

Shows all public keys.

Command Mode

Privileged Exec

Command Usage

If no parameters are entered, all keys are displayed. If the user keyword is entered, but no user name is specified, then the public keys for all users are displayed.

Example

```
Console#show public-key host
Host:
RSA:
-----BEGIN RSA PUBLIC KEY-----
MIIBCgKCAQEAspl/UuyjRJzxtmsLQUc28rtCzK0zxV4SACwLE4jPdJacX7yIMgyD
P+6wcj6QhZ5LYTByYLtgZ8OpvhgcTcLbOPp/LWEgII+ntzUiJGIqgXgggZtWWsTp
XC9WXgHzknKAvfI0zk2Ec/x4ryvSlWazEb0ygnozDPc8ZRV2iST+nzAKSCb3Oii3
SmpGk/NOzFK4OK3ouX1692PfB64QSDXyi1BcmR0nMU943xC/F8JPtLKxQLiZSnSa
Ef1dcbOIXHKd7dedw4MauUhzDznIawAEu6R4d2HSjxDM9pOIio8he860+S8gpBSN
9kSgNXU7o3BarVvYZo2hPaEOLAFBv+tklQIDAQAB
-----END RSA PUBLIC KEY-----

Console#
```

show ssh

This command displays the current SSH server connections.

Command Mode

Privileged Exec

Example

```
Console#show ssh
Connection Version State               Username Encryption
  1          2.0   Session-Started      admin   ctos aes128-cbc-hmac-md5
```

```
                                                    stoc aes128-cbc-hmac-md5
Console#
```

802.1X Port Authentication

The switch supports IEEE 802.1X (dot1x) port-based access control that prevents unauthorized access to the network by requiring users to first submit credentials for authentication. Client authentication is controlled centrally by a RADIUS server using EAP (Extensible Authentication Protocol).

Table 39: 802.1X Port Authentication Commands

Command	Function	Mode
General Commands		
dot1x default	Resets all dot1x parameters to their default values	GC
dot1x eapol-pass-through	Passes EAPOL frames to all ports in STP forwarding state when dot1x is globally disabled	GC
dot1x system-auth-control	Enables dot1x globally on the switch.	GC
Authenticator Commands		
dot1x intrusion-action	Sets the port response to intrusion when authentication fails	IC
dot1x max-reauth-req	Sets the maximum number of times that the switch sends an EAP-request/identity frame to the client before restarting the authentication process	IC
dot1x max-req	Sets the maximum number of times that the switch retransmits an EAP request/identity packet to the client before it times out the authentication session	IC
dot1x operation-mode	Allows single or multiple hosts on an dot1x port	IC
dot1x port-control	Sets dot1x mode for a port interface	IC
dot1x re-authentication	Enables re-authentication for all ports	IC
dot1x timeout quiet-period	Sets the time that a switch port waits after the Max Request Count has been exceeded before attempting to acquire a new client	IC
dot1x timeout re-authperiod	Sets the time period after which a connected client must be re-authenticated	IC
dot1x timeout supp-timeout	Sets the interval for a supplicant to respond	IC
dot1x timeout tx-period	Sets the time period during an authentication session that the switch waits before re-transmitting an EAP packet	IC
dot1x re-authenticate	Forces re-authentication on specific ports	PE
Supplicant Commands		
dot1x identity profile	Configures dot1x supplicant user name and password	GC
dot1x max-start	Sets the maximum number of times that a port supplicant will send an EAP start frame to the client	IC
dot1x pae supplicant	Enables dot1x supplicant mode on an interface	IC

Table 39: 802.1X Port Authentication Commands (Continued)

Command	Function	Mode
dot1x timeout auth-period	Sets the time that a supplicant port waits for a response from the authenticator	IC
dot1x timeout held-period	Sets the time a port waits after the maximum start count has been exceeded before attempting to find another authenticator	IC
dot1x timeout start-period	Sets the time that a supplicant port waits before resending an EAPOL start frame to the authenticator	IC
Information Display Commands		
show dot1x	Shows all dot1x related information	PE

General Commands

dot1x default

This command sets all configurable dot1x authenticator global and port settings to their default values.

Command Mode

Global Configuration

Command Usage

This command resets the following commands to their default settings:

- dot1x system-auth-control
- dot1x eapol-pass-through
- dot1x port-control
- dot1x port-control multi-host max-count
- dot1x operation-mode
- dot1x max-req
- dot1x timeout quiet-period
- dot1x timeout tx-period
- dot1x timeout re-authperiod
- dot1x timeout sup-timeout
- dot1x re-authentication
- dot1x intrusion-action

Example

```
Console(config)#dot1x default
Console(config)#
```

dot1x eapol-pass-through

This command passes EAPOL frames through to all ports in STP forwarding state when dot1x is globally disabled. Use the **no** form to restore the default.

Syntax

[no] dot1x eapol-pass-through

Default Setting

Discards all EAPOL frames when dot1x is globally disabled

Command Mode

Global Configuration

Command Usage

- When this device is functioning as intermediate node in the network and does not need to perform dot1x authentication, the **dot1x eapol pass-through** command can be used to forward EAPOL frames from other switches on to the authentication servers, thereby allowing the authentication process to still be carried out by switches located on the edge of the network.

- When this device is functioning as an edge switch but does not require any attached clients to be authenticated, the **no dot1x eapol-pass-through** command can be used to discard unnecessary EAPOL traffic.

Example

This example instructs the switch to pass all EAPOL frame through to any ports in STP forwarding state.

```
Console(config)#dot1x eapol-pass-through
Console(config)#
```

dot1x system-auth-control

This command enables IEEE 802.1X port authentication globally on the switch. Use the **no** form to restore the default.

Syntax

[no] dot1x system-auth-control

Default Setting

Disabled

Command Mode

Global Configuration

Example

```
Console(config)#dot1x system-auth-control
Console(config)#
```

Authenticator Commands

dot1x intrusion-action

This command sets the port's response to a failed authentication, either to block all traffic, or to assign all traffic for the port to a guest VLAN. Use the **no** form to reset the default.

Syntax

dot1x intrusion-action {**block-traffic** | **guest-vlan**}

no dot1x intrusion-action

block-traffic - Blocks traffic on this port.

guest-vlan - Assigns the user to the Guest VLAN.

Default

block-traffic

Command Mode

Interface Configuration

Command Usage

- For guest VLAN assignment to be successful, the VLAN must be configured and set as active (see the vlan database command) and assigned as the guest VLAN for the port (see the network-access guest-vlan command).
- A port can only be assigned to the guest VLAN in case of failed authentication, if switchport mode is set to Hybrid.

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x intrusion-action guest-vlan
Console(config-if)#
```

dot1x max-reauth-req

This command sets the maximum number of times that the switch sends an EAP-request/identity frame to the client before restarting the authentication process. Use the **no** form to restore the default.

Syntax

dot1x max-reauth-req *count*

no dot1x max-reauth-req

count – The maximum number of requests (Range: 1-10)

Default

2

Command Mode
Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x max-reauth-req 2
Console(config-if)#
```

dot1x max-req

This command sets the maximum number of times the switch port will retransmit an EAP request/identity packet to the client before it times out the authentication session. Use the **no** form to restore the default.

Syntax

dot1x max-req *count*

no dot1x max-req

count – The maximum number of requests (Range: 1-10)

Default
2

Command Mode
Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x max-req 2
Console(config-if)#
```

dot1x operation-mode

This command allows hosts (clients) to connect to an 802.1X-authorized port. Use the **no** form with no keywords to restore the default to single host. Use the **no** form with the **multi-host max-count** keywords to restore the default maximum count.

Syntax

dot1x operation-mode {**single-host** | **multi-host** [**max-count** *count*] | **mac-based-auth**}

no dot1x operation-mode [**multi-host max-count**]

single-host – Allows only a single host to connect to this port.

multi-host – Allows multiple host to connect to this port.

max-count – Keyword for the maximum number of hosts.

count – The maximum number of hosts that can connect to a port. (Range: 1-1024; Default: 5)

mac-based – Allows multiple hosts to connect to this port, with each host needing to be authenticated.

Default
Single-host

Command Mode
Interface Configuration

Command Usage
- The "max-count" parameter specified by this command is only effective if the dot1x mode is set to "auto" by the dot1x port-control command.
- In "multi-host" mode, only one host connected to a port needs to pass authentication for all other hosts to be granted network access. Similarly, a port can become unauthorized for all hosts if one attached host fails re-authentication or sends an EAPOL logoff message.
- In "mac-based-auth" mode, each host connected to a port needs to pass authentication. The number of hosts allowed access to a port operating in this mode is limited only by the available space in the secure address table (i.e., up to 1024 addresses).

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x operation-mode multi-host max-count 10
Console(config-if)#
```

dot1x port-control

This command sets the dot1x mode on a port interface. Use the **no** form to restore the default.

Syntax

dot1x port-control {**auto** | **force-authorized** | **force-unauthorized**}

no dot1x port-control

auto – Requires a dot1x-aware connected client to be authorized by the RADIUS server. Clients that are not dot1x-aware will be denied access.

force-authorized – Configures the port to grant access to all clients, either dot1x-aware or otherwise.

force-unauthorized – Configures the port to deny access to all clients, either dot1x-aware or otherwise.

Default
force-authorized

Command Mode
Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x port-control auto
Console(config-if)#
```

dot1x re-authentication

This command enables periodic re-authentication for a specified port. Use the **no** form to disable re-authentication.

Syntax

[no] **dot1x re-authentication**

Command Mode
Interface Configuration

Command Usage

- The re-authentication process verifies the connected client's user ID and password on the RADIUS server. During re-authentication, the client remains connected the network and the process is handled transparently by the dot1x client software. Only if re-authentication fails is the port blocked.
- The connected client is re-authenticated after the interval specified by the dot1x timeout re-authperiod command. The default is 3600 seconds.

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x re-authentication
Console(config-if)#
```

dot1x timeout quiet-period

This command sets the time that a switch port waits after the maximum request count (see page 233) has been exceeded before attempting to acquire a new client. Use the **no** form to reset the default.

Syntax

dot1x timeout quiet-period *seconds*

no dot1x timeout quiet-period

seconds - The number of seconds. (Range: 1-65535)

Default
60 seconds

Command Mode
Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout quiet-period 350
Console(config-if)#
```

dot1x timeout re-authperiod

This command sets the time period after which a connected client must be re-authenticated. Use the **no** form of this command to reset the default.

Syntax

dot1x timeout re-authperiod *seconds*

no dot1x timeout re-authperiod

seconds - The number of seconds. (Range: 1-65535)

Default
3600 seconds

Command Mode
Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout re-authperiod 300
Console(config-if)#
```

dot1x timeout supp-timeout

This command sets the time that an interface on the switch waits for a response to an EAP request from a client before re-transmitting an EAP packet. Use the **no** form to reset to the default value.

Syntax

dot1x timeout supp-timeout *seconds*

no dot1x timeout supp-timeout

seconds - The number of seconds. (Range: 1-65535)

Default
30 seconds

Command Mode
Interface Configuration

Command Usage

This command sets the timeout for EAP-request frames other than EAP-request/ identity frames. If dot1x authentication is enabled on a port, the switch will initiate authentication when the port link state comes up. It will send an EAP-request/ identity frame to the client to request its identity, followed by one or more requests for authentication information. It may also send other EAP-request frames to the client during an active connection as required for reauthentication.

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout supp-timeout 300
Console(config-if)#
```

dot1x timeout tx-period

This command sets the time that an interface on the switch waits during an authentication session before re-transmitting an EAP packet. Use the **no** form to reset to the default value.

Syntax

dot1x timeout tx-period *seconds*

no dot1x timeout tx-period

seconds - The number of seconds. (Range: 1-65535)

Default

30 seconds

Command Mode

Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout tx-period 300
Console(config-if)#
```

dot1x re-authenticate

This command forces re-authentication on all ports or a specific interface.

Syntax

dot1x re-authenticate [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode
Privileged Exec

Command Usage
The re-authentication process verifies the connected client's user ID and password on the RADIUS server. During re-authentication, the client remains connected the network and the process is handled transparently by the dot1x client software. Only if re-authentication fails is the port blocked.

Example
```
Console#dot1x re-authenticate
Console#
```

Supplicant Commands

dot1x identity profile
This command sets the dot1x supplicant user name and password. Use the **no** form to delete the identity settings.

Syntax
dot1x identity profile {**username** *username* | **password** *password* | **encrypted-password** *encrypted-password*}

no dot1x identity profile {**username** | **password**}

username - Specifies the supplicant user name. (Range: 1-8 characters)

password - Specifies the supplicant password. (Range: 1-8 characters)

encrypted-password - Specifies the supplicant password in encrypted text. (Range: 8-16 characters)

Default
No user name or password

Command Mode
Global Configuration

Command Usage
The global supplicant user name and password are used to identify this switch as a supplicant when responding to an MD5 challenge from the authenticator. These parameters must be set when this switch passes client authentication requests to another authenticator on the network (see the dot1x pae supplicant command.

Example

```
Console(config)#dot1x identity profile username steve
Console(config)#dot1x identity profile password excess
Console(config)#
```

dot1x max-start

This command sets the maximum number of times that a port supplicant will send an EAP start frame to the client before assuming that the client is 802.1X unaware. Use the **no** form to restore the default value.

Syntax

dot1x max-start *count*

no dot1x max-start

count - Specifies the maximum number of EAP start frames. (Range: 1-65535)

Default

3

Command Mode

Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x max-start 10
Console(config-if)#
```

dot1x pae supplicant

This command enables dot1x supplicant mode on a port. Use the **no** form to disable dot1x supplicant mode on a port.

Syntax

[no] **dot1x pae supplicant**

Default
Disabled

Command Mode
Interface Configuration

Command Usage
- When devices attached to a port must submit requests to another authenticator on the network, configure the identity profile parameters (see dot1x identity profile command) which identify this switch as a supplicant, and enable dot1x supplicant mode for those ports which must authenticate clients through a remote authenticator using this command. In this mode the port will not respond to dot1x messages meant for an authenticator.

- This switch can be configured to serve as the authenticator on selected ports by setting the control mode to "auto" (see the dot1x port-control command), and as a supplicant on other ports by the setting the control mode to "force-authorized" and enabling dot1x supplicant mode with this command.

- A port cannot be configured as a dot1x supplicant if it is a member of a trunk or LACP is enabled on the port.

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#dot1x pae supplicant
Console(config-if)#
```

dot1x timeout auth-period

This command sets the time that a supplicant port waits for a response from the authenticator. Use the **no** form to restore the default setting.

Syntax

dot1x timeout auth-period *seconds*

no dot1x timeout auth-period

seconds - The number of seconds. (Range: 1-65535)

Default
30 seconds

Command Mode
Interface Configuration

Command Usage
This command sets the time that the supplicant waits for a response from the authenticator for packets other than EAPOL-Start.

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout auth-period 60
Console(config-if)#
```

dot1x timeout held-period

This command sets the time that a supplicant port waits before resending its credentials to find a new an authenticator. Use the **no** form to reset the default.

Syntax

dot1x timeout held-period *seconds*

no dot1x timeout held-period

seconds - The number of seconds. (Range: 1-65535)

Default

60 seconds

Command Mode

Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout held-period 120
Console(config-if)#
```

dot1x timeout start-period

This command sets the time that a supplicant port waits before resending an EAPOL start frame to the authenticator. Use the **no** form to restore the default setting.

Syntax

dot1x timeout start-period *seconds*

no dot1x timeout start-period

seconds - The number of seconds. (Range: 1-65535)

Default
30 seconds

Command Mode
Interface Configuration

Example

```
Console(config)#interface eth 1/2
Console(config-if)#dot1x timeout start-period 60
Console(config-if)#
```

Information Display Commands

show dot1x This command shows general port authentication related settings on the switch or a specific interface.

Syntax

show dot1x [**statistics**] [**interface** *interface*]

statistics - Displays dot1x status for each port.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode
Privileged Exec

Command Usage
This command displays the following information:

- *Global 802.1X Parameters* – Shows whether or not 802.1X port authentication is globally enabled on the switch (page 231).
- *802.1X Port Summary* – Displays the port access control parameters for each interface that has enabled 802.1X, including the following items:
  - Type – Administrative state for port access control (Enabled, Authenticator, or Supplicant).
  - Operation Mode – Allows single or multiple hosts (page 233).
  - Control Mode – Dot1x port control mode (page 234).
  - Authorized – Authorization status (yes or n/a - not authorized).
- *802.1X Port Details* – Displays the port access control parameters for each interface, including the following items:

- Reauthentication – Periodic re-authentication (page 235).
- Reauth Period – Time after which a connected client must be re-authenticated (page 236).
- Quiet Period – Time a port waits after Max Request Count is exceeded before attempting to acquire a new client (page 235).
- TX Period – Time a port waits during authentication session before re-transmitting EAP packet (page 237).
- Supplicant Timeout – Supplicant timeout.
- Server Timeout – Server timeout. A RADIUS server must be set before the correct operational value of 10 seconds will be displayed in this field.
- Reauth Max Retries – Maximum number of reauthentication attempts.
- Max Request – Maximum number of times a port will retransmit an EAP request/identity packet to the client before it times out the authentication session (page 233).
- Operation Mode – Shows if single or multiple hosts (clients) can connect to an 802.1X-authorized port.
- Port Control –Shows the dot1x mode on a port as auto, force-authorized, or force-unauthorized (page 234).
- Intrusion Action – Shows the port response to intrusion when authentication fails (page 232).
- Supplicant – MAC address of authorized client.

- *Authenticator PAE State Machine*
  - State – Current state (including initialize, disconnected, connecting, authenticating, authenticated, aborting, held, force_authorized, force_unauthorized).
  - Reauth Count – Number of times connecting state is re-entered.
  - Current Identifier – The integer (0-255) used by the Authenticator to identify the current authentication session.

- *Backend State Machine*
  - State – Current state (including request, response, success, fail, timeout, idle, initialize).
  - Request Count – Number of EAP Request packets sent to the Supplicant without receiving a response.
  - Identifier (Server) – Identifier carried in the most recent EAP Success, Failure or Request packet received from the Authentication Server.

- *Reauthentication State Machine*

  State – Current state (including initialize, reauthenticate).

Example

```
Console#show dot1x
Global 802.1X Parameters
 System Auth Control       : Enabled

Authenticator Parameters:
 EAPOL Pass Through        : Disabled

802.1X Port Summary
```

```
Port     Type          Operation Mode Control Mode       Authorized
-------- ------------- -------------- ------------------ ----------
Eth 1/ 1 Disabled      Single-Host    Force-Authorized   Yes
Eth 1/ 2 Disabled      Single-Host    Force-Authorized   Yes
,,,
Eth 1/17 Disabled      Single-Host    Force-Authorized   Yes
Eth 1/18 Enabled       Single-Host    Auto               Yes

Console#show dot1x interface ethernet 1/5

802.1X Authenticator is enabled on port 1/5
 Reauthentication     : Enabled
 Reauth Period        : 3600 seconds
 Quiet Period         : 60 seconds
 TX Period            : 30 seconds
 Supplicant Timeout   : 30 seconds
 Server Timeout       : 0 seconds
 Reauth Max Retries   : 2
 Max Request          : 2
 Operation Mode       : Multi-host
 Port Control         : Auto
 Intrusion Action     : Block traffic

Supplicant           : 00-e0-29-94-34-65

 Authenticator PAE State Machine
  State               : Authenticated
  Reauth Count        : 0
  Current Identifier  : 3

 Backend State Machine
  State               : Idle
  Request Count       : 0
  Identifier(Server)  : 2

 Reauthentication State Machine
  State               : Initialize
Console#
```

Management IP Filter

This section describes commands used to configure IP management access to the switch.

Table 40: Management IP Filter Commands

Command	Function	Mode
management	Configures IP addresses that are allowed management access	GC
show management	Displays the switch to be monitored or configured from a browser	PE

management

This command specifies the client IP addresses that are allowed management access to the switch through various protocols. A list of up to 15 IP addresses or IP address groups can be specified. Use the **no** form to restore the default setting.

Syntax

[no] management {all-client | http-client | snmp-client | telnet-client} *start-address* [*end-address*]

all-client - Adds IP address(es) to all groups.

http-client - Adds IP address(es) to the web group.

snmp-client - Adds IP address(es) to the SNMP group.

telnet-client - Adds IP address(es) to the Telnet group.

start-address - A single IP address, or the starting address of a range.

end-address - The end address of a range.

Default Setting

All addresses

Command Mode

Global Configuration

Command Usage

- The management interfaces are open to all IP addresses by default. Once you add an entry to a filter list, access to that interface is restricted to the specified addresses.
- If anyone tries to access a management interface on the switch from an invalid address, the switch will reject the connection, enter an event message in the system log, and send a trap message to the trap manager.

- IP address can be configured for SNMP, web, and Telnet access respectively. Each of these groups can include up to five different sets of addresses, either individual addresses or address ranges.
- When entering addresses for the same group (i.e., SNMP, web, or Telnet), the switch will not accept overlapping address ranges. When entering addresses for different groups, the switch will accept overlapping address ranges.
- You cannot delete an individual address from a specified range. You must delete the entire range, and re-enter the addresses.
- You can delete an address range just by specifying the start address, or by specifying both the start address and end address.

Example

This example restricts management access to the indicated addresses.

```
Console(config)#management all-client 192.168.1.19
Console(config)#management all-client 192.168.1.25 192.168.1.30
Console#
```

show management

This command displays the client IP addresses that are allowed management access to the switch through various protocols.

Syntax

show management {**all-client** | **http-client** | **snmp-client** | **telnet-client**}

all-client - Displays IP addresses for all groups.

http-client - Displays IP addresses for the web group.

snmp-client - Displays IP addresses for the SNMP group.

telnet-client - Displays IP addresses for the Telnet group.

Command Mode

Privileged Exec

Example

```
Console#show management all-client
Management Ip Filter
 HTTP-Client:
   Start IP address      End IP address
-----------------------------------------------
1. 192.168.1.19          192.168.1.19
2. 192.168.1.25          192.168.1.30
```

```
 SNMP-Client:
   Start IP address      End IP address
-----------------------------------------------
1. 192.168.1.19          192.168.1.19
2. 192.168.1.25          192.168.1.30

 TELNET-Client:
   Start IP address      End IP address
-----------------------------------------------
1. 192.168.1.19          192.168.1.19
2. 192.168.1.25          192.168.1.30

Console#
```

PPPoE Intermediate Agent

This section describes commands used to configure the PPPoE Intermediate Agent (PPPoE IA) relay parameters required for passing authentication messages between a client and broadband remote access servers.

Table 41: PPPoE Intermediate Agent Commands

Command	Function	Mode
pppoe intermediate-agent	Enables the PPPoE IA globally on the switch	GC
pppoe intermediate-agent format-type	Sets the access node identifier, generic error message, or vendor identifier for the switch	GC
pppoe intermediate-agent port-enable	Enables the PPPoE IA on an interface	IC
pppoe intermediate-agent port-format-type	Sets the circuit-id, remote-id, or remote-id delimiter for an interface	IC
pppoe intermediate-agent port-format-type remote-id-delimiter	Sets the remote-id delimiter for an interface	IC
pppoe intermediate-agent trust	Sets the trust mode for an interface	IC
pppoe intermediate-agent vendor-tag strip	Enables the stripping of vendor tags from PPPoE Discovery packets sent from a PPPoE server	IC
clear pppoe intermediate-agent statistics	Clears PPPoE IA statistics	PE
show pppoe intermediate-agent info	Displays PPPoE IA configuration settings	PE
show pppoe intermediate-agent statistics	Displays PPPoE IA statistics	PE

pppoe intermediate-agent

This command enables the PPPoE Intermediate Agent globally on the switch. Use the **no** form to disable this feature.

Syntax

[no] pppoe intermediate-agent

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
- The switch inserts a tag identifying itself as a PPPoE Intermediate Agent residing between the attached client requesting network access and the ports connected to broadband remote access servers (BRAS). The switch extracts access-loop information from the client's PPPoE Active Discovery Request, and forwards this information to all trusted ports designated by the pppoe intermediate-agent trust command. The BRAS detects the presence of the subscriber's circuit-ID tag inserted by the switch during the PPPoE discovery phase, and sends this tag as a NAS-port-ID attribute in PPP authentication and AAA accounting requests to a RADIUS server.

- PPPoE IA must be enabled globally by this command before this feature can be enabled on an interface using the pppoe intermediate-agent port-enable command.

Example

```
Console(config)#pppoe intermediate-agent
Console(config)#
```

pppoe intermediate-agent format-type

This command sets the access node identifier, generic error message, or vendor identifier for the switch. Use the **no** form to restore the default settings.

Syntax

pppoe intermediate-agent format-type {**access-node-identifier** *node-id-string* | **generic-error-message** *error-message* | **vendor-id** *vendor-id-string*}

no pppoe intermediate-agent format-type {**access-node-identifier** | **generic-error-message**}

node-id-string - String identifying this switch as an PPPoE IA to the PPPoE server. (Range: 1-48 ASCII characters)

error-message - An error message notifying the sender that the PPPoE Discovery packet was too large.

vendor-id-string - This tag is used to pass vendor proprietary information. The first four octets of the tag contain the vendor id and the remainder is unspecified. The high-order octet of the vendor id is 0 and the low-order 3 octets are the SMI Network Management Private Enterprise Code of the Vendor in network byte order, as defined in the Assigned Numbers RFC (RFC 1700). (Range: 0-4294967295)

Default Setting

- Access Node Identifier: IP address of the first IPv4 interface on the switch.
- Generic Error Message: PPPoE Discover packet too large to process. Try reducing the number of tags added.
- Vendor Identifier: 3561
  (This is the enterprise number assigned to the Broadband Forum.)

Command Mode

Global Configuration

Command Usage

- The switch uses the access-node-identifier to generate the circuit-id for PPPoE discovery stage packets sent to the BRAS, but does not modify the source or destination MAC address of these PPPoE discovery packets.
- The vendor-specific tag is used to pass vendor proprietary information. The first four octets of this tag value contain the vendor identifier and the remainder is unspecified. The high-order octet of the vendor ID is 0 and the low-order 3 octets are the SMI Network Management Private Enterprise Code of the Vendor in network byte order, as defined in Assigned Numbers RFC 1700.
- These messages are forwarded to all trusted ports designated by the pppoe intermediate-agent trust command.

Example

```
Console(config)#pppoe intermediate-agent format-type access-node-identifier
  billibong
Console(config)#
```

pppoe intermediate-agent port-enable

This command enables the PPPoE IA on an interface. Use the **no** form to disable this feature.

Syntax

[no] **pppoe intermediate-agent port-enable**

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

PPPoE IA must also be enabled globally on the switch for this command to take effect.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#pppoe intermediate-agent port-enable
Console(config-if)#
```

pppoe intermediate-agent port-format-type

This command sets the circuit-id, remote-id, or remote-id delimiter for an interface. Use the **no** form to restore the default settings.

Syntax

pppoe intermediate-agent port-format-type
{**carry-to-client** |
circuit-id [string | hostname-port-vlan] *circuit-id-string* |
remote-id {**mac-cpe** | **string** *remote-id-string*} |
remote-id-delimiter {**enable** | *ascii-code*}}

no pppoe intermediate-agent port-format-type {**carry-to-client** | **circuit-id** | **remote-id** | **remote-id-delimiter enable**}

carry-to-client - Carries circuit ID/remote ID to the client.

circuit-id-string - String identifying the circuit identifier (or interface) on this switch to which the user is connected. (Range: 1-10 ASCII characters)

circuit-id hostname-port-vlan - Specifies circuit ID format hostname/port/vlan

mac-cpe - The MAC address of the CPE attached to this interface is used as the remote ID.

remote-id-string - String identifying the remote identifier (or interface) on this switch to which the user is connected. (Range: 1-63 ASCII characters)

remote-id-delimiter enable - Enables a user-specified delimiter value for the remote ID.

ascii-code - A character used to separate components in the remote circuit ID value. (Range: 0-255)

Default Setting

carry-to-client: No
circuit-id: unit/port:vlan-id or 0/trunk-id:vlan-id
remote-id: port MAC address
remote-id-delimiter: ASCII code 35, ASCII character "#"

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- The PPPoE server extracts the Line-ID tag from PPPoE discovery stage messages, and uses the Circuit-ID field of that tag as a NAS-Port-ID attribute in AAA access and accounting requests.

- The switch intercepts PPPoE discovery frames from the client and inserts a unique line identifier using the PPPoE Vendor-Specific tag (0x0105) to PPPoE Active Discovery Initiation (PADI) and Request (PADR) packets. The switch then forwards these packets to the PPPoE server. The tag contains the Line-ID of the customer line over which the discovery packet was received, entering the switch (or access node) where the intermediate agent resides.

- Outgoing PAD Offer (PADO) and Session-confirmation (PADS) packets sent from the PPPoE Server include the Circuit-Id tag inserted by the switch, and should be stripped out of PADO and PADS packets which are to be passed directly to end-node clients using the pppoe intermediate-agent vendor-tag strip command.

- If the remote-id is unspecified, the port name will be used for this parameter. If the port name is not configured, the remote-id is set to the port MAC (yy-yy-yy-yy-yy-yy#), where # is the default delimiter.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#pppoe intermediate-agent port-format-type circuit-id
  string ECS5550-54X
Console(config-if)#
```

pppoe intermediate-agent port-format-type remote-id-delimiter

This command sets the remote-id delimiter for an interface. Use the **enable** keyword to enable the delimiter. Use the **no** form with the **enable** keyword to disable the delimiter. Use the **no** form without any keywords toto restore the default settings.

Syntax

pppoe intermediate-agent port-format-type remote-id-delimiter {**enable** | *ascii-code*}

ascii-code - ASCII character of delimiter. (Range: 0-255)

Default Setting

Disabled
ASCII code: 35 (“#”)

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

If the delimiter is enabled and it occurs in the remote ID string, the string will be truncated at that point.

Example

This command enables the delimiter for port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#pppoe intermediate-agent port-format-type remote-id-
  delimiter enable
Console(config-if)#
```

pppoe intermediate-agent trust

This command sets an interface to trusted mode to indicate that it is connected to a PPPoE server. Use the **no** form to set an interface to untrusted mode.

Syntax

[no] **pppoe intermediate-agent trust**

Default Setting

Untrusted

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Set any interfaces connecting the switch to a PPPoE Server as trusted. Interfaces that connect the switch to users (PPPoE clients) should be set as untrusted.
- At least one trusted interface must be configured on the switch for the PPPoE IA to function.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#pppoe intermediate-agent trust
Console(config-if)#
```

pppoe intermediate-agent vendor-tag strip

This command enables the stripping of vendor tags from PPPoE Discovery packets sent from a PPPoE server. Use the **no** form to disable this feature.

Syntax

[no] **pppoe intermediate-agent vendor-tag strip**

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This command only applies to trusted interfaces. It is used to strip off vendor-specific tags (which carry subscriber and line identification information) in PPPoE Discovery packets received from an upstream PPPoE server before forwarding them to a user.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#pppoe intermediate-agent vendor-tag strip
Console(config-if)#
```

clear pppoe intermediate-agent statistics

This command clears statistical counters for the PPPoE Intermediate Agent.

Syntax

clear pppoe intermediate-agent statistics interface [*interface*]

interface

ethernet *unit/port*

unit - Stack unit

port - Port number

port-channel *channel-id*

Command Mode

Privileged Exec

Example

```
Console#clear pppoe intermediate-agent statistics
Console#
```

show pppoe intermediate-agent info

This command displays configuration settings for the PPPoE Intermediate Agent.

Syntax

show pppoe intermediate-agent info [**interface** [*interface*]]

interface

ethernet *unit/port*

unit - Stack unit.

port - Port number

port-channel *channel-id*

Command Mode

Privileged Exec

Example

```
Console#show pppoe intermediate-agent info
PPPoE Intermediate Agent Global Status                : Enabled
PPPoE Intermediate Agent Vendor ID                    : 3561
PPPoE Intermediate Agent Admin Access Node Identifier : 192.168.0.2
PPPoE Intermediate Agent Oper Access Node Identifier  : 192.168.0.2
PPPoE Intermediate Agent Admin Generic Error Message  :
 PPPoE Discover packet too large to process. Try reducing the number of tags
  added.
PPPoE Intermediate Agent Oper Generic Error Message   :
 PPPoE Discover packet too large to process. Try reducing the number of tags
  added.
Console#show pppoe intermediate-agent info interface ethernet 1/1
Interface PPPoE IA Trusted Vendor-Tag Strip Admin Circuit-ID Admin Remote-ID
--------- -------- ------- ---------------- ---------------- ----------------
Eth 1/1   No       No      No
          R-ID Delimiter   Delimiter ASCII  Oper Circuit-ID  Oper Remote-ID
          ---------------- ---------------- ---------------- ----------------
          No                           35 1/1:vid          CC-37-AB-BC-4F-FB
Carry Circuit and Remote ID  to client: FALSE
Console#
```

show pppoe intermediate-agent statistics

This command displays statistics for the PPPoE Intermediate Agent.

Syntax

show pppoe intermediate-agent statistics interface [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode

Privileged Exec

Example

```
Console#show pppoe intermediate-agent statistics interface ethernet 1/1
Eth 1/1 statistics
-------------------------------------------------------------------------------
 Received :        All       PADI       PADO       PADR       PADS       PADT
           ---------- ---------- ---------- ---------- ---------- ----------
                    3          0          0          0          0          3

 Dropped  : Response from untrusted  Request towards untrusted  Malformed
            ----------------------   -------------------------  ---------
                                  0                          0          0
Console#
```

10 General Security Measures

This switch supports many methods of segregating traffic for clients attached to each of the data ports, and for ensuring that only authorized clients gain access to the network. In addition to these methods, several other options of providing client security are described in this chapter.

Table 42: General Security Commands

Command Group	Function
Port Security*	Configures secure addresses for a port
Network Access*	Configures MAC authentication and dynamic VLAN assignment
Web Authentication*	Configures Web authentication
Access Control Lists*	Provides filtering for IP frames (based on address, protocol, TCP/UDP port number or TCP control code) or non-IP frames (based on MAC address or Ethernet type)
DHCPv4 Snooping*	Filters untrusted DHCPv4 messages on unsecure ports by building and maintaining a DHCPv4 snooping binding table
DHCPv6 Snooping*	Filters untrusted DHCPv6 messages on unsecure ports by building and maintaining a DHCPv6 snooping binding table
IPv4 Source Guard*	Filters IP traffic on insecure ports for which the source address cannot be identified via DHCP snooping nor static source bindings
IPv6 Source Guard*	Filters IPv6 traffic on insecure ports for which the source address cannot be identified via DHCPv6 snooping nor static source bindings
ND Snooping	Maintains IPv6 prefix table and user address binding table which can be used for stateless address auto-configuration or for address filtering by IPv6 Source Guard
ARP Inspection	Validates the MAC-to-IP address bindings in ARP packets
Denial of Service Protection	Protects against Denial-of-Service attacks
Port-based Traffic Segmentation	Configures traffic segmentation for different client sessions based on specified downlink and uplink ports

* The priority of execution for these filtering commands is Port Security, Port Authentication, Network Access, Web Authentication, Access Control Lists, DHCP Snooping, and then IPv4 Source Guard.

Port Security

These commands can be used to enable port security on a port.

When MAC address learning is disabled on an interface, only incoming traffic with source addresses already stored in the dynamic or static address table for this port will be authorized to access the network.

When using port security, the switch stops learning new MAC addresses on the specified port when it has reached a configured maximum number. Only incoming traffic with source addresses already stored in the dynamic or static address table for this port will be authorized to access the network. The port will drop any incoming frames with a source MAC address that is unknown or has been previously learned from another port. If a device with an unauthorized MAC address attempts to use the switch port, the intrusion will be detected and the switch can automatically take action by disabling the port and sending a trap message.

Table 43: Management IP Filter Commands

Command	Function	Mode
mac-address-table static	Maps a static address to a port in a VLAN	GC
mac-learning	Enables MAC address learning on the selected physical interface or VLAN	IC
port security	Configures a secure port	IC
port security mac-address sticky	Saves the MAC addresses learned by port security as "sticky" entries	IC
port security mac-address-as-permanent	Saves the MAC addresses learned by port security as static entries.	PE
show mac-address-table	Displays entries in the bridge-forwarding database	PE
show port security	Displays port security status and secure address count	PE

mac-learning

This command enables MAC address learning on the selected interface. Use the **no** form to disable MAC address learning.

Syntax

[no] mac-learning

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet or Port Channel)

Command Usage

- The **no mac-learning** command immediately stops the switch from learning new MAC addresses on the specified port or trunk. Incoming traffic with source addresses not stored in the static address table, will be flooded. However, if a security function such as 802.1X or DHCP snooping is enabled and mac-learning is disabled, then only incoming traffic with source addresses stored in the static address table will be accepted, all other packets are dropped. Note that the dynamic addresses stored in the address table when MAC address learning is disabled are flushed from the system, and no dynamic addresses are subsequently learned until MAC address learning has been re-enabled.

- The mac-learning commands cannot be used if 802.1X Port Authentication has been globally enabled on the switch with the dot1x system-auth-control command, or if MAC Address Security has been enabled by the port security command on the same interface.

Example

The following example disables MAC address learning for port 2.

```
Console(config)#interface ethernet 1/2
Console(config-if)#no mac-learning
Console(config-if)#
```

port security

This command enables or configures port security. Use the **no** form without any keywords to disable port security. Use the **no** form with the appropriate keyword to restore the default settings for a response to security violation or for the maximum number of allowed addresses.

Syntax

port security [**action** {**shutdown** | **trap** | **trap-and-shutdown**} | **max-mac-count** *address-count*]

no port security [**action** | **max-mac-count**]

action - Response to take when port security is violated.

shutdown - Disable port only.

trap - Issue SNMP trap message only.

trap-and-shutdown - Issue SNMP trap message and disable port.

max-mac-count

address-count - The maximum number of MAC addresses that can be learned on a port. (Range: 0 - 1024, where 0 means disabled)

Default Setting

Status: Disabled
Action: None
Maximum Addresses: 0

Command Mode
Interface Configuration (Ethernet)

Command Usage
- The default maximum number of MAC addresses allowed on a secure port is zero (that is, port security is disabled). To use port security, you must configure the maximum number of addresses allowed on a port using the **port security max-mac-count** command.

- When port security is enabled using the **port security** command, or the maximum number or allowed addresses is set to a value lower than the current limit after port security has been enabled, the switch first clears all dynamically learned entries from the address table. It then starts learning new MAC addresses on the specified port, and stops learning addresses when it reaches a configured maximum number. Only incoming traffic with source addresses already stored in the dynamic or static address table will be accepted.

- To configure the maximum number of address entries which can be learned on a port, specify the maximum number of dynamic addresses allowed. The switch will learn up to the maximum number of allowed address pairs <source MAC address, VLAN> for frames received on the port. (The specified maximum address count is effective when port security is enabled or disabled.) Note that you can manually add additional secure addresses to a port using the mac-address-table static command. When the port has reached the maximum number of MAC addresses, the port will stop learning new addresses. The MAC addresses already in the address table will be retained and will not be aged out.

- MAC addresses that port security has learned, can be saved in the configuration file as static entries. See command port security mac-address-as-permanent.

- If port security is enabled, and the maximum number of allowed addresses are set to a non-zero value, any device not in the address table that attempts to use the port will be prevented from accessing the switch.

- If a port is disabled due to a security violation, it must be manually re-enabled using the no shutdown command.

- A secure port has the following restrictions:
  - Cannot be connected to a network interconnection device.
  - Cannot be a trunk port.
  - RSPAN and port security are mutually exclusive functions. If port security is enabled on a port, that port cannot be set as an RSPAN uplink port. Also, when a port is configured as an RSPAN uplink port, source port, or destination port, port security cannot be enabled on that port.

Example

The following example enables port security for port 5, and sets the response to a security violation to issue a trap message:

```
Console(config)#interface ethernet 1/5
Console(config-if)#port security action trap
```

port security mac-address sticky

Use this command to save the MAC addresses that port security has learned as "sticky" entries.

Syntax

port security mac-address sticky

Command Mode

Interface Configuration

Command Usage

- Sticky MAC addresses that port security has learned are dynamic addresses that cannot be moved to another port.
- If sticky MAC addresses are received on another secure port, then the port intrusion action is taken.

Example

```
Console(config-if)#port security mac-address sticky
Console#
```

port security mac-address-as-permanent

Use this command to save the MAC addresses that port security has learned as static entries.

Syntax

port security mac-address-as-permanent [**interface** *interface*]

interface - Specifies a port interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode

Privileged Exec

Example

This example shows the switch saving the MAC addresses learned by port security on ethernet port 1/3.

```
Console#port security mac-address-as-permanent interface ethernet 1/3
Console#
```

show port security

This command displays port security status and the secure address count.

Syntax

show port security [**interface** *interface*]

interface - Specifies a port interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode

Privileged Exec

Example

This example shows the port security settings and number of secure addresses for all ports.

```
Console#show port security
Global Port Security Parameters
 Secure MAC Aging Mode : Disabled

Port Security Port Summary
 Port     Port Security Port Status Intrusion Action  MaxMacCnt CurrMacCnt
 -------- ------------- ----------- -----------------  --------- ----------
 Eth 1/ 1 Enabled       Secure/Up   Shutdown                20          2
 Eth 1/ 2 Disabled      Secure/Down None                    0          0
 Eth 1/ 3 Disabled      Secure/Down None                    0          0
 Eth 1/ 4 Disabled      Secure/Down None                    0          0
 Eth 1/ 5 Disabled      Secure/Down None                    0          0
 .
 .
 .
```

The following example shows the port security settings and number of secure addresses for a specific port. The Last Intrusion MAC and Last Time Detected Intrusion MAC fields show information about the last detected intrusion MAC address. These fields are not applicable if no intrusion has been detected or port security is disabled. The MAC Filter ID field is configured by the network-access mac-filter command. If this field displays Disabled, then any unknown source MAC address can be learned as a secure MAC address. If it displays a filter identifier,

then only source MAC address entries in MAC Filter table can be learned as secure MAC addresses.

```
Console#show port security interface ethernet 1/2
Global Port Security Parameters
 Secure MAC Aging Mode : Disabled

Port Security Details
 Port                                : 1/2
 Port Security                       : Enabled
 Port Status                         : Secure/Up
 Intrusion Action                    : None
 Max MAC Count                       : 0
 Current MAC Count                   : 0
 MAC Filter                          : Disabled
 Last Intrusion MAC                  : NA
 Last Time Detected Intrusion MAC    : NA
Console#
```

This example shows information about a detected intrusion.

```
Console#show port security interface ethernet 1/2
Global Port Security Parameters
 Secure MAC Aging Mode : Disabled

Port Security Details
 Port                                : 1/2
 Port Security                       : Enabled
 Port Status                         : Secure/Up
 Intrusion Action                    : None
 Max MAC Count                       : 0
 Current MAC Count                   : 0
 MAC Filter                          : Disabled
 Last Intrusion MAC                  : 00-10-22-00-00-01
 Last Time Detected Intrusion MAC    : 2017/7/29 15:13:03
Console#
```

Network Access (MAC Address Authentication)

Network Access authentication controls access to the network by authenticating the MAC address of each host that attempts to connect to a switch port. Traffic received from a specific MAC address is forwarded by the switch only if the source MAC address is successfully authenticated by a central RADIUS server. While authentication for a MAC address is in progress, all traffic is blocked until authentication is completed. Once successfully authenticated, the RADIUS server may optionally assign VLAN and QoS settings for the switch port.

Table 44: Network Access Commands

Command	Function	Mode
network-access aging	Enables MAC address aging	GC
network-access mac-filter	Adds a MAC address to a filter table	GC

Table 44: Network Access Commands (Continued)

Command	Function	Mode
mac-authentication reauth-time	Sets the time period after which a connected MAC address must be re-authenticated	GC
network-access dynamic-qos	Enables the dynamic quality of service feature	IC
network-access dynamic-vlan	Enables dynamic VLAN assignment from a RADIUS server	IC
network-access guest-vlan	Specifies the guest VLAN	IC
network-access link-detection	Enables the link detection feature	IC
network-access link-detection link-down	Configures the link detection feature to detect and act upon link-down events	IC
network-access link-detection link-up	Configures the link detection feature to detect and act upon link-up events	IC
network-access link-detection link-up-down	Configures the link detection feature to detect and act upon both link-up and link-down events	IC
network-access max-mac-count	Sets the maximum number of MAC addresses that can be authenticated on a port via all forms of authentication	IC
network-access mode mac-authentication	Enables MAC authentication on an interface	IC
network-access port-mac-filter	Enables the specified MAC address filter	IC
mac-authentication intrusion-action	Determines the port response when a connected host fails MAC authentication.	IC
mac-authentication max-mac-count	Sets the maximum number of MAC addresses that can be authenticated on a port via MAC authentication	IC
clear network-access	Clears authenticated MAC addresses from the address table	PE
show network-access	Displays the MAC authentication settings for port interfaces	PE
show network-access mac-address-table	Displays information for entries in the secure MAC address table	PE
show network-access mac-filter	Displays information for entries in the MAC filter tables	PE

network-access aging

Use this command to enable aging for authenticated MAC addresses stored in the secure MAC address table. Use the **no** form of this command to disable address aging.

Syntax

[no] network-access aging

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- Authenticated MAC addresses are stored as dynamic entries in the switch's secure MAC address table and are removed when the aging time expires. The address aging time is determined by the mac-address-table aging-time command.
- This parameter applies to authenticated MAC addresses configured by the MAC Address Authentication process described in this section, as well as to any secure MAC addresses authenticated by 802.1X, regardless of the 802.1X Operation Mode (Single-Host, Multi-Host, or MAC-Based authentication as described under the dot1x operation-mode command).
- The maximum number of secure MAC addresses supported for the switch system is 1024.

Example

```
Console(config)#network-access aging
Console(config)#
```

network-access mac-filter

Use this command to add a MAC address into a filter table. Use the **no** form of this command to remove the specified MAC address.

Syntax

network-access mac-filter *filter-id*
mac-address *mac-address* [**mask** *mask-address*]

no network-access mac-filter *filter-id*
mac-address *mac-address* **mask** *mask-address*

filter-id - Specifies a MAC address filter table. (Range: 1-64)

mac-address - Specifies a MAC address entry. (Format: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx)

mask - Specifies a MAC address bit mask for a range of addresses.

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- Specified addresses are exempt from network access authentication.
- This command is different from configuring static addresses with the mac-address-table static command in that it allows you configure a range of addresses when using a mask, and then to assign these addresses to one or more ports with the network-access port-mac-filter command.

- Up to 64 filter tables can be defined.
- There is no limitation on the number of entries that can entered in a filter table.

Example

```
Console(config)#network-access mac-filter 1 mac-address 11-22-33-44-55-66
Console(config)#
```

mac-authentication reauth-time

Use this command to set the time period after which an authenticated MAC address is removed from the secure address table. Use the **no** form of this command to restore the default value.

Syntax

mac-authentication reauth-time *seconds*

no mac-authentication reauth-time

seconds - The reauthentication time period. (Range: 120-1000000 seconds)

Default Setting

1800

Command Mode

Global Configuration

Command Usage

- The reauthentication time is a global setting and applies to all ports.
- When the reauthentication time expires for a secure MAC address it is reauthenticated with the RADIUS server. During the reauthentication process traffic through the port remains unaffected.

Example

```
Console(config)#mac-authentication reauth-time 300
Console(config)#
```

network-access dynamic-qos

Use this command to enable the dynamic QoS feature for an authenticated port. Use the **no** form to restore the default.

Syntax

[no] **network-access dynamic-qos**

Default Setting
Disabled

Command Mode
Interface Configuration

Command Usage
- The RADIUS server may optionally return dynamic QoS assignments to be applied to a switch port for an authenticated user. The "Filter-ID" attribute (attribute 11) can be configured on the RADIUS server to pass the following QoS information:

Table 45: Dynamic QoS Profiles

Profile	Attribute Syntax	Example
DiffServ	**service-policy-in**=*policy-map-name*	service-policy-in=p1
Rate Limit	**rate-limit-input**=*rate (kbps)*	rate-limit-input=100 (kbps)
	rate-limit-output=*rate (kbps)*	rate-limit-output=200 (kbps)
802.1p	**switchport-priority-default**=*value*	switchport-priority-default=2
IP ACL	**ip-access-group-in**=*ip-acl-name*	ip-access-group-in=ipv4acl
IPv6 ACL	**ipv6-access-group-in**=*ipv6-acl-name*	ipv6-access-group-in=ipv6acl
MAC ACL	**mac-access-group-in**=*mac-acl-name*	mac-access-group-in=macAcl

- When the last user logs off of a port with a dynamic QoS assignment, the switch restores the original QoS configuration for the port.
- When a user attempts to log into the network with a returned dynamic QoS profile that is different from users already logged on to the same port, the user is denied access.
- While a port has an assigned dynamic QoS profile, any manual QoS configuration changes only take effect after all users have logged off of the port.

Note: Any configuration changes for dynamic QoS are not saved to the switch configuration file.

Example
The following example enables the dynamic QoS feature on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access dynamic-qos
Console(config-if)#
```

network-access dynamic-vlan

Use this command to enable dynamic VLAN assignment for an authenticated port. Use the **no** form to disable dynamic VLAN assignment.

Syntax

[no] network-access dynamic-vlan

Default Setting

Enabled

Command Mode

Interface Configuration

Command Usage

- When enabled, the VLAN identifiers returned by the RADIUS server through the 802.1X authentication process will be applied to the port, providing the VLANs have already been created on the switch. GVRP is not used to create the VLANs.
- The VLAN settings specified by the first authenticated MAC address are implemented for a port. Other authenticated MAC addresses on the port must have same VLAN configuration, or they are treated as an authentication failure.
- If dynamic VLAN assignment is enabled on a port and the RADIUS server returns no VLAN configuration, the authentication is still treated as a success, and the host assigned to the default untagged VLAN.
- When the dynamic VLAN assignment status is changed on a port, all authenticated addresses are cleared from the secure MAC address table.

Example

The following example enables dynamic VLAN assignment on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access dynamic-vlan
Console(config-if)#
```

network-access guest-vlan

Use this command to assign all traffic on a port to a guest VLAN when 802.1x authentication or MAC authentication is rejected. Use the **no** form of this command to disable guest VLAN assignment.

Syntax

network-access guest-vlan *vlan-id*

no network-access guest-vlan

vlan-id - VLAN ID (Range: 1-4094)

Default Setting
Disabled

Command Mode
Interface Configuration

Command Usage
- The VLAN to be used as the guest VLAN must be defined and set as active (See the vlan database command).
- When used with 802.1X authentication, the intrusion-action must be set for "guest-vlan" to be effective (see the dot1x intrusion-action command).
- A port can only be assigned to the guest VLAN in case of failed authentication, if switchport mode is set to Hybrid.

Example
```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access guest-vlan 25
Console(config-if)#
```

network-access link-detection

Use this command to enable link detection for the selected port. Use the **no** form of this command to restore the default.

Syntax
[no] network-access link-detection

Default Setting
Disabled

Command Mode
Interface Configuration

Example
```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access link-detection
Console(config-if)#
```

network-access link-detection link-down

Use this command to detect link-down events. When detected, the switch can shut down the port, send an SNMP trap, or both. Use the **no** form of this command to disable this feature.

Syntax

network-access link-detection link-down
action [**shutdown** | **trap** | **trap-and-shutdown**]

no network-access link-detection

action - Response to take when port security is violated.

shutdown - Disable port only.

trap - Issue SNMP trap message only.

trap-and-shutdown - Issue SNMP trap message and disable the port.

Default Setting

Disabled

Command Mode

Interface Configuration

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access link-detection link-down action trap
Console(config-if)#
```

network-access link-detection link-up

Use this command to detect link-up events. When detected, the switch can shut down the port, send an SNMP trap, or both. Use the **no** form of this command to disable this feature.

Syntax

network-access link-detection link-up
action [**shutdown** | **trap** | **trap-and-shutdown**]

no network-access link-detection

action - Response to take when port security is violated.

shutdown - Disable port only.

trap - Issue SNMP trap message only.

trap-and-shutdown - Issue SNMP trap message and disable the port.

Default Setting

Disabled

Command Mode
Interface Configuration

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access link-detection link-up action trap
Console(config-if)#
```

network-access link-detection link-up-down

Use this command to detect link-up and link-down events. When either event is detected, the switch can shut down the port, send an SNMP trap, or both. Use the **no** form of this command to disable this feature.

Syntax

network-access link-detection link-up-down
action [**shutdown** | **trap** | **trap-and-shutdown**]

no network-access link-detection

action - Response to take when port security is violated.

shutdown - Disable port only.

trap - Issue SNMP trap message only.

trap-and-shutdown - Issue SNMP trap message and disable the port.

Default Setting
Disabled

Command Mode
Interface Configuration

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access link-detection link-up-down action trap
Console(config-if)#
```

network-access max-mac-count

Use this command to set the maximum number of MAC addresses that can be authenticated on a port interface via all forms of authentication. Use the **no** form of this command to restore the default.

Syntax

network-access max-mac-count *count*

no network-access max-mac-count

count - The maximum number of authenticated IEEE 802.1X and MAC addresses allowed. (Range: 1-2048)

Default Setting
1024

Command Mode
Interface Configuration

Command Usage
The maximum number of MAC addresses per port is 1024, and the maximum number of secure MAC addresses supported for the switch system is 1024. When the limit is reached, all new MAC addresses are treated as authentication failures.

Example

```
Console(config-if)#network-access max-mac-count 5
Console(config-if)#
```

network-access mode mac-authentication

Use this command to enable network access authentication on a port. Use the **no** form of this command to disable network access authentication.

Syntax

[no] network-access mode mac-authentication

Default Setting
Disabled

Command Mode
Interface Configuration

Command Usage
- When enabled on a port, the authentication process sends a Password Authentication Protocol (PAP) request to a configured RADIUS server. The user name and password are both equal to the MAC address being authenticated.
- On the RADIUS server, PAP user name and passwords must be configured in the MAC address format XX-XX-XX-XX-XX-XX (all in upper case).
- Authenticated MAC addresses are stored as dynamic entries in the switch secure MAC address table and are removed when the aging time expires. The maximum number of secure MAC addresses supported for the switch system is 1024.
- Configured static MAC addresses are added to the secure address table when seen on a switch port. Static addresses are treated as authenticated without sending a request to a RADIUS server.
- MAC authentication cannot be configured on trunks (i.e., static nor dynamic).

- When port status changes to down, all MAC addresses are cleared from the secure MAC address table. Static VLAN assignments are not restored.
- The RADIUS server may optionally return a VLAN identifier list. VLAN identifier list is carried in the "Tunnel-Private-Group-ID" attribute. The VLAN list can contain multiple VLAN identifiers in the format "1u 2t", where "u" indicates an untagged VLAN and "t" a tagged VLAN. The "Tunnel-Type" attribute should be set to "VLAN", the "Tunnel-Medium-Type" attribute set to "802", and the "Radius:Avenda Avenda-Tag-Id" attribute should be set to 0.

Example

```
Console(config-if)#network-access mode mac-authentication
Console(config-if)#
```

network-access port-mac-filter

Use this command to enable the specified MAC address filter. Use the **no** form of this command to disable the specified MAC address filter.

Syntax

network-access port-mac-filter *filter-id*

no network-access port-mac-filter

filter-id - Specifies a MAC address filter table. (Range: 1-64)

Default Setting

None

Command Mode

Interface Configuration

Command Mode

- Entries in the MAC address filter table can be configured with the network-access mac-filter command.
- Only one filter table can be assigned to a port.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#network-access port-mac-filter 1
Console(config-if)#
```

mac-authentication intrusion-action

Use this command to configure the port response to a host MAC authentication failure. Use the **no** form of this command to restore the default.

Syntax

mac-authentication intrusion-action {**block-traffic** | **pass-traffic**}

no mac-authentication intrusion-action

block-traffic - Blocks traffic when the authentication has failed.

pass-traffic - Allows network access when authentication has failed.

Default Setting

Block Traffic

Command Mode

Interface Configuration

Example

```
Console(config-if)#mac-authentication intrusion-action block-traffic
Console(config-if)#
```

mac-authentication max-mac-count

Use this command to set the maximum number of MAC addresses that can be authenticated on a port via MAC authentication. Use the **no** form of this command to restore the default.

Syntax

mac-authentication max-mac-count *count*

no mac-authentication max-mac-count

count - The maximum number of MAC-authenticated MAC addresses allowed. (Range: 1-1024)

Default Setting

1024

Command Mode

Interface Configuration

Example

```
Console(config-if)#mac-authentication max-mac-count 32
Console(config-if)#
```

clear network-access

Use this command to clear entries from the secure MAC addresses table.

Syntax

clear network-access mac-address-table [static | dynamic] [address *mac-address*] [interface *interface*]

static - Specifies static address entries.

dynamic - Specifies dynamic address entries.

mac-address - Specifies a MAC address entry. (Format: xx-xx-xx-xx-xx-xx)

interface - Specifies a port interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#clear network-access mac-address-table interface ethernet 1/1
Console#
```

show network-access

Use this command to display the MAC authentication settings for port interfaces.

Syntax

show network-access [interface *interface*]

interface - Specifies a port interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Default Setting

Displays the settings for all interfaces.

Command Mode

Privileged Exec

Example

```
Console#show network-access interface ethernet 1/1
Global secure port information
Reauthentication Time                 : 1800
MAC Address Aging                     : Disabled

Port : 1/1
MAC Authentication                    : Disabled
MAC Authentication Intrusion Action   : Block traffic
MAC Authentication Maximum MAC Counts : 1024
Maximum MAC Counts                    : 1024
Dynamic VLAN Assignment               : Enabled
Dynamic QoS Assignment                : Disabled
MAC Filter ID                         : Disabled
Guest VLAN                            : Disabled
Link Detection                        : Disabled
Detection Mode                        : Link-down
Detection Action                      : Trap
Console#
```

show network-access mac-address-table

Use this command to display secure MAC address table entries.

Syntax

show network-access mac-address-table [**static** | **dynamic**] [**address** *mac-address* [*mask*]] [**interface** *interface*] [**sort** {**address** | **interface**}]

static - Specifies static address entries.

dynamic - Specifies dynamic address entries.

mac-address - Specifies a MAC address entry. (Format: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx)

mask - Specifies a MAC address bit mask for filtering displayed addresses.

interface - Specifies a port interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

sort - Sorts displayed entries by either MAC address or interface.

Default Setting

Displays all filters.

Command Mode

Privileged Exec

Command Usage

When using a bit mask to filter displayed MAC addresses, a 1 means “care” and a 0 means “don't care”. For example, a MAC of 00-00-01-02-03-04 and mask FF-

FF-FF-00-00-00 would result in all MACs in the range 00-00-01-00-00-00 to 00-00-01-FF-FF-FF to be displayed. All other MACs would be filtered out.

Example

```
Console#show network-access mac-address-table
Interface MAC Address       RADIUS Server   Time                      Attribute
--------- ----------------- --------------- ------------------------- ---------
1/1       00-00-01-02-03-04 172.155.120.17  00d06h32m50s              Static
1/1       00-00-01-02-03-05 172.155.120.17  00d06h33m20s              Dynamic
1/1       00-00-01-02-03-06 172.155.120.17  00d06h35m10s              Static
1/3       00-00-01-02-03-07 172.155.120.17  00d06h34m20s              Dynamic

Console#
```

show network-access mac-filter

Use this command to display information for entries in the MAC filter tables.

Syntax

show network-access mac-filter [*filter-id*]

filter-id - Specifies a MAC address filter table. (Range: 1-64)

Default Setting

Displays all filters.

Command Mode

Privileged Exec

Example

```
Console#show network-access mac-filter
Filter ID MAC Address       MAC Mask
--------- ----------------- -----------------
        1 00-00-01-02-03-08 FF-FF-FF-FF-FF-FF
Console#
```

Web Authentication

Web authentication allows stations to authenticate and access the network in situations where 802.1X or Network Access authentication are infeasible or impractical. The web authentication feature allows unauthenticated hosts to request and receive a DHCP assigned IP address and perform DNS queries. All other traffic, except for HTTP protocol traffic, is blocked. The switch intercepts HTTP protocol traffic and redirects it to a switch-generated web page that facilitates user name and password authentication via RADIUS. Once authentication is successful, the web browser is forwarded on to the originally requested web page. Successful authentication is valid for all hosts connected to the port.

Note: RADIUS authentication must be activated and configured for the web authentication feature to work properly (see "Authentication Sequence" on page 190).

Note: Web authentication cannot be configured on trunk ports.

Table 46: Web Authentication

Command	Function	Mode
web-auth login-attempts	Defines the limit for failed web authentication login attempts	GC
web-auth quiet-period	Defines the amount of time to wait after the limit for failed login attempts is exceeded.	GC
web-auth session-timeout	Defines the amount of time a session remains valid	GC
web-auth system-auth-control	Enables web authentication globally for the switch	GC
web-auth	Enables web authentication for an interface	IC
web-auth re-authenticate (Port)	Ends all web authentication sessions on the port and forces the users to re-authenticate	PE
web-auth re-authenticate (IP)	Ends the web authentication session associated with the designated IP address and forces the user to re-authenticate	PE
show web-auth	Displays global web authentication parameters	PE
show web-auth interface	Displays interface-specific web authentication parameters and statistics	PE
show web-auth summary	Displays a summary of web authentication port parameters and statistics	PE

web-auth login-attempts

This command defines the limit for failed web authentication login attempts. After the limit is reached, the switch refuses further login attempts until the quiet time expires. Use the **no** form to restore the default.

Syntax

web-auth login-attempts *count*

no web-auth login-attempts

count - The limit of allowed failed login attempts. (Range: 1-3)

Default Setting

3 login attempts

Command Mode

Global Configuration

Example

```
Console(config)#web-auth login-attempts 2
Console(config)#
```

web-auth quiet-period

This command defines the amount of time a host must wait after exceeding the limit for failed login attempts, before it may attempt web authentication again. Use the **no** form to restore the default.

Syntax

web-auth quiet-period *time*

no web-auth quiet period

time - The amount of time the host must wait before attempting authentication again. (Range: 1-180 seconds)

Default Setting

60 seconds

Command Mode

Global Configuration

Example

```
Console(config)#web-auth quiet-period 120
Console(config)#
```

web-auth session-timeout

This command defines the amount of time a web-authentication session remains valid. When the session timeout has been reached, the host is logged off and must re-authenticate itself the next time data transmission takes place. Use the **no** form to restore the default.

Syntax

web-auth session-timeout *timeout*

no web-auth session timeout

timeout - The amount of time that an authenticated session remains valid. (Range: 300-3600 seconds)

Default Setting

3600 seconds

Command Mode

Global Configuration

Example

```
Console(config)#web-auth session-timeout 1800
Console(config)#
```

web-auth system-auth-control

This command globally enables web authentication for the switch. Use the **no** form to restore the default.

Syntax

[no] **web-auth system-auth-control**

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

Both **web-auth system-auth-control** for the switch and web-auth for an interface must be enabled for the web authentication feature to be active.

Example

```
Console(config)#web-auth system-auth-control
Console(config)#
```

web-auth

This command enables web authentication for an interface. Use the no form to restore the default.

Syntax

[no] web-auth

Default Setting

Disabled

Command Mode

Interface Configuration

Command Usage

Both web-auth system-auth-control for the switch and **web-auth** for a port must be enabled for the web authentication feature to be active.

Example

```
Console(config-if)#web-auth
Console(config-if)#
```

web-auth re-authenticate (Port)

This command ends all web authentication sessions connected to the port and forces the users to re-authenticate.

Syntax

web-auth re-authenticate interface *interface*

interface - Specifies a port interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#web-auth re-authenticate interface ethernet 1/2
Console#
```

web-auth re-authenticate (IP)

This command ends the web authentication session associated with the designated IP address and forces the user to re-authenticate.

Syntax

web-auth re-authenticate interface *interface ip*

interface - Specifies a port interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

ip - IPv4 formatted IP address

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#web-auth re-authenticate interface ethernet 1/2 192.168.1.5
Console#
```

show web-auth

This command displays global web authentication parameters.

Command Mode

Privileged Exec

Example

```
Console#show web-auth
Global Web-Auth Parameters
  System Auth Control      : Enabled
  Session Timeout          : 3600
  Quiet Period             : 60
  Max Login Attempts       : 3
Console#
```

show web-auth interface

This command displays interface-specific web authentication parameters and statistics.

Syntax

show web-auth interface *interface*

interface - Specifies a port interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode

Privileged Exec

Example

```
Console#show web-auth interface ethernet 1/2
Web Auth Status      : Enabled

Host Summary

IP address      Web-Auth-State Remaining-Session-Time
--------------- -------------- ----------------------
1.1.1.1         Authenticated  295
1.1.1.2         Authenticated  111
Console#
```

show web-auth summary

This command displays a summary of web authentication port parameters and statistics.

Command Mode

Privileged Exec

Example

```
Console#show web-auth summary
Global Web-Auth Parameters
  System Auth Control      : Enabled
Port       Status         Authenticated Host Count
----       ------         ------------------------
1/ 1       Disabled       0
1/ 2       Enabled        8
1/ 3       Disabled       0
1/ 4       Disabled       0
1/ 5       Disabled       0
:
```

DHCPv4 Snooping

DHCPv4 snooping allows a switch to protect a network from rogue DHCPv4 servers or other devices which send port-related information to a DHCPv4 server. This information can be useful in tracking an IP address back to a physical port. This section describes commands used to configure DHCPv4 snooping.

Table 47: DHCP Snooping Commands

Command	Function	Mode
ip dhcp snooping	Enables DHCP snooping globally	GC
ip dhcp snooping information option	Enables or disables the use of DHCP Option 82 information, and specifies frame format for the remote-id	GC
ip dhcp snooping information option encode no-subtype	Disables use of sub-type and sub-length for the CID/RID in Option 82 information	GC
ip dhcp snooping information option remote-id	Sets the remote ID to the switch's IP address, MAC address, or arbitrary string, TR-101 compliant node identifier, or removes VLAN ID from the end of the TR101 field	GC, IC
ip dhcp snooping information option remote-id format user-defined	Sets the DHCP snooping Option 82 remote ID user-defined format	GC, IC
ip dhcp snooping information option tr101 board-id	Sets the board identifier used in Option 82 information based on TR-101 syntax	GC
ip dhcp snooping information policy	Sets the information option policy for DHCP client packets that include Option 82 information	GC, IC
ip dhcp snooping verify mac-address	Verifies the client's hardware address stored in the DHCP packet against the source MAC address in the Ethernet header	GC
ip dhcp snooping vlan	Enables DHCP snooping on the specified VLAN	GC
ip dhcp snooping information option circuit-id	Enables or disables the use of DHCP Option 82 information circuit-id suboption	GC, IC
ip dhcp snooping information option circuit-id format user-defined	Sets the DHCP snooping Option 82 circuit ID user-defined format	GC, IC
ip dhcp snooping max-number	configures the maximum number of DHCP clients which can be supported per interface	IC
ip dhcp snooping trust	Configures the specified interface as trusted	IC
clear ip dhcp snooping binding	Clears DHCP snooping binding table entries from RAM	PE
clear ip dhcp snooping database flash	Removes all dynamically learned snooping entries from flash memory.	PE
ip dhcp snooping database flash	Writes all dynamically learned snooping entries to flash memory	PE
show ip dhcp snooping	Shows the DHCP snooping configuration settings	PE
show ip dhcp snooping binding	Shows the DHCP snooping binding table entries	PE

ip dhcp snooping

This command enables DHCP snooping globally. Use the **no** form to restore the default setting.

Syntax

[no] ip dhcp snooping

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- Network traffic may be disrupted when malicious DHCP messages are received from an outside source. DHCP snooping is used to filter DHCP messages received on an unsecure interface from outside the network or fire wall. When DHCP snooping is enabled globally by this command, and enabled on a VLAN interface by the ip dhcp snooping vlan command, DHCP messages received on an untrusted interface (as specified by the no ip dhcp snooping trust command) from a device not listed in the DHCP snooping table will be dropped.

- When enabled, DHCP messages entering an untrusted interface are filtered based upon dynamic entries learned via DHCP snooping.

- Table entries are only learned for trusted interfaces. Each entry includes a MAC address, IP address, lease time, VLAN identifier, and port identifier.

- When DHCP snooping is enabled, the rate limit for the number of DHCP messages that can be processed by the switch is 100 packets per second. Any DHCP packets in excess of this limit are dropped.

- Filtering rules are implemented as follows:

  - If global DHCP snooping is disabled, all DHCP packets are forwarded.

  - If DHCP snooping is enabled globally, and also enabled on the VLAN where the DHCP packet is received, all DHCP packets are forwarded for a *trusted* port. If the received packet is a DHCP ACK message, a dynamic DHCP snooping entry is also added to the binding table.

  - If DHCP snooping is enabled globally, and also enabled on the VLAN where the DHCP packet is received, but the port is *not trusted*, it is processed as follows:

    - If the DHCP packet is a reply packet from a DHCP server (including OFFER, ACK or NAK messages), the packet is dropped.

- If the DHCP packet is from a client, such as a DECLINE or RELEASE message, the switch forwards the packet only if the corresponding entry is found in the binding table.

- If the DHCP packet is from client, such as a DISCOVER, REQUEST, INFORM, DECLINE or RELEASE message, the packet is forwarded if MAC address verification is disabled (as specified by the ip dhcp snooping verify mac-address command). However, if MAC address verification is enabled, then the packet will only be forwarded if the client's hardware address stored in the DHCP packet is the same as the source MAC address in the Ethernet header.

- If the DHCP packet is not a recognizable type, it is dropped.

- If a DHCP packet from a client passes the filtering criteria above, it will only be forwarded to trusted ports in the same VLAN.

- If a DHCP packet is from server is received on a trusted port, it will be forwarded to both trusted and untrusted ports in the same VLAN.

- If DHCP snooping is globally disabled, all dynamic bindings are removed from the binding table.

- *Additional considerations when the switch itself is a DHCP client* – The port(s) through which the switch submits a client request to the DHCP server must be configured as trusted (using the ip dhcp snooping trust command). Note that the switch will not add a dynamic entry for itself to the binding table when it receives an ACK message from a DHCP server. Also, when the switch sends out DHCP client packets for itself, no filtering takes place. However, when the switch receives any messages from a DHCP server, any packets received from untrusted ports are dropped.

Example

This example enables DHCP snooping globally for the switch.

```
Console(config)#ip dhcp snooping
Console(config)#
```

ip dhcp snooping information option

This command enables the use of DHCP Option 82 information for the switch, and specifies the frame format to use for the remote-id when Option 82 information is generated by the switch. Use the **no** form without any keywords to disable this function.

Syntax

ip dhcp snooping information option

no ip dhcp snooping information option

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- DHCP provides a relay mechanism for sending information about the switch and its DHCP clients to the DHCP server. Known as DHCP Option 82, it allows compatible DHCP servers to use the information when assigning IP addresses, or to set other services or policies for clients.

- When the DHCP Snooping Information Option 82 is enabled, the requesting client (or an intermediate relay agent that has used the information fields to describe itself) can be identified in the DHCP request packets forwarded by the switch and in reply packets sent back from the DHCP server.

- When the DHCP Snooping Information Option is enabled, clients can be identified by the switch port to which they are connected rather than just their MAC address. DHCP client-server exchange messages are then forwarded directly between the server and client without having to flood them to the entire VLAN.

- DHCP snooping must be enabled for the DHCP Option 82 information to be inserted into packets. When enabled, the switch will only add/remove option 82 information in incoming DHCP packets but not relay them. Packets are processed as follows:

  - If an incoming packet is a DHCP request packet with option 82 information, it will modify the option 82 information according to settings specified with ip dhcp snooping information policy command.

  - If an incoming packet is a DHCP request packet without option 82 information, enabling the DHCP snooping information option will add option 82 information to the packet.

  - If an incoming packet is a DHCP reply packet with option 82 information, enabling the DHCP snooping information option will remove option 82 information from the packetExample

This example enables the DHCP Snooping Information Option.

```
Console(config)#ip dhcp snooping information option
Console(config)#
```

ip dhcp snooping information option encode no-subtype

This command disables the use of sub-type and sub-length fields for the circuit-ID (CID) and remote-ID (RID) in Option 82 information generated by the switch. Use the **no** form to enable the use of these fields.

Syntax

[no] ip dhcp snooping information option encode no-subtype

Default Setting

CID/RID sub-type: Enabled

Command Mode

Global Configuration

Command Usage

- Option 82 information generated by the switch is based on TR-101 syntax as shown below:

Table 48: Option 82 information

82	3-69	1	1-67	x1	x2	x3	x4	x5	x63
opt82	opt-len	sub-opt1	string-len			R-124 string			

The circuit identifier used by this switch starts at sub-option1 and goes to the end of the R-124 string. The R-124 string includes the following information:

- sub-type - Distinguishes different types of circuit IDs.
- sub-length - Length of the circuit ID type
- access node identifier - ASCII string. Default is the MAC address of the switch's CPU. This field is set by the ip dhcp snooping information option command,
- eth - The second field is the fixed string "eth"
- slot - The slot represents the stack unit for this system.
- port - The port which received the DHCP request. If the packet arrives over a trunk, the value is the ifIndex of the trunk.
- vlan - Tag of the VLAN which received the DHCP request.

  Note that the sub-type and sub-length fields can be enabled or disabled using the ip dhcp snooping information option command.

- The **ip dhcp snooping information option circuit-id** command can be used to modify the default settings described above.

- The format for TR101 option 82 is: "<IP> eth <SID>/<PORT>[:<VLAN>]". Note that the SID (Switch ID) is always 0. By default the PVID is added to the end of the TR101 field for untagged packets. For tagged packets, the VLAN ID is always added.

Example

This example enables the use of sub-type and sub-length fields for the circuit-ID (CID) and remote-ID (RID).

```
Console(config)#no ip dhcp snooping information option encode no-subtype
Console(config)#
```

ip dhcp snooping information option remote-id

This command sets the remote ID to the switch's IP address, MAC address, or arbitrary string, TR-101 compliant node identifier, or removes VLAN ID from the end of the TR101 field. Use the **no** form to restore the default setting.

Syntax

ip dhcp snooping information option remote-id
{**ip-address** [**encode** {**ascii** | **hex**}] |
mac-address [**encode** {**ascii** | **hex**}] |
port-description |
string *string* [**sub-option port-description** [**delimiter** *delimiter*]] |
tr101 {**node-identifier** {**ip** | **sysname**} | **no-vlan-field** }}

no ip dhcp snooping information option remote-id
[**ip-address encode**] | [**mac-address encode**] | [**string sub-option port-description delimiter**] | [**tr101 no-vlan-field**]

mac-address - Inserts a MAC address in the remote ID sub-option for the DHCP snooping agent (that is, the MAC address of the switch's CPU).

ip-address - Inserts an IP address in the remote ID sub-option for the DHCP snooping agent (that is, the IP address of the management interface).

encode - Indicates encoding in ASCII or hexadecimal.

string - An arbitrary string inserted into the remote identifier field. (Range: 1-255 characters)

port-description - Inserts the port description in the remote ID sub-option.

sub-option port-description - Include the port description string.

delimiter *delimiter* - Include the delimiter (Range 0-255)

tr101 node-identifier - The remote ID generated by the switch is based on TR-101 syntax (R-124, Access_Node_ID).

ip - Specifies the switch's IP address as the node identifier.

sysname - Specifies the system name as the node identifier.

tr101 no-vlan-field - Do not add ":VLAN" in TR101 field for untagged packets.

Default Setting

MAC address: hexadecimal
tr101 no-vlan-field: disabled

Command Mode

Global Configuration and Interface Configuration (Ethernet, Port Channel)

Command Usage

The format for TR101 option 82 is: "<IP> eth <SID>/<PORT>[:<VLAN>]". Note that the SID (Switch ID) is always 0. By default the PVID is added to the end of the TR101 field for untagged packets. For tagged packets, the VLAN ID is always added. Use the **ip dhcp snooping information option remote-id tr101 no-vlan-field** command to remove the VLAN ID from the end of the TR101 field for untagged packets. Use the **no** form of this command to add the PVID for untagged packets at the end of the TR101 field.

Example

This example sets the remote ID to the switch's IP address.

```
Console(config)#ip dhcp snooping information option remote-id tr101
  node-identifier ip
Console(config)#
```

ip dhcp snooping information option remote-id format user-defined

This command sets the DHCP snooping Option 82 remote ID user-defined format. Use the **no** form to restore the default setting.

Syntax

ip dhcp snooping information option remote-id [**vlan** {*vlan-id* | *vlan-range*}] **format user-defined** *text-string*

no ip dhcp snooping information option remote-id [**vlan** {*vlan-id* | *vlan-range*}] **format user-defined**

vlan-id - ID of a configured VLAN. (Range: 1-4094)

vlan-range - A list of configured VLAN IDs. Separate nonconsecutive VLAN IDs with a comma and no spaces; or use a hyphen to designate a range of VLAN IDs. (Range: 1-4094)

text-string - The DHCP Option 82 remote ID message format string. See Command Usage below for details.

Default Setting
No user-defined format configured

Command Mode
Global Configuration and Interface Configuration (Ethernet, Port Channel)

Command Usage
- The text string can use hexadecimal notation, ASCII, or combination of the two. Contents in quotation marks (" ") are encapsulated as an ASCII string, and contents outside the quotation marks are encapsulated in hexadecimal notation.

  The symbol % followed by a keyword indicates the format of the keyword. Delimiters must be added between keywords, which cannot be numbers.

  For example: %port "%sysname %portname:%svlan.%cvlan."

- A number to the left of the symbol % indicates the length of the following keyword. In an ASCII string, %05 has the same meaning as %05d. In a hexadecimal string, the number indicates the keyword length in bits. For example, %8svlan indicates first 8 bits of the SVLAN ID, and %2port indicates the first 2 bits of the port number.

- The symbol \ indicates an escape character. The symbols % and \ following the escape character indicate themselves. For example, \\ represents \.

- The following keywords can be used to define the Option 82 field:

  - sysname - Indicates the hostname of the device. This keyword is valid only in ASCII format.

  - portname - Indicates the name of a port. This keyword is valid only in ASCII format.

  - mac - Indicates the MAC address of the device. In ASCII format, the value is in the format of H-H-H; in hexadecimal notation, the value is a number of six bytes.

  - port - Indicates the port number. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 1 byte by default.

  - svlan - Indicates the outer VLAN ID. The value ranges from 1 to 4094. If this field is not required, this field is 0. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 2 bytes by default.

- **cvlan** - Specifies the inner VLAN ID. The value ranges from 1 to 4094. If this field is not required, this field is 0. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 2 bytes by default.
- **length** - Indicates the total length of the keywords following the keyword length. It occupies 2 bytes by default.
- **d** - Indicates the value of the keyword **svlan** or **cvlan** if the SVLAN or CVLAN does not exist. This keyword is valid in ASCII format or in hexadecimal notation.

- All other symbols are processed as common characters. The rules for setting the format string in ASCII format or hexadecimal notation are as follows:
  - An ASCII character string can contain Arabic numerals, uppercase letters, lowercase letters, and the following symbols: ! @ # $ % ^ & * ( ) _ + | - = \ [ ] { } ; : ' " / ? . , < > `.
  - By default, the length of each keyword in an ASCII character string is the actual length of the keyword.
  - A hexadecimal notation string can contain numerals, spaces, and % + keywords.
  - In a hexadecimal notation string, numbers are encapsulated in the Option 82 field in hexadecimal notation. A number from 0 to 255 occupies 1 byte; a number from 256 to 65535 occupies 2 bytes; a number from 65536 to 4294967295 occupies 4 bytes. Numbers larger than 4294967295 are not supported. Multiple numbers must be separated by spaces; otherwise, they are considered as one number.
  - All the spaces in a hexadecimal character string are ignored.
  - If the length of each keyword in a hexadecimal character string is specified, the total length of the hexadecimal character string must be a multiple of 8.
  - A hexadecimal notation string can contain only the keywords whose values are numbers. Other keywords, such as port name, cannot be added to the hexadecimal notation string.
  - If a string is not contained in quotation marks, it is encapsulated in hexadecimal notation. To encapsulate the string in the ASCII format, use a pair of quotation marks to contain the string. For example, the SVLAN is 3, and the port number is 4. If the string is in the %svlan %port format, the value of the encapsulated string is a hexadecimal number 00030004. If the string is in the "%svlan %port" format, the value of the encapsulated string is 3 4.

- All Option 82 fields configured in the system view or in the same interface view share a length of 1-255 bytes. If their total length exceeds 255 bytes, some Option 82 information will be lost.

Example

The following command configures a user-defined format for the remote ID in the Option 82 field and encapsulate the port name, outer VLAN ID, inner VLAN ID, and host name in ASCII format.

```
Console(config)#ip dhcp snooping information option remote-id format user-
  defined "%portname:%svlan.%cvlan %sysname"
Console(config)#
```

ip dhcp snooping information option tr101 board-id

This command sets the board identifier used in Option 82 information based on TR-101 syntax. Use the **no** form to remove the board identifier.

Syntax

ip dhcp snooping information option tr101 board-id *board-id*

no ip dhcp snooping information option tr101 board-id

board-id – TR101 Board ID. (Range: 0-9)

Default Setting

not defined

Command Mode

Global Configuration

Example

This example sets the board ID to 0.

```
Console(config)#ip dhcp snooping information option tr101 board-id 0
Console(config)#
```

ip dhcp snooping information policy

This command sets the DHCP snooping information option policy for DHCP client packets that include Option 82 information. Use the **no** form to restore the default setting.

Syntax

ip dhcp snooping information policy {**clear** |**drop** | **keep** | **replace**}

no ip dhcp snooping information policy

clear - Clears the Option 82 information and forwards the packets to trusted ports.

drop - Drops the client's request packet instead of relaying it.

keep - Retains the Option 82 information in the client request, and forwards the packets to trusted ports.

replace - Replaces the Option 82 information circuit-id and remote-id fields in the client's request with information about the relay agent itself, inserts the relay agent's address (when DHCP snooping is enabled), and forwards the packets to trusted ports.

Default Setting
replace

Command Mode
Global Configuration and Interface Configuration (Ethernet, Port Channel)

Command Usage
When the switch receives DHCP packets from clients that already include DHCP Option 82 information, the switch can be configured to set the action policy for these packets. The switch can either drop the DHCP packets, keep the existing information, clear the information, or replace it with the switch's relay information.

Example

```
Console(config)#ip dhcp snooping information policy drop
Console(config)#
```

ip dhcp snooping verify mac-address

This command verifies the client's hardware address stored in the DHCP packet against the source MAC address in the Ethernet header. Use the **no** form to disable this function.

Syntax

[no] ip dhcp snooping verify mac-address

Default Setting
Enabled

Command Mode
Global Configuration

Command Usage
If MAC address verification is enabled, and the source MAC address in the Ethernet header of the packet is not same as the client's hardware address in the DHCP packet, the packet is dropped.

Example
This example enables MAC address verification.

```
Console(config)#ip dhcp snooping verify mac-address
Console(config)#
```

ip dhcp snooping vlan

This command enables DHCP snooping on the specified VLAN. Use the **no** form to restore the default setting.

Syntax

[no] **ip dhcp snooping vlan** *vlan-id*

vlan-id - ID of a configured VLAN (Range: 1-4094)

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
- When DHCP snooping is enabled globally using the ip dhcp snooping command, and enabled on a VLAN with this command, DHCP packet filtering will be performed on any untrusted ports within the VLAN as specified by the ip dhcp snooping trust command.
- When the DHCP snooping is globally disabled, DHCP snooping can still be configured for specific VLANs, but the changes will not take effect until DHCP snooping is globally re-enabled.
- When DHCP snooping is globally enabled, and then disabled on a VLAN, all dynamic bindings learned for this VLAN are removed from the binding table.

Example
This example enables DHCP snooping for VLAN 1.

```
Console(config)#ip dhcp snooping vlan 1
Console(config)#
```

ip dhcp snooping information option circuit-id

This command specifies DHCP Option 82 circuit-id suboption information. Use the **no** form to use the default settings.

Syntax

ip dhcp snooping information option circuit-id string *string* | {**tr101** {**node-identifier** {**ip** | **sysname**} | **no-vlan-field**}

no dhcp snooping information option circuit-id [**tr101 no-vlan-field**]

string - An arbitrary string inserted into the circuit identifier field. (Range: 1-255 characters)

tr101 node-identifier - The remote ID generated by the switch is based on TR-101 syntax (R-124, Access_Node_ID).

ip - Specifies the switch's IP address as the node identifier.

sysname - Specifies the system name as the node identifier.

tr101 no-vlan-field - Do not add ":VLAN" in TR101 field for untagged packets.

Default Setting

VLAN-Unit-Port

Command Mode

Global Configuration and Interface Configuration (Ethernet, Port Channel)

Command Usage

- DHCP provides a relay mechanism for sending information about the switch and its DHCP clients to the DHCP server. DHCP Option 82 allows compatible DHCP servers to use the information when assigning IP addresses, to set other services or policies for clients. For more information of this process, refer to the Command Usage section under the ip dhcp snooping information option command.

- Option 82 information generated by the switch is based on TR-101 syntax as shown below:

Table 49: Option 82 information

82	3-69	1	1-67	x1	x2	x3	x4	x5	x63
opt82	opt-len	sub-opt1	string-len			R-124 string			

The circuit identifier used by this switch starts at sub-option1 and goes to the end of the R-124 string. The R-124 string includes the following information:

- sub-type - Distinguishes different types of circuit IDs.
- sub-length - Length of the circuit ID type

- access node identifier - ASCII string. Default is the MAC address of the switch's CPU. This field is set by the ip dhcp snooping information option command,
- eth - The second field is the fixed string "eth"
- slot - The slot represents the stack unit for this system.
- port - The port which received the DHCP request. If the packet arrives over a trunk, the value is the ifIndex of the trunk.
- vlan - Tag of the VLAN which received the DHCP request.

  Note that the sub-type and sub-length fields can be enabled or disabled using the ip dhcp snooping information option command.
- The **ip dhcp snooping information option circuit-id** command can be used to modify the default settings described above.

- The format for TR101 option 82 is: "<IP> eth <SID>/<PORT>[:<VLAN>]". Note that the SID (Switch ID) is always 0. By default the PVID is added to the end of the TR101 field for untagged packets. For tagged packets, the VLAN ID is always added. Use the **ip dhcp snooping information option remote-id tr101 no-vlan-field** command to remove the VLAN ID from the end of the TR101 field for untagged packets. Use the **no** form of this command to add the PVID for untagged packets at the end of the TR101 field.

Example

This example sets the DHCP Snooping Information circuit-id suboption string.

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip dhcp snooping information option circuit-id string 4500
Console(config-if)#
```

ip dhcp snooping information option circuit-id format user-defined

This command sets the DHCP snooping Option 82 circuit ID user-defined format. Use the **no** form to restore the default setting.

Syntax

ip dhcp snooping information option circuit-id [**vlan** {*vlan-id* | *vlan-range*}] **format user-defined** *text-string*

no ip dhcp snooping information option circuit-id [**vlan** {*vlan-id* | *vlan-range*}] **format**

vlan-id - ID of a configured VLAN. (Range: 1-4094)

vlan-range - A list of configured VLAN IDs. Separate nonconsecutive VLAN IDs with a comma and no spaces; or use a hyphen to designate a range of VLAN IDs. (Range: 1-4094)

text-string - The DHCP Option 82 circuit ID message format string. See Command Usage below for details.

Default Setting
No user-defined format configured

Command Mode
Global Configuration and Interface Configuration (Ethernet, Port Channel)

Command Usage
- The text string can use hexadecimal notation, ASCII, or combination of the two. Contents in quotation marks (" ") are encapsulated as an ASCII string, and contents outside the quotation marks are encapsulated in hexadecimal notation.

  The symbol % followed by a keyword indicates the format of the keyword. Delimiters must be added between keywords, which cannot be numbers.

  For example: %port "%sysname %portname:%svlan.%cvlan."

- A number to the left of the symbol % indicates the length of the following keyword. In an ASCII string, %05 has the same meaning as %05d. In a hexadecimal string, the number indicates the keyword length in bits. For example, %8svlan indicates first 8 bits of the SVLAN ID, and %2port indicates the first 2 bits of the port number.

- The symbol \ indicates an escape character. The symbols % and \ following the escape character indicate themselves. For example, \\ represents \.

- The following keywords can be used to define the Option 82 field:

  - sysname - Indicates the hostname of the device. This keyword is valid only in ASCII format.

  - portname - Indicates the name of a port. This keyword is valid only in ASCII format.

  - mac - Indicates the MAC address of the device. In ASCII format, the value is in the format of H-H-H; in hexadecimal notation, the value is a number of six bytes.

  - port - Indicates the port number. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 1 byte by default.

  - svlan - Indicates the outer VLAN ID. The value ranges from 1 to 4094. If this field is not required, this field is 0. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 2 bytes by default.

  - cvlan - Specifies the inner VLAN ID. The value ranges from 1 to 4094. If this field is not required, this field is 0. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 2 bytes by default.

- **length** - Indicates the total length of the keywords following the keyword length. It occupies 2 bytes by default.
- **d** - Indicates the value of the keyword **svlan** or **cvlan** if the SVLAN or CVLAN does not exist. This keyword is valid in ASCII format or in hexadecimal notation.

- All other symbols are processed as common characters. The rules for setting the format string in ASCII format or hexadecimal notation are as follows:
  - An ASCII character string can contain Arabic numerals, uppercase letters, lowercase letters, and the following symbols: ! @ # $ % ^ & * ( ) _ + | - = \ [ ] { } ; : ' " / ? . , < > `.
  - By default, the length of each keyword in an ASCII character string is the actual length of the keyword.
  - A hexadecimal notation string can contain numerals, spaces, and % + keywords.
  - In a hexadecimal notation string, numbers are encapsulated in the Option 82 field in hexadecimal notation. A number from 0 to 255 occupies 1 byte; a number from 256 to 65535 occupies 2 bytes; a number from 65536 to 4294967295 occupies 4 bytes. Numbers larger than 4294967295 are not supported. Multiple numbers must be separated by spaces; otherwise, they are considered as one number.
  - All the spaces in a hexadecimal character string are ignored.
  - If the length of each keyword in a hexadecimal character string is specified, the total length of the hexadecimal character string must be a multiple of 8.
  - A hexadecimal notation string can contain only the keywords whose values are numbers. Other keywords, such as port name, cannot be added to the hexadecimal notation string.
  - If a string is not contained in quotation marks, it is encapsulated in hexadecimal notation. To encapsulate the string in the ASCII format, use a pair of quotation marks to contain the string. For example, the SVLAN is 3, and the port number is 4. If the string is in the %svlan %port format, the value of the encapsulated string is a hexadecimal number 00030004. If the string is in the "%svlan %port" format, the value of the encapsulated string is 3 4.
- All Option 82 fields configured in the system view or in the same interface view share a length of 1-255 bytes. If their total length exceeds 255 bytes, some Option 82 information will be lost.

Example

The following command configures a user-defined format for the remote ID in the Option 82 field and encapsulate the port name, outer VLAN ID, inner VLAN ID, and host name in ASCII format.

```
Console(config)#ip dhcp snooping information option circuit-id format user-
  defined "%portname:%svlan.%cvlan %sysname"
Console(config)#
```

ip dhcp snooping max-number

This command configures the maximum number of DHCP clients which can be supported per interface. Use the **no** form to restore the default setting.

Syntax

ip dhcp snooping max-number {*max-number* | **filter-only**}

no ip dhcp snooping max-number

max-number - Maximum number of DHCP clients. (Range: 1-16)

filter-only - Only filters DHCP packets based on the trust status of a port interface and the content of packets. No binding entry is added and the number of clients is not limited.

Default Setting

16

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- The filter-only mode may be used if the client number is larger than the maximum binding limit and there is no demand for IP Source Guard and Dynamic Arp Inspection (which both rely on binding entries).
- When the filter-only mode is enabled, all existing binding entries on a port interface are cleared.

Example

This example sets the maximum number of DHCP clients supported on port 1 to 2.

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip dhcp snooping max-number 2
Console(config-if)#
```

ip dhcp snooping trust

This command configures the specified interface as trusted. Use the **no** form to restore the default setting.

Syntax

[no] ip dhcp snooping trust

Default Setting

All interfaces are untrusted

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- A trusted interface is an interface that is configured to receive only messages from within the network. An untrusted interface is an interface that is configured to receive messages from outside the network or fire wall.
- Set all ports connected to DHCP servers within the local network or fire wall to trusted, and all other ports outside the local network or fire wall to untrusted.
- When DHCP snooping is enabled globally using the ip dhcp snooping command, and enabled on a VLAN with ip dhcp snooping vlan command, DHCP packet filtering will be performed on any untrusted ports within the VLAN according to the default status, or as specifically configured for an interface with the **no ip dhcp snooping trust** command.
- When an untrusted port is changed to a trusted port, all the dynamic DHCP snooping bindings associated with this port are removed.
- *Additional considerations when the switch itself is a DHCP client* – The port(s) through which it submits a client request to the DHCP server must be configured as trusted.

Example

This example sets port 5 to untrusted.

```
Console(config)#interface ethernet 1/5
Console(config-if)#no ip dhcp snooping trust
Console(config-if)#
```

clear ip dhcp snooping binding

This command clears DHCP snooping binding table entries from RAM. Use this command without any optional keywords to clear all entries from the binding table.

Syntax

clear ip dhcp snooping binding [*mac-address* vlan *vlan-id*]

mac-address - Specifies a MAC address entry. (Format: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx)

vlan-id - ID of a configured VLAN (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#clear ip dhcp snooping binding 11-22-33-44-55-66 192.168.1.234
Console#
```

clear ip dhcp snooping database flash

This command removes all dynamically learned snooping entries from flash memory.

Command Mode

Privileged Exec

Example

```
Console#clear ip dhcp snooping database flash
Console#
```

ip dhcp snooping database flash

This command writes all dynamically learned snooping entries to flash memory.

Command Mode

Privileged Exec

Command Usage

This command can be used to store the currently learned dynamic DHCP snooping entries to flash memory. These entries will be restored to the snooping table when the switch is reset. However, note that the lease time shown for a dynamic entry that has been restored from flash memory will no longer be valid.

Example

```
Console#ip dhcp snooping database flash
Console#
```

show ip dhcp snooping

This command shows the DHCP snooping configuration settings.

Command Mode

Privileged Exec

Example

```
Console#show ip dhcp snooping

Global DHCP Snooping Status: enabled
DHCP Snooping Information Option Status: disabled
DHCP Snooping Information Option Sub-option Format: extra subtype included
DHCP Snooping Information Option Remote ID: port-description
DHCP Snooping Information Option Remote ID TR101 VLAN Field: enabled
DHCP Snooping Information Option TR101 Board ID: none
DHCP Snooping Information Policy: replace
DHCP Snooping is configured on the following VLANs:

Verify Source MAC-Address: enabled
DHCP Snooping Rate Limit: unlimited
DHCP Snooping Information Option Remote ID User-defined Format:
  Global:

  VLANs:

  Interfaces:

  Interfaces and VLANs:

DHCP Snooping Information Option Circuit ID User-defined Format:
  Global:

  VLANs:

  Interfaces:

  Interfaces and VLANs:

                          Circuit-ID      Circuit-ID  Circuit-ID
Interface Trusted Max-Num mode            Value       TR101 VLAN   Policy
--------- ------- ------- --------------- ----------- ---------- ----------
Eth 1/1   No      16      VLAN-Unit-Port  ---         enabled     none
Eth 1/2   No      16      VLAN-Unit-Port  ---         enabled     none
Eth 1/3   No      16      VLAN-Unit-Port  ---         enabled     none
Eth 1/4   No      16      VLAN-Unit-Port  ---         enabled     none
Eth 1/5   No      16      VLAN-Unit-Port  ---         enabled     none
.
.
.
```

show ip dhcp snooping binding

This command shows the DHCP snooping binding table entries.

Command Mode

Privileged Exec

Example

```
Console#show ip dhcp snooping binding
MAC Address       IP Address      Lease(sec) Type                VLAN Interface
----------------- --------------- ---------- -------------------- ---- ------
11-22-33-44-55-66 192.168.0.99             0 Dynamic-DHCPSNP       1 Eth 1/5
Console#
```

DHCPv6 Snooping

DHCPv6 snooping allows a switch to protect a network from rogue DHCPv6 servers or other devices which send port-related information to a DHCPv6 server. This information can be useful in tracking an IP address back to a physical port. This section describes commands used to configure DHCPv6 snooping.

Table 50: DHCP Snooping Commands

Command	Function	Mode
ipv6 dhcp snooping	Enables DHCPv6 snooping globally	GC
ipv6 dhcp snooping option remote-id	Enables insertion of DHCPv6 Option 37 relay agent remote-id	GC, IC
ipv6 dhcp snooping option remote-id format user-defined	Sets the DHCPv6 snooping Option 37 remote ID user-defined format	GC, IC
ipv6 dhcp snooping option interface-id	Enables insertion of DHCPv6 Option 18 relay agent interface-id	GC, IC
ipv6 dhcp snooping option interface-id format user-defined	Sets the DHCPv6 snooping Option 18 interface ID user-defined format	GC, IC
ipv6 dhcp snooping option remote-id policy	Sets the information option policy for DHCPv6 client packets that include Option 37 information	GC, IC
ipv6 dhcp snooping option interface-id policy	Sets the information option policy for DHCPv6 client packets that include Option 18 information	GC, IC
ipv6 dhcp snooping vlan	Enables DHCPv6 snooping on the specified VLAN	GC
ipv6 dhcp snooping max-binding	Sets the maximum number of entries which can be stored in the binding database for an interface	IC
ipv6 dhcp snooping trust	Configures the specified interface as trusted	IC
clear ipv6 dhcp snooping binding	Clears DHCPv6 snooping binding table entries from RAM	PE
clear ipv6 dhcp snooping statistics	Clears statistical counters for DHCPv6 snooping client, server and relay packets	PE
show ipv6 dhcp snooping	Shows the DHCPv6 snooping configuration settings	PE

Table 50: DHCP Snooping Commands (Continued)

Command	Function	Mode
show ipv6 dhcp snooping binding	Shows the DHCPv6 snooping binding table entries	PE
show ipv6 dhcp snooping statistics	Shows statistics for DHCPv6 snooping client, server and relay packets	PE

ipv6 dhcp snooping

This command enables DHCPv6 snooping globally. Use the **no** form to restore the default setting.

Syntax

[no] ipv6 dhcp snooping

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- Network traffic may be disrupted when malicious DHCPv6 messages are received from an outside source. DHCPv6 snooping is used to filter DHCPv6 messages received on an unsecure interface from outside the network or fire wall. When DHCPv6 snooping is enabled globally by this command, and enabled on a VLAN interface by the ipv6 dhcp snooping vlan command, DHCP messages received on an untrusted interface (as specified by the no ipv6 dhcp snooping trust command) from a device not listed in the DHCPv6 snooping table will be dropped.

- When enabled, DHCPv6 messages entering an untrusted interface are filtered based upon dynamic entries learned via DHCPv6 snooping.

- Table entries are only learned for trusted interfaces. Each entry includes a MAC address, IPv6 address, lease time, binding type, VLAN identifier, and port identifier.

- When DHCPv6 snooping is enabled, the rate limit for the number of DHCPv6 messages that can be processed by the switch is 100 packets per second. Any DHCPv6 packets in excess of this limit are dropped.

- Filtering rules are implemented as follows:

  - If global DHCPv6 snooping is disabled, all DHCPv6 packets are forwarded.

- If DHCPv6 snooping is enabled globally, and also enabled on the VLAN where the DHCPv6 packet is received, DHCPv6 packets are forwarded for a *trusted* port as described below.

- If DHCPv6 snooping is enabled globally, and also enabled on the VLAN where the DHCP packet is received, but the port is *not trusted*, DHCP packets are processed according to message type as follows:

  DHCP Client Packet

  - Request: Update entry in binding cache, recording client's DHCPv6 Unique Identifier (DUID), server's DUID, Identity Association (IA) type, IA Identifier, and address (4 message exchanges to get IPv6 address), and forward to trusted port.

  - Solicit: Add new entry in binding cache, recording client's DUID, IA type, IA ID (2 message exchanges to get IPv6 address with rapid commit option, otherwise 4 message exchanges), and forward to trusted port.

  - Decline: If no matching entry is found in binding cache, drop this packet.

  - Renew, Rebind, Release, Confirm: If no matching entry is found in binding cache, drop this packet.

  - If the DHCPv6 packet is not a recognizable type, it is dropped.

  If a DHCPv6 packet from a client passes the filtering criteria above, it will only be forwarded to trusted ports in the same VLAN.

  DHCP Server Packet

  - If a DHCP server packet is received on an *untrusted* port, drop this packet and add a log entry in the system.

  - If a DHCPv6 Reply packet is received from a server on a *trusted* port, it will be processed in the following manner:

    a. Check if IPv6 address in IA option is found in binding table:
       - If yes, continue to C.
       - If not, continue to B.

    b. Check if IPv6 address in IA option is found in binding cache:
       - If yes, continue to C.
       - If not, check failed, and forward packet to trusted port.

c. Check status code in IA option:

- If successful, and entry is in binding table, update lease time and forward to original destination.
- If successful, and entry is in binding cache, move entry from binding cache to binding table, update lease time and forward to original destination.
- Otherwise, remove binding entry. and check failed.
- If a DHCPv6 Relay packet is received, check the relay message option in Relay-Forward or Relay-Reply packet, and process client and server packets as described above.

- If DHCPv6 snooping is globally disabled, all dynamic bindings are removed from the binding table.
- *Additional considerations when the switch itself is a DHCPv6 client* – The port(s) through which the switch submits a client request to the DHCPv6 server must be configured as trusted (using the ipv6 dhcp snooping trust command). Note that the switch will not add a dynamic entry for itself to the binding table when it receives an ACK message from a DHCPv6 server. Also, when the switch sends out DHCPv6 client packets for itself, no filtering takes place. However, when the switch receives any messages from a DHCPv6 server, any packets received from untrusted ports are dropped.

Example

This example enables DHCPv6 snooping globally for the switch.

```
Console(config)#ipv6 dhcp snooping
Console(config)#
```

ipv6 dhcp snooping option remote-id

This command enables the insertion of remote-id Option 37 information into DHCPv6 client messages. Remote-id option information such as the port attached to the client, DUID, and VLAN ID is used by the DHCPv6 server to assign preassigned configuration data specific to the DHCPv6 client. Use the **no** form of the command to disable this function.

Syntax

[no] **ipv6 dhcp snooping option remote-id**

Default Setting

Disabled

Command Mode

Global Configuration and Interface Configuration (Ethernet, Port Channel)

Command Usage

- DHCPv6 provides a relay mechanism for sending information about the switch and its DHCPv6 clients to the DHCPv6 server. Known as DHCPv6 Option 37, it allows compatible DHCPv6 servers to use the information when assigning IP addresses, or to set other services or policies for clients.

- When DHCPv6 Snooping Information Option 37 is enabled, the requesting client (or an intermediate relay agent that has used the information fields to describe itself) can be identified in the DHCPv6 request packets forwarded by the switch and in reply packets sent back from the DHCPv6 server.

- When the DHCPv6 Snooping Option 37 is enabled, clients can be identified by the switch port to which they are connected rather than just their MAC address. DHCPv6 client-server exchange messages are then forwarded directly between the server and client without having to flood them to the entire VLAN.

- DHCPv6 snooping must be enabled for the DHCPv6 Option 37 information to be inserted into packets. When enabled, the switch will either drop, keep or remove option 37 information in incoming DHCPv6 packets. Packets are processed as follows:
  - If an incoming packet is a DHCPv6 request packet with option 37 information, it will modify the option 37 information according to settings specified with ipv6 dhcp snooping option remote-id policy command.
  - If an incoming packet is a DHCPv6 request packet without option 37 information, enabling the DHCPv6 snooping information option will add option 37 information to the packet.
  - If an incoming packet is a DHCPv6 reply packet with option 37 information, enabling the DHCPv6 snooping information option will remove option 37 information from the packet.

- When this switch inserts Option 37 information in DHCPv6 client request packets, the switch's MAC address (hexadecimal) is used for the remote ID.

Example

This example enables the DHCPv6 Snooping Remote-ID Option.

```
Console(config)#ipv6 dhcp snooping option remote-id
Console(config)#
```

ipv6 dhcp snooping option remote-id format user-defined

This command sets the DHCPv6 snooping Option 37 remote ID user-defined format. Use the **no** form to restore the default setting.

Syntax

ipv6 dhcp snooping option remote-id [**vlan** {*vlan-id* | *vlan-range*}] **format user-defined** *text-string*

no ipv6 dhcp snooping option remote-id [**vlan** {*vlan-id* | *vlan-range*}] **format**

vlan-id - ID of a configured VLAN. (Range: 1-4094)

vlan-range - A list of configured VLAN IDs. Separate nonconsecutive VLAN IDs with a comma and no spaces; or use a hyphen to designate a range of VLAN IDs. (Range: 1-4094)

text-string - The DHCPv6 Option 37 remote ID message format string. See Command Usage below for details.

Default Setting

No user-defined format configured

Command Mode

Global Configuration and Interface Configuration (Ethernet, Port Channel)

Command Usage

- The text string can use hexadecimal notation, ASCII, or combination of the two. Contents in quotation marks (" ") are encapsulated as an ASCII string, and contents outside the quotation marks are encapsulated in hexadecimal notation.

  The symbol % followed by a keyword indicates the format of the keyword. Delimiters must be added between keywords, which cannot be numbers.

  For example: %port "%sysname %portname:%svlan.%cvlan."

- A number to the left of the symbol % indicates the length of the following keyword. In an ASCII string, %05 has the same meaning as %05d. In a hexadecimal string, the number indicates the keyword length in bits. For example, %8svlan indicates first 8 bits of the SVLAN ID, and %2port indicates the first 2 bits of the port number.

- The symbol \ indicates an escape character. The symbols % and \ following the escape character indicate themselves. For example, \\ represents \.

- The following keywords can be used to define the Option 37 field:

  - **sysname** - Indicates the hostname of the device. This keyword is valid only in ASCII format.

  - **portname** - Indicates the name of a port. This keyword is valid only in ASCII format.

- **mac** - Indicates the MAC address of the device. In ASCII format, the value is in the format of H-H-H; in hexadecimal notation, the value is a number of six bytes.
- **port** - Indicates the port number. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 1 byte by default.
- **svlan** - Indicates the outer VLAN ID. The value ranges from 1 to 4094. If this field is not required, this field is 0. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 2 bytes by default.
- **cvlan** - Specifies the inner VLAN ID. The value ranges from 1 to 4094. If this field is not required, this field is 0. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 2 bytes by default.
- **length** - Indicates the total length of the keywords following the keyword length. It occupies 2 bytes by default.
- **d** - Indicates the value of the keyword **svlan** or **cvlan** if the SVLAN or CVLAN does not exist. This keyword is valid in ASCII format or in hexadecimal notation.

- All other symbols are processed as common characters. The rules for setting the format string in ASCII format or hexadecimal notation are as follows:
  - An ASCII character string can contain Arabic numerals, uppercase letters, lowercase letters, and the following symbols: ! @ # $ % ^ & * ( ) _ + | - = \ [ ] { } ; : ' " / ? . , < > `.
  - By default, the length of each keyword in an ASCII character string is the actual length of the keyword.
  - A hexadecimal notation string can contain numerals, spaces, and % + keywords.
  - In a hexadecimal notation string, numbers are encapsulated in the Option 82 field in hexadecimal notation. A number from 0 to 255 occupies 1 byte; a number from 256 to 65535 occupies 2 bytes; a number from 65536 to 4294967295 occupies 4 bytes. Numbers larger than 4294967295 are not supported. Multiple numbers must be separated by spaces; otherwise, they are considered as one number.
  - All the spaces in a hexadecimal character string are ignored.
  - If the length of each keyword in a hexadecimal character string is specified, the total length of the hexadecimal character string must be a multiple of 8.
  - A hexadecimal notation string can contain only the keywords whose values are numbers. Other keywords, such as port name, cannot be added to the hexadecimal notation string.

- If a string is not contained in quotation marks, it is encapsulated in hexadecimal notation. To encapsulate the string in the ASCII format, use a pair of quotation marks to contain the string. For example, the SVLAN is 3, and the port number is 4. If the string is in the %svlan %port format, the value of the encapsulated string is a hexadecimal number 00030004. If the string is in the "%svlan %port" format, the value of the encapsulated string is 3 4.

- All Option 82 fields configured in the system view or in the same interface view share a length of 1-255 bytes. If their total length exceeds 255 bytes, some Option 82 information will be lost.

Example

The following command configures a user-defined format for the remote ID in the Option 37 field and encapsulate the port name, outer VLAN ID, inner VLAN ID, and host name in ASCII format.

```
Console(config)#ipv6 dhcp snooping option remote-id format user-defined
  "%portname:%svlan.%cvlan %sysname"
Console(config)#
```

ipv6 dhcp snooping option interface-id

This command enables the insertion of interface-ID Option 18 information into DHCPv6 client messages. Use the **no** form of the command to disable this function.

Syntax

[no] ipv6 dhcp snooping option interface-id

Default Setting

Disabled

Command Mode

Global Configuration and Interface Configuration (Ethernet, Port Channel)

Example

```
Console(config)#ipv6 dhcp snooping option interface-id
Console(config)#
```

ipv6 dhcp snooping option interface-id format user-defined

This command sets the DHCPv6 snooping Option 18 interface ID user-defined format. Use the **no** form to restore the default setting.

Syntax

ipv6 dhcp snooping option interface-id [**vlan** {*vlan-id* | *vlan-range*}] **format user-defined** *text-string*

no ipv6 dhcp snooping option interface-id [**vlan** {*vlan-id* | *vlan-range*}] **format**

vlan-id - ID of a configured VLAN. (Range: 1-4094)

vlan-range - A list of configured VLAN IDs. Separate nonconsecutive VLAN IDs with a comma and no spaces; or use a hyphen to designate a range of VLAN IDs. (Range: 1-4094)

text-string - The DHCPv6 Option 18 interface ID message format string. See Command Usage below for details.

Default Setting

No user-defined format configured

Command Mode

Global Configuration and Interface Configuration (Ethernet, Port Channel)

Command Usage

- The text string can use hexadecimal notation, ASCII, or combination of the two. Contents in quotation marks (" ") are encapsulated as an ASCII string, and contents outside the quotation marks are encapsulated in hexadecimal notation.

  The symbol % followed by a keyword indicates the format of the keyword. Delimiters must be added between keywords, which cannot be numbers.

  For example: %port "%sysname %portname:%svlan.%cvlan."

- A number to the left of the symbol % indicates the length of the following keyword. In an ASCII string, %05 has the same meaning as %05d. In a hexadecimal string, the number indicates the keyword length in bits. For example, %8svlan indicates first 8 bits of the SVLAN ID, and %2port indicates the first 2 bits of the port number.

- The symbol \ indicates an escape character. The symbols % and \ following the escape character indicate themselves. For example, \\ represents \.

- The following keywords can be used to define the Option 18 field:

  - **sysname** - Indicates the hostname of the device. This keyword is valid only in ASCII format.

  - **portname** - Indicates the name of a port. This keyword is valid only in ASCII format.

- **mac** - Indicates the MAC address of the device. In ASCII format, the value is in the format of H-H-H; in hexadecimal notation, the value is a number of six bytes.
- **port** - Indicates the port number. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 1 byte by default.
- **svlan** - Indicates the outer VLAN ID. The value ranges from 1 to 4094. If this field is not required, this field is 0. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 2 bytes by default.
- **cvlan** - Specifies the inner VLAN ID. The value ranges from 1 to 4094. If this field is not required, this field is 0. This keyword is valid in ASCII format or in hexadecimal notation. It occupies 2 bytes by default.
- **length** - Indicates the total length of the keywords following the keyword length. It occupies 2 bytes by default.
- **d** - Indicates the value of the keyword **svlan** or **cvlan** if the SVLAN or CVLAN does not exist. This keyword is valid in ASCII format or in hexadecimal notation.

- All other symbols are processed as common characters. The rules for setting the format string in ASCII format or hexadecimal notation are as follows:
  - An ASCII character string can contain Arabic numerals, uppercase letters, lowercase letters, and the following symbols: ! @ # $ % ^ & * ( ) _ + | - = \ [ ] { } ; : ' " / ? . , < > `.
  - By default, the length of each keyword in an ASCII character string is the actual length of the keyword.
  - A hexadecimal notation string can contain numerals, spaces, and % + keywords.
  - In a hexadecimal notation string, numbers are encapsulated in the Option 82 field in hexadecimal notation. A number from 0 to 255 occupies 1 byte; a number from 256 to 65535 occupies 2 bytes; a number from 65536 to 4294967295 occupies 4 bytes. Numbers larger than 4294967295 are not supported. Multiple numbers must be separated by spaces; otherwise, they are considered as one number.
  - All the spaces in a hexadecimal character string are ignored.
  - If the length of each keyword in a hexadecimal character string is specified, the total length of the hexadecimal character string must be a multiple of 8.
  - A hexadecimal notation string can contain only the keywords whose values are numbers. Other keywords, such as port name, cannot be added to the hexadecimal notation string.

- If a string is not contained in quotation marks, it is encapsulated in hexadecimal notation. To encapsulate the string in the ASCII format, use a pair of quotation marks to contain the string. For example, the SVLAN is 3, and the port number is 4. If the string is in the %svlan %port format, the value of the encapsulated string is a hexadecimal number 00030004. If the string is in the "%svlan %port" format, the value of the encapsulated string is 3 4.

- All Option 18 fields configured in the system view or in the same interface view share a length of 1-255 bytes. If their total length exceeds 255 bytes, some Option 18 information will be lost.

Example

The following command configures a user-defined format for the interface ID in the Option 18 field and encapsulate the port name, outer VLAN ID, inner VLAN ID, and host name in ASCII format.

```
Console(config)#ipv6 dhcp snooping option interface-id format user-defined
  "%portname:%svlan.%cvlan %sysname"
Console(config)#
```

ipv6 dhcp snooping option remote-id policy

This command sets the remote-ID option policy for DHCPv6 client packets that include Option 37 information. Use the **no** form to disable this function.

Syntax

ipv6 dhcp snooping option remote-id policy {**clear** | **drop** | **keep** | **replace**}

no ipv6 dhcp snooping option remote-id policy

clear - Clears the Option 37 remote-ID information and forwards the packets to trusted ports.

drop - Drops the client's request packet instead of relaying it.

keep - Retains the Option 37 information in the client request, and forwards the packets to trusted ports.

replace - Replaces the Option 37 remote-ID in the client's request with the relay agent's remote-ID (when DHCPv6 snooping is enabled), and forwards the packets to trusted ports.

Default Setting

drop

Command Mode

Global Configuration and Interface Configuration (Ethernet, Port Channel)

Command Usage
When the switch receives DHCPv6 packets from clients that already include DHCP Option 37 information, the switch can be configured to set the action policy for these packets. The switch can either drop the DHCPv6 packets, keep the existing information, clear the information, or replace it with the switch's relay agent information.

Example
This example configures the switch to keep existing remote-ID Option 37 information within DHCPv6 client packets and forward it.

```
Console(config)#ipv6 dhcp snooping option remote-id policy keep
Console(config)#
```

ipv6 dhcp snooping option interface-id policy

This command sets the interface-ID option policy for DHCPv6 client packets that include Option 18 information. Use the **no** form to disable this function.

Syntax

ipv6 dhcp snooping option interface-id policy {**clear** |**drop** | **keep** | **replace**}

no ipv6 dhcp snooping option interface-id policy

clear - Clears the Option 18 interface-ID information and forwards the packets to trusted ports.

drop - Drops the client's request packet instead of relaying it.

keep - Retains the Option 18 information in the client request, and forwards the packets to trusted ports.

replace - Replaces the Option 18 interface-ID in the client's request with the relay agent's interface-ID (when DHCPv6 snooping is enabled), and forwards the packets to trusted ports.

Default Setting
drop

Command Mode
Global Configuration and Interface Configuration (Ethernet, Port Channel)

Command Usage
When the switch receives DHCPv6 packets from clients that already include DHCP Option 18 information, the switch can be configured to set the action policy for these packets. The switch can either drop the DHCPv6 packets, keep the existing information, clear the information, or replace it with the switch's relay agent information.

Example

This example configures the switch to keep existing interface-ID Option 18 information within DHCPv6 client packets and forward it.

```
Console(config)#ipv6 dhcp snooping option interface-id policy keep
Console(config)#
```

ipv6 dhcp snooping vlan

This command enables DHCPv6 snooping on the specified VLAN. Use the **no** form to restore the default setting.

Syntax

[no] **ipv6 dhcp snooping vlan** {*vlan-id* | *vlan-range*}

vlan-id - ID of a configured VLAN (Range: 1-4094)

vlan-range - A consecutive range of VLANs indicated by the use a hyphen, or a random group of VLANs with each entry separated by a comma.

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- When DHCPv6 snooping enabled globally using the ipv6 dhcp snooping command, and enabled on a VLAN with this command, DHCPv6 packet filtering will be performed on any untrusted ports within the VLAN as specified by the ipv6 dhcp snooping trust command.
- When the DHCPv6 snooping is globally disabled, DHCPv6 snooping can still be configured for specific VLANs, but the changes will not take effect until DHCPv6 snooping is globally re-enabled.
- When DHCPv6 snooping is enabled globally, and then disabled on a VLAN, all dynamic bindings learned for this VLAN are removed from the binding table.

Example

This example enables DHCP6 snooping for VLAN 1.

```
Console(config)#ipv6 dhcp snooping vlan 1
Console(config)#
```

ipv6 dhcp snooping max-binding

This command sets the maximum number of entries which can be stored in the binding database for an interface. Use the **no** form to restore the default setting.

Syntax

ipv6 dhcp snooping max-binding *count*

no ipv6 dhcp snooping max-binding

count - Maximum number of entries. (Range: 1-5)

Default Setting

5

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

This example sets the maximum number of binding entries to 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 dhcp snooping max-binding 1
Console(config-if)#
```

ipv6 dhcp snooping trust

This command configures the specified interface as trusted. Use the **no** form to restore the default setting.

Syntax

[**no**] **ipv6 dhcp snooping trust**

Default Setting

All interfaces are untrusted

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- A trusted interface is an interface that is configured to receive only messages from within the network. An untrusted interface is an interface that is configured to receive messages from outside the network or fire wall.
- Set all ports connected to DHCv6 servers within the local network or fire wall to trusted, and all other ports outside the local network or fire wall to untrusted.
- When DHCPv6 snooping is enabled globally using the ipv6 dhcp snooping command, and enabled on a VLAN with ipv6 dhcp snooping vlan command, DHCPv6 packet filtering will be performed on any untrusted ports within the

VLAN according to the default status, or as specifically configured for an interface with the **no ipv6 dhcp snooping trust** command.

- When an untrusted port is changed to a trusted port, all the dynamic DHCPv6 snooping bindings associated with this port are removed.
- *Additional considerations when the switch itself is a DHCPv6 client* – The port(s) through which it submits a client request to the DHCPv6 server must be configured as trusted.

Example

This example sets port 5 to untrusted.

```
Console(config)#interface ethernet 1/5
Console(config-if)#no ipv6 dhcp snooping trust
Console(config-if)#
```

clear ipv6 dhcp snooping binding

This command clears DHCPv6 snooping binding table entries from RAM. Use this command without any optional keywords to clear all entries from the binding table.

Syntax

clear ipv6 dhcp snooping binding [*mac-address ipv6-address*]

mac-address - Specifies a MAC address entry. (Format: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx)

ipv6-address - Corresponding IPv6 address. This address must be entered according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

Command Mode

Privileged Exec

Example

```
Console(config)#clear ipv6 dhcp snooping binding 00-12-cf-01-02-03 2001::1
Console(config)#
```

clear ipv6 dhcp snooping statistics

This command clears statistical counters for DHCPv6 snooping client, server and relay packets.

Command Mode

Privileged Exec

Example

```
Console(config)#clear ipv6 dhcp snooping statistics
Console(config)#
```

show ipv6 dhcp snooping

This command shows the DHCPv6 snooping configuration settings.

Command Mode

Privileged Exec

Example

```
Console#show ipv6 dhcp snooping
Global DHCPv6 Snooping status: disabled
DHCPv6 Snooping remote-id option status: disabled
DHCPv6 Snooping remote-id policy: drop
DHCPv6 Snooping interface-id option status: disabled
DHCPv6 Snooping interface-id policy: drop
DHCPv6 Snooping is configured on the following VLANs:

DHCPV6 Snooping Information Option Remote ID User-defined Format:
  Global:

  VLANs:

  Interfaces:

  Interfaces and VLANs:

DHCPV6 Snooping Information Option Interface ID User-defined Format:
  Global:

  VLANs:

  Interfaces:

  Interfaces and VLANs:

Interface           Trusted       Max-binding  Current-binding
---------           ---------     -----------  ---------------
Eth 1/1             No                      5                0
Eth 1/2             No                      5                0
Eth 1/3             No                      5                0
Eth 1/4             No                      5                0
Eth 1/5             Yes                     5                0
.
.
.
```

show ipv6 dhcp snooping binding

This command shows the DHCPv6 snooping binding table entries.

Command Mode

Privileged Exec

Example

```
Console#show ipv6 dhcp snooping binding
NA - Non-temporary address
TA - Temporary address
------------------------------------ ----------- ---- ------- ----
Link-layer Address: 00-13-49-aa-39-26
IPv6 Address                         Lifetime   VLAN Port    Type
------------------------------------ ---------- ---- ------- ----
2001:b021:1435:5612:ab3c:6792:a452:6712    2591998    1 Eth 1/5   NA
------------------------------------ ---------- ---- ------- ----
Link-layer Address: 00-12-cf-01-02-03
IPv6 Address                         Lifetime   VLAN Port    Type
------------------------------------ ---------- ---- ------- ----
                           2001:b000::1    2591912    1 Eth 1/3   NA
Console#
```

show ipv6 dhcp snooping statistics

This command shows statistics for DHCPv6 snooping client, server and relay packets.

Command Mode

Privileged Exec

Example

```
Console#show ipv6 dhcp snooping statistics
DHCPv6 Snooping Statistics:
    Client Packet: Solicit, Request, Confirm, Renew, Rebind,
                   Decline, Release, Information-request
    Server Packet: Advertise, Reply, Reconfigure
    Relay  Packet: Relay-forward, Relay-reply
State     Client    Server    Relay     Total
--------  --------  --------  --------  --------
Received        10         9         0        19
Sent             9         9         0        18
Droped           1         0         0         1

Console#
```

IPv4 Source Guard

IPv4 Source Guard is a security feature that filters IPv4 traffic on network interfaces based on manually configured entries in the IPv4 Source Guard table, or dynamic entries in the DHCPv4 Snooping table when enabled (see "DHCPv4 Snooping" on page 282). IPv4 source guard can be used to prevent traffic attacks caused when a host tries to use the IPv4 address of a neighbor to access the network. This section describes commands used to configure IPv4 Source Guard.

Table 51: IPv4 Source Guard Commands

Command	Function	Mode
ip source-guard binding	Adds a static address to the source-guard binding table	GC
ip source-guard	Configures the switch to filter inbound traffic based on source IP address, or source IP address and corresponding MAC address	IC
ip source-guard max-binding	Sets the maximum number of entries that can be bound to an interface	IC
ip source-guard mode	Sets the source-guard learning mode to search for addresses in the ACL binding table or the MAC address binding table	IC
clear ip source-guard binding blocked	Remove all blocked records	PE
show ip source-guard	Shows whether source guard is enabled or disabled on each interface	PE
show ip source-guard binding	Shows the source guard binding table	PE

ip source-guard binding

This command adds a static address to the source-guard ACL or MAC address binding table. Use the **no** form to remove a static entry.

Syntax

ip source-guard binding [**mode** {**acl** | **mac**}] *mac-address*
vlan *vlan-id ip-address* **interface ethernet** *unit/port-list*

no ip source-guard binding [**mode** {**acl** | **mac**}] *mac-address ip-address*

mode - Specifies the binding mode.

acl - Adds binding to ACL table.

mac - Adds binding to MAC address table.

mac-address - A valid unicast MAC address.

vlan-id - ID of a configured VLAN for an ACL filtering table or a range of VLANs for a MAC address filtering table. To specify a list separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. (Range: 1-4094)

ip-address - A valid unicast IP address, including classful types A, B or C.

unit - Unit identifier. (Range: 1)

port-list - Physical port number or list of port numbers. Separate nonconsecutive port numbers with a comma and no spaces; or use a hyphen to designate a range of port numbers. (Range: 1-18)

Default Setting
No configured entries

Command Mode
Global Configuration

Command Usage
- If the binding mode is not specified in this command, the entry is bound to the ACL table by default.
- Table entries include a MAC address, IP address, lease time, entry type (Static-IP-SG-Binding, Dynamic-DHCP-Binding), VLAN identifier, and port identifier.
- All static entries are configured with an infinite lease time, which is indicated with a value of zero by the show ip source-guard command.
- When source guard is enabled, traffic is filtered based upon dynamic entries learned via DHCP snooping, or static addresses configured in the source guard binding table with this command.
- An entry with same MAC address and a different VLAN ID cannot be added to the binding table.
- Static bindings are processed as follows:
  - A valid static IP source guard entry will be added to the binding table in ACL mode if one of the following conditions is true:
    - If there is no binding entry with the same VLAN ID and MAC address, a new entry will be added to the binding table using the type of static IP source guard binding.
    - If there is an entry with the same VLAN ID and MAC address, and the type of entry is static IP source guard binding, then the new entry will replace the old one.
    - If there is an entry with the same VLAN ID and MAC address, and the type of the entry is dynamic DHCP snooping binding, then the new entry will replace the old one and the entry type will be changed to static IP source guard binding.
    - Note that a static IP source guard entry cannot be added for an non-existent VLAN.
  - A valid static IP source guard entry will be added to the binding table in MAC mode if one of the following conditions are true:

- If there is no binding entry with the same IP address and MAC address, a new entry will be added to the binding table using the type of static IP source guard binding entry.
- If there is a binding entry with same IP address and MAC address, then the new entry shall replace the old one.

- Only unicast addresses are accepted for static bindings.

Example

This example configures a static source-guard binding on port 5. Since the binding mode is not specified, the entry is bound to the ACL table by default.

```
Console(config)#ip source-guard binding 00-E0-4C-68-14-79 vlan 1 192.168.0.99
  interface ethernet 1/5
Console(config-if)#
```

ip source-guard

This command configures the switch to filter inbound traffic based on source IP address, or source IP address and corresponding MAC address. Use the **no** form to disable this function.

Syntax

ip source-guard {**sip** | **sip-mac**}

no ip source-guard

sip - Filters traffic based on IP addresses stored in the binding table.

sip-mac - Filters traffic based on IP addresses and corresponding MAC addresses stored in the binding table.

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

Command Usage

- Source guard is used to filter traffic on an insecure port which receives messages from outside the network or fire wall, and therefore may be subject to traffic attacks caused by a host trying to use the IP address of a neighbor.
- Setting source guard mode to "sip" or "sip-mac" enables this function on the selected port. Use the "sip" option to check the VLAN ID, source IP address, and port number against all entries in the binding table. Use the "sip-mac" option to check these same parameters, plus the source MAC address. Use the **no ip source guard** command to disable this function on the selected port.

- When enabled, traffic is filtered based upon dynamic entries learned via DHCP snooping, or static addresses configured in the source guard binding table.
- Table entries include a MAC address, IP address, lease time, entry type (Static-IP-SG-Binding, Dynamic-DHCP-Binding, VLAN identifier, and port identifier.
- Static addresses entered in the source guard binding table with the ip source-guard binding command are automatically configured with an infinite lease time. Dynamic entries learned via DHCP snooping are configured by the DHCP server itself.
- If the IP source guard is enabled, an inbound packet's IP address (sip option) or both its IP address and corresponding MAC address (sip-mac option) will be checked against the binding table. If no matching entry is found, the packet will be dropped.
- Filtering rules are implemented as follows:
  - If DHCPv4 snooping is disabled (see page 283), IP source guard will check the VLAN ID, source IP address, port number, and source MAC address (for the sip-mac option). If a matching entry is found in the binding table and the entry type is static IP source guard binding, the packet will be forwarded.
  - If the DHCP snooping is enabled, IP source guard will check the VLAN ID, source IP address, port number, and source MAC address (for the sip-mac option). If a matching entry is found in the binding table and the entry type is static IP source guard binding, or dynamic DHCP snooping binding, the packet will be forwarded.
  - If IP source guard is enabled on an interface for which IP source bindings (dynamically learned via DHCP snooping or manually configured) are not yet configured, the switch will drop all IP traffic on that port, except for DHCP packets allowed by DHCP snooping.
  - Only unicast addresses are accepted for static bindings.

Example

This example enables IP source guard on port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#ip source-guard sip
Console(config-if)#
```

ip source-guard max-binding

This command sets the maximum number of entries that can be bound to an interface. Use the **no** form to restore the default setting.

Syntax

ip source-guard [**mode** {**acl** | **mac**}] **max-binding** *number*

no ip source-guard [**mode** {**acl** | **mac**}] **max-binding**

mode - Specifies the learning mode.

acl - Searches for addresses in the ACL table.

mac - Searches for addresses in the MAC address table.

number - The maximum number of IP addresses that can be mapped to an interface in the binding table. (Range: 1-32)

Default Setting

Mode: ACL, Maximum Binding: 5
Mode: MAC, Maximum Binding: 1024

Command Mode

Interface Configuration (Ethernet)

Command Usage

- This command sets the maximum number of address entries that can be mapped to an interface in the binding table for the specified mode (ACL binding table or MAC address table) including dynamic entries discovered by DHCP snooping and static entries set by the ip source-guard command.
- The maximum binding for ACL mode restricts the number of "active" entries per port. If binding entries exceed the maximum number in IP source guard, only the maximum number of binding entries will be set. Dynamic binding entries exceeding the maximum number will be created but will not be active.
- The maximum binding for MAC mode restricts the number of MAC addresses learned per port. Authenticated IP traffic with different source MAC addresses cannot be learned if it would exceed this maximum number.

Example

This example sets the maximum number of allowed entries for ACL mode in the binding table for port 5 to one entry. The mode is not specified, and therefore defaults to the ACL binding table.

```
Console(config)#interface ethernet 1/5
Console(config-if)#ip source-guard max-binding 1
Console(config-if)#
```

ip source-guard mode

This command sets the source-guard learning mode to search for addresses in the ACL binding table or the MAC address binding table. Use the **no** form to restore the default setting.

Syntax

ip source-guard mode {**acl** | **mac**}

no ip source-guard mode

mode - Specifies the learning mode.

acl - Searches for addresses in the ACL binding table.

mac - Searches for addresses in the MAC address binding table.

Default Setting

ACL

Command Mode

Interface Configuration (Ethernet)

Command Usage

There are two modes for the filtering table:

- ACL - IP traffic will be forwarded if it passes the checking process in the ACL mode binding table.
- MAC - A MAC entry will be added in MAC address table if IP traffic passes the checking process in MAC mode binding table.

Example

This command sets the binding table mode for the specified interface to MAC mode:

```
Console(config)#interface ethernet 1/5
Console(config-if)#ip source-guard mode mac
Console(config-if)#
```

clear ip source-guard binding blocked

This command clears source-guard binding table entries from RAM.

Syntax

clear ip source-guard binding blocked

Command Mode

Privileged Exec

Command Usage

When IP Source-Guard detects an invalid packet it creates a blocked record. These records can be viewed using the show ip source-guard binding blocked command.

A maximum of 512 blocked records can be stored before the switch overwrites the oldest record with new blocked records. Use the **clear ip source-guard binding blocked** command to clear this table.

Example

This command clears the blocked record table.

```
Console(config)#clear ip source-guard binding blocked
Console(config)#
```

show ip source-guard

This command shows whether source guard is enabled or disabled on each interface.

Command Mode

Privileged Exec

Example

```
Console#show ip source-guard
                                          ACL Table     MAC Table
Interface   Filter-type   Filter-table    Max-binding   Max-binding
---------   -----------   ------------    -----------   -----------
Eth 1/1     DISABLED      ACL                       5          1024
Eth 1/2     DISABLED      ACL                       5          1024
Eth 1/3     DISABLED      ACL                       5          1024
Eth 1/4     DISABLED      ACL                       5          1024
Eth 1/5     DISABLED      ACL                       5          1024
:
```

show ip source-guard binding

This command shows the source guard binding table.

Syntax

show ip source-guard binding [**dhcp-snooping** | **static** [**acl** | **mac**] | **blocked** [**vlan** *vlan-id* | **interface** *interface*]

dhcp-snooping - Shows dynamic entries configured with DHCP Snooping commands (see page 282)

static - Shows static entries configured with the ip source-guard binding command.

acl - Shows static entries in the ACL binding table.

mac - Shows static entries in the MAC address binding table.

blocked - Shows MAC addresses which have been blocked by IP Source Guard.

vlan-id - ID of a configured VLAN (Range: 1-4094)

interface - Specifies a port interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode
Privileged Exec

Example

```
Console#show ip source-guard binding
MAC Address       IP Address      Type            VLAN      Interface
----------------- --------------- --------------- --------- ---------
00-10-b5-f4-d0-01 10.2.44.96      static-acl              1 Eth 1/1
Console#
```

IPv6 Source Guard

IPv6 Source Guard is a security feature that filters IPv6 traffic on non-routed, Layer 2 network interfaces based on manually configured entries in the IPv6 Source Guard table, or dynamic entries in the Neighbor Discovery Snooping table or DHCPv6 Snooping table when either snooping protocol is enabled (see "DHCPv6 Snooping" on page 302). IPv6 source guard can be used to prevent traffic attacks caused when a host tries to use the IPv6 address of a neighbor to access the network. This section describes commands used to configure IPv6 Source Guard.

Table 52: IPv6 Source Guard Commands

Command	Function	Mode
ipv6 source-guard binding	Adds a static address to the source-guard binding table	GC
ipv6 source-guard	Configures the switch to filter inbound traffic based on source IP address	IC
ipv6 source-guard max-binding	Sets the maximum number of entries that can be bound to an interface	IC
show ipv6 source-guard	Shows whether source guard is enabled or disabled on each interface	PE
show ipv6 source-guard binding	Shows the source guard binding table	PE

ipv6 source-guard binding

This command adds a static address to the source-guard binding table. Use the **no** form to remove a static entry.

Syntax

ipv6 source-guard binding *mac-address* **vlan** *vlan-id ipv6-address* **interface** *interface*

no ipv6 source-guard binding *mac-address ipv6-address*

mac-address - A valid unicast MAC address.

vlan-id - ID of a configured VLAN (Range: 1-4094)

ipv6-address - Corresponding IPv6 address. This address must be entered according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Default Setting

No configured entries

Command Mode

Global Configuration

Command Usage

- Table entries include an associated MAC address, IPv6 global unicast address, entry type (Static-IPv6-SG-Binding, Dynamic-ND-Snooping, Dynamic-DHCPv6-Snooping), VLAN identifier, and port identifier.
- Traffic filtering is based only on the source IPv6 address, VLAN ID, and port number.
- All static entries are configured with an infinite lease time, which is indicated with a value of zero by the show ipv6 source-guard command.
- When source guard is enabled, traffic is filtered based upon dynamic entries learned via ND snooping, DHCPv6 snooping, or static addresses configured in the source guard binding table with this command.
- An entry with same MAC address and a different VLAN ID cannot be added to the binding table.
- Static bindings are processed as follows:
  - If there is no entry with same and MAC address and IPv6 address, a new entry is added to binding table using static IPv6 source guard binding.
  - If there is an entry with same MAC address and IPv6 address, and the type of entry is static IPv6 source guard binding, then the new entry will replace the old one.

- If there is an entry with same MAC address and IPv6 address, and the type of the entry is either a dynamic ND snooping binding or DHCPv6 snooping binding, then the new entry will replace the old one and the entry type will be changed to static IPv6 source guard binding.
- Only unicast addresses are accepted for static bindings.

Example

This example configures a static source-guard binding on port 5.

```
Console(config)#ipv6 source-guard binding 00-ab-11-cd-23-45 vlan 1 2001::1
  interface ethernet 1/5
Console(config)#
```

ipv6 source-guard

This command configures the switch to filter inbound traffic based on the source IP address stored in the binding table. Use the **no** form to disable this function.

Syntax

ipv6 source-guard sip

no ipv6 source-guard

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

Command Usage

- Source guard is used to filter traffic on an insecure port which receives messages from outside the network or fire wall, and therefore may be subject to traffic attacks caused by a host trying to use the IP address of a neighbor.
- This command checks the VLAN ID, IPv6 global unicast source IP address, and port number against all entries in the binding table. Use the **no ipv6 source guard** command to disable this function on the selected port.
- After IPv6 source guard is enabled on an interface, the switch initially blocks all IPv6 traffic received on that interface, except for ND packets allowed by ND snooping and DHCPv6 packets allowed by DHCPv6 snooping. A port access control list (ACL) is applied to the interface. Traffic is then filtered based upon dynamic entries learned via ND snooping or DHCPv6 snooping, or static addresses configured in the source guard binding table. The port allows only IPv6 traffic with a matching entry in the binding table and denies all other IPv6 traffic.

- Table entries include a MAC address, IPv6 global unicast address, entry type (Static-IPv6-SG-Binding, Dynamic-ND-Snooping, Dynamic-DHCPv6-Snooping), VLAN identifier, and port identifier.
- Static addresses entered in the source guard binding table with the ipv6 source-guard binding command are automatically configured with an infinite lease time. Dynamic entries learned via DHCPv6 snooping are configured by the DHCPv6 server itself.
- If IPv6 source guard is enabled, an inbound packet's source IPv6 address will be checked against the binding table. If no matching entry is found, the packet will be dropped.
- Filtering rules are implemented as follows:
  - If ND snooping and DHCPv6 snooping are disabled, IPv6 source guard will check the VLAN ID, source IPv6 address, and port number. If a matching entry is found in the binding table and the entry type is static IPv6 source guard binding, the packet will be forwarded.
  - If ND snooping or DHCPv6 snooping is enabled, IPv6 source guard will check the VLAN ID, source IP address, and port number. If a matching entry is found in the binding table and the entry type is static IPv6 source guard binding, dynamic ND snooping binding, or dynamic DHCPv6 snooping binding, the packet will be forwarded.
  - If IPv6 source guard is enabled on an interface for which IPv6 source bindings (dynamically learned via ND snooping or DHCPv6 snooping, or manually configured) are not yet configured, the switch will drop all IPv6 traffic on that port, except for ND packets and DHCPv6 packets allowed by DHCPv6 snooping.
  - Only IPv6 global unicast addresses are accepted for static bindings.

Example

This example enables IP source guard on port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#ipv6 source-guard sip
Console(config-if)#
```

ipv6 source-guard max-binding

This command sets the maximum number of entries that can be bound to an interface. Use the **no** form to restore the default setting.

Syntax

ipv6 source-guard max-binding *number*

no ipv6 source-guard max-binding

number - The maximum number of IPv6 addresses that can be mapped to an interface in the binding table. (Range: 1-5)

Default Setting

5

Command Mode

Interface Configuration (Ethernet)

Command Usage

- This command sets the maximum number of address entries that can be mapped to an interface in the binding table, including both dynamic entries discovered by ND snooping, DHCPv6 snooping, and static entries set by the ipv6 source-guard command.
- IPv6 source guard maximum bindings must be set to a value higher than DHCPv6 snooping maximum bindings and ND snooping maximum bindings.
- If IPv6 source guard, ND snooping, and DHCPv6 snooping are enabled on a port, the dynamic bindings used by ND snooping, DHCPv6 snooping, and IPv6 source guard static bindings cannot exceed the maximum allowed bindings set by the **ipv6 source-guard max-binding** command. In other words, no new entries will be added to the IPv6 source guard binding table.
- If IPv6 source guard is enabled on a port, and the maximum number of allowed bindings is changed to a lower value, precedence is given to deleting entries learned through DHCPv6 snooping, ND snooping, and then manually configured IPv6 source guard static bindings, until the number of entries in the binding table reaches the newly configured maximum number of allowed bindings.

Example

This example sets the maximum number of allowed entries in the binding table for port 5 to one entry.

```
Console(config)#interface ethernet 1/5
Console(config-if)#ipv6 source-guard max-binding 1
Console(config-if)#
```

show ipv6 source-guard

This command shows whether IPv6 source guard is enabled or disabled on each interface, and the maximum allowed bindings.

Command Mode

Privileged Exec

Example

```
Console#show ipv6 source-guard
ipv6 permit link-local status: disable

Interface   Filter-type   Max-binding
---------   -----------   -----------
Eth 1/1     Disabled                5
Eth 1/2     Disabled                5
Eth 1/3     Disabled                5
Eth 1/4     Disabled                5
Eth 1/5     SIP                     1
Eth 1/6     Disabled                5
:
```

show ipv6 source-guard binding

This command shows the IPv6 source guard binding table.

Syntax

show ipv6 source-guard binding [dynamic | static]

dynamic - Shows dynamic entries configured with ND Snooping or DHCPv6 Snooping commands (see page 302)

static - Shows static entries configured with the ipv6 source-guard binding command.

Command Mode

Privileged Exec

Example

```
Console#show ipv6 source-guard binding
DHCPV6SNP:
 DHCP - Stateful address
NDSNP:
 ND - Stateless address
STA - Static IPv6 source guard binding

MAC Address    IPv6 Address                          VLAN Interface Type
-------------- ------------------------------------- ---- --------- ----
00AB-11CD-2345                                2001::1    1  Eth 1/5   STA
Console#
```

ARP Inspection

ARP Inspection validates the MAC-to-IP address bindings in Address Resolution Protocol (ARP) packets. It protects against ARP traffic with invalid address bindings, which forms the basis for certain "man-in-the-middle" attacks. This is accomplished by intercepting all ARP requests and responses and verifying each of these packets before the local ARP cache is updated or the packet is forwarded to the appropriate destination, dropping any invalid ARP packets.

ARP Inspection determines the validity of an ARP packet based on valid IP-to-MAC address bindings stored in a trusted database – the DHCP snooping binding database. ARP Inspection can also validate ARP packets against user-configured ARP access control lists (ACLs) for hosts with statically configured IP addresses.

This section describes commands used to configure ARP Inspection.

Table 53: ARP Inspection Commands

Command	Function	Mode
ip arp inspection	Enables ARP Inspection globally on the switch	GC
ip arp inspection filter	Specifies an ARP ACL to apply to one or more VLANs	GC
ip arp inspection log-buffer logs	Sets the maximum number of entries saved in a log message, and the rate at these messages are sent	GC
ip arp inspection validate	Specifies additional validation of address components in an ARP packet	GC
ip arp inspection vlan	Enables ARP Inspection for a specified VLAN or range of VLANs	GC
ip arp inspection limit	Sets a rate limit for the ARP packets received on a port	IC
ip arp inspection trust	Sets a port as trusted, and thus exempted from ARP Inspection	IC
show ip arp inspection configuration	Displays the global configuration settings for ARP Inspection	PE
show ip arp inspection interface	Shows the trust status and inspection rate limit for ports	PE
show ip arp inspection log	Shows information about entries stored in the log, including the associated VLAN, port, and address components	PE
show ip arp inspection statistics	Shows statistics about the number of ARP packets processed, or dropped for various reasons	PE
show ip arp inspection vlan	Shows configuration setting for VLANs, including ARP Inspection status, the ARP ACL name, and if the DHCP Snooping database is used after ACL validation is completed	PE

ip arp inspection

This command enables ARP Inspection globally on the switch. Use the **no** form to disable this function.

Syntax

[no] ip arp inspection

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- When ARP Inspection is enabled globally with this command, it becomes active only on those VLANs where it has been enabled with the ip arp inspection vlan command.
- When ARP Inspection is enabled globally and enabled on selected VLANs, all ARP request and reply packets on those VLANs are redirected to the CPU and their switching is handled by the ARP Inspection engine.
- When ARP Inspection is disabled globally, it becomes inactive for all VLANs, including those where ARP Inspection is enabled.
- When ARP Inspection is disabled, all ARP request and reply packets bypass the ARP Inspection engine and their manner of switching matches that of all other packets.
- Disabling and then re-enabling global ARP Inspection will not affect the ARP Inspection configuration for any VLANs.
- When ARP Inspection is disabled globally, it is still possible to configure ARP Inspection for individual VLANs. These configuration changes will only become active after ARP Inspection is globally enabled again.

Example

```
Console(config)#ip arp inspection
Console(config)#
```

ip arp inspection filter

This command specifies an ARP ACL to apply to one or more VLANs. Use the **no** form to remove an ACL binding. Use the **no** form to remove an ACL binding.

Syntax

ip arp inspection filter *arp-acl-name* **vlan** {*vlan-id* | *vlan-range*} [**static**]

no ip arp inspection filter *arp-acl-name* **vlan** {*vlan-id* | *vlan-range*}

arp-acl-name - Name of an ARP ACL. (Maximum length: 16 characters)

vlan-id - VLAN ID. (Range: 1-4094)

vlan-range - A consecutive range of VLANs indicated by the use a hyphen, or a random group of VLANs with each entry separated by a comma.

static - ARP packets are only validated against the specified ACL, address bindings in the DHCP snooping database is not checked.

Default Setting

ARP ACLs are not bound to any VLAN
Static mode is not enabled

Command Mode

Global Configuration

Command Usage

- ARP ACLs are configured with the commands described under "ARP ACLs" on page 371.
- If static mode is enabled, the switch compares ARP packets to the specified ARP ACLs. Packets matching an IP-to-MAC address binding in a permit or deny rule are processed accordingly. Packets not matching any of the ACL rules are dropped. Address bindings in the DHCP snooping database are not checked.
- If static mode is not enabled, packets are first validated against the specified ARP ACL. Packets matching a deny rule are dropped. All remaining packets are validated against the address bindings in the DHCP snooping database.

Example

```
Console(config)#ip arp inspection filter sales vlan 1
Console(config)#
```

ip arp inspection log-buffer logs

This command sets the maximum number of entries saved in a log message, and the rate at which these messages are sent. Use the **no** form to restore the default settings.

Syntax

ip arp inspection log-buffer logs *message-number* **interval** *seconds*

no ip arp inspection log-buffer logs

message-number - The maximum number of entries saved in a log message. (Range: 0-256, where 0 means no events are saved and no messages sent)

seconds - The interval at which log messages are sent. (Range: 0-86400)

Default Setting

Message Number: 20
Interval: 10 seconds

Command Mode

Global Configuration

Command Usage

- ARP Inspection must be enabled with the ip arp inspection command before this command will be accepted by the switch.
- By default, logging is active for ARP Inspection, and cannot be disabled.
- When the switch drops a packet, it places an entry in the log buffer. Each entry contains flow information, such as the receiving VLAN, the port number, the source and destination IP addresses, and the source and destination MAC addresses.
- If multiple, identical invalid ARP packets are received consecutively on the same VLAN, then the logging facility will only generate one entry in the log buffer and one corresponding system message.
- The maximum number of entries that can be stored in the log buffer is determined by the *message-number* parameter. If the log buffer fills up before a message is sent, the oldest entry will be replaced with the newest one.
- The switch generates a system message on a rate-controlled basis determined by the *seconds* values. After the system message is generated, all entries are cleared from the log buffer.

Example

```
Console(config)#ip arp inspection log-buffer logs 1 interval 10
Console(config)#
```

ip arp inspection validate

This command specifies additional validation of address components in an ARP packet. Use the **no** form to restore the default setting.

Syntax

ip arp inspection validate
{**dst-mac** [**ip** [**allow-zeros**] [**src-mac**]] |
ip [**allow-zeros**] [**src-mac**] | **src-mac**}

no ip arp inspection validate

dst-mac - Checks the destination MAC address in the Ethernet header against the target MAC address in the ARP body. This check is performed for ARP responses. When enabled, packets with different MAC addresses are classified as invalid and are dropped.

ip - Checks the ARP body for invalid and unexpected IP addresses. Addresses include 0.0.0.0, 255.255.255.255, and all IP multicast addresses. Sender IP addresses are checked in all ARP requests and responses, while target IP addresses are checked only in ARP responses.

allow-zeros - Allows sender IP address to be 0.0.0.0.

src-mac - Checks the source MAC address in the Ethernet header against the sender MAC address in the ARP body. This check is performed on both ARP requests and responses. When enabled, packets with different MAC addresses are classified as invalid and are dropped.

Default Setting

No additional validation is performed

Command Mode

Global Configuration

Command Usage

By default, ARP Inspection only checks the IP-to-MAC address bindings specified in an ARP ACL or in the DHCP Snooping database.

Example

```
Console(config)#ip arp inspection validate dst-mac
Console(config)#
```

ip arp inspection vlan

This command enables ARP Inspection for a specified VLAN or range of VLANs. Use the **no** form to disable this function.

Syntax

[**no**] **ip arp inspection vlan** {*vlan-id* | *vlan-range*}

vlan-id - VLAN ID. (Range: 1-4094)

vlan-range - A consecutive range of VLANs indicated by the use a hyphen, or a random group of VLANs with each entry separated by a comma.

Default Setting
Disabled on all VLANs

Command Mode
Global Configuration

Command Usage
- When ARP Inspection is enabled globally with the ip arp inspection command, it becomes active only on those VLANs where it has been enabled with this command.
- When ARP Inspection is enabled globally and enabled on selected VLANs, all ARP request and reply packets on those VLANs are redirected to the CPU and their switching is handled by the ARP Inspection engine.
- When ARP Inspection is disabled globally, it becomes inactive for all VLANs, including those where ARP Inspection is enabled.
- When ARP Inspection is disabled, all ARP request and reply packets bypass the ARP Inspection engine and their manner of switching matches that of all other packets.
- Disabling and then re-enabling global ARP Inspection will not affect the ARP Inspection configuration for any VLANs.
- When ARP Inspection is disabled globally, it is still possible to configure ARP Inspection for individual VLANs. These configuration changes will only become active after ARP Inspection is globally enabled again.

Example
```
Console(config)#ip arp inspection vlan 1,2
Console(config)#
```

ip arp inspection limit
This command sets a rate limit for the ARP packets received on a port. Use the **no** form to restore the default setting.

Syntax
ip arp inspection limit {**rate** *pps* | **none**}

no ip arp inspection limit

pps - The maximum number of ARP packets that can be processed by the CPU per second on trusted or untrusted ports. (Range: 0-2048, where 0 means that no ARP packets can be forwarded)

none - There is no limit on the number of ARP packets that can be processed by the CPU.

Default Setting
15

Command Mode
Interface Configuration (Port, Static Aggregation)

Command Usage
- This command applies to both trusted and untrusted ports.
- When the rate of incoming ARP packets exceeds the configured limit, the switch drops all ARP packets in excess of the limit.

Example
```
Console(config)#interface ethernet 1/1
Console(config-if)#ip arp inspection limit rate 150
Console(config-if)#
```

ip arp inspection trust
This command sets a port as trusted, and thus exempted from ARP Inspection. Use the **no** form to restore the default setting.

Syntax
[no] ip arp inspection trust

Default Setting
Untrusted

Command Mode
Interface Configuration (Port, Static Aggregation)

Command Usage
Packets arriving on untrusted ports are subject to any configured ARP Inspection and additional validation checks. Packets arriving on trusted ports bypass all of these checks, and are forwarded according to normal switching rules.

Example
```
Console(config)#interface ethernet 1/1
Console(config-if)#ip arp inspection trust
Console(config-if)#
```

show ip arp inspection configuration

This command displays the global configuration settings for ARP Inspection.

Command Mode

Privileged Exec

Example

```
Console#show ip arp inspection configuration

ARP Inspection Global Information:

Global IP ARP Inspection Status : disabled
Log Message Interval            : 1 s
Log Message Number              : 5
Need Additional Validation(s)   : Yes
Additional Validation Type      : Destination MAC address
Console#
```

show ip arp inspection interface

This command shows the trust status and ARP Inspection rate limit for ports.

Syntax

show ip arp inspection interface [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode

Privileged Exec

Example

```
Console#show ip arp inspection interface ethernet 1/1

Port Number        Trust Status             Rate Limit (pps)
-------------   --------------------    -------------------------------
Eth 1/1            Trusted                    150
Console#
```

show ip arp inspection log

This command shows information about entries stored in the log, including the associated VLAN, port, and address components.

Command Mode

Privileged Exec

Example

```
Console#show ip arp inspection log
Total log entries number is 1

Num VLAN Port Src IP Address  Dst IP Address  Src MAC Address  Dst MAC Address
--- ---- ---- --------------  --------------  ---------------  --------------
1   1     11  192.168.2.2     192.168.2.1     00-04-E2-A0-E2-7C FF-FF-FF-FF-FF-FF
Console#
```

show ip arp inspection statistics

This command shows statistics about the number of ARP packets processed, or dropped for various reasons.

Command Mode

Privileged Exec

Example

```
Console#show ip arp inspection statistics

ARP packets received                                                : 150
ARP packets dropped due to rate limt                                : 5
Total ARP packets processed by ARP Inspection                       : 150
ARP packets dropped by additional validation (source MAC address)     : 0
ARP packets dropped by additional validation (destination MAC address): 0
ARP packets dropped by additional validation (IP address)           : 0
ARP packets dropped by ARP ACLs                                     : 0
ARP packets dropped by DHCP snooping                                : 0

Console#
```

show ip arp inspection vlan

This command shows the configuration settings for VLANs, including ARP Inspection status, the ARP ACL name, and if the DHCP Snooping database is used after ARP ACL validation is completed.

Syntax

show ip arp inspection vlan [*vlan-id* | *vlan-range*]

vlan-id - VLAN ID. (Range: 1-4094)

vlan-range - A consecutive range of VLANs indicated by the use a hyphen, or a random group of VLANs with each entry separated by a comma.

Command Mode

Privileged Exec

Command Usage

Enter this command to display the configuration settings for all VLANs, or display the settings for a specific VLAN by entering the VLAN identifier.

Example

```
Console#show ip arp inspection vlan 1

VLAN ID     DAI Status             ACL Name             ACL Status
--------   ---------------    --------------------    --------------------
1           disabled               sales               static
Console#
```

Denial of Service Protection

A denial-of-service attack (DoS attack) is an attempt to block the services provided by a computer or network resource. This kind of attack tries to prevent an Internet site or service from functioning efficiently or at all. In general, DoS attacks are implemented by either forcing the target to reset, to consume most of its resources so that it can no longer provide its intended service, or to obstruct the communication media between the intended users and the target so that they can no longer communicate adequately.

This section describes commands used to protect against DoS attacks.

Table 54: DoS Protection Commands

Command	Function	Mode
dos-protection echo-chargen	Protects against DoS echo/chargen attacks	GC
dos-protection smurf	Protects against DoS smurf attacks	GC
dos-protection tcp-flooding	Protects against DoS TCP-flooding attacks	GC
dos-protection tcp-null-scan	Protects against DoS TCP-null-scan attacks	GC
dos-protection tcp-syn-fin-scan	Protects against DoS TCP-SYN/FIN-scan attacks	GC
dos-protection tcp-udp-port-zero	Protects against attacks which set the Layer 4 source or destination port to zero	GC
dos-protection tcp-xmas-scan	Protects against DoS TCP-XMAS-scan attacks	GC
dos-protection udp-flooding	Protects against DoS UDP-flooding attacks	GC
dos-protection win-nuke	Protects against DoS WinNuke attacks	GC
show dos-protection	Shows the configuration settings for DoS protection	PE

dos-protection echo-chargen

This command protects against DoS echo/chargen attacks in which the echo service repeats anything sent to it, and the chargen (character generator) service generates a continuous stream of data. When used together, they create an infinite loop and result in a denial-of-service. Use the **no** form without the bit rate parameter to disable this feature, or with the bit rate parameter to restore the defautl rate limit..

Syntax

dos-protection echo-chargen [**bit-rate-in-kilo** *rate*]

no dos-protection echo-chargen [**bit-rate-in-kilo**]

rate – Maximum allowed rate. (Range: 64-2000 kbits/second)

Default Setting

Disabled, 1000 kbits/second

Command Mode

Global Configuration

Example

```
Console(config)#dos-protection echo-chargen bit-rate-in-kilo 65
Console(config)#
```

dos-protection smurf

This command protects against DoS smurf attacks in which a perpetrator generates a large amount of spoofed ICMP Echo Request traffic to the broadcast destination IP address (255.255.255.255), all of which uses a spoofed source address of the intended victim. The victim should crash due to the many interrupts required to send ICMP Echo response packets. Use the **no** form to disable this feature.

Syntax

[**no**] **dos-protection smurf**

Default Setting

Disabled

Command Mode

Global Configuration

Example

```
Console(config)#dos-protection smurf
Console(config)#
```

dos-protection tcp-flooding

This command protects against DoS TCP-flooding attacks in which a perpetrator sends a succession of TCP SYN requests (with or without a spoofed-Source IP) to a target and never returns ACK packets. These half-open connections will bind resources on the target, and no new connections can be made, resulting in a denial of service. Use the **no** form without the bit rate parameter to disable this feature, or with the bit rate parameter to restore the default rate limit.

Syntax

dos-protection tcp-flooding [**bit-rate-in-kilo** *rate*]

no dos-protection tcp-flooding [**bit-rate-in-kilo**]

rate – Maximum allowed rate. (Range: 64-2000 kbits/second)

Default Setting

Disabled, 1000 kbits/second

Command Mode

Global Configuration

Example

```
Console(config)#dos-protection tcp-flooding bit-rate-in-kilo 65
Console(config)#
```

dos-protection tcp-null-scan

This command protects against DoS TCP-null-scan attacks in which a TCP NULL scan message is used to identify listening TCP ports. The scan uses a series of strangely configured TCP packets which contain a sequence number of 0 and no flags. If the target's TCP port is closed, the target replies with a TCP RST (reset) packet. If the target TCP port is open, it simply discards the TCP NULL scan. Use the **no** form to disable this feature.

Syntax

[**no**] **dos-protection tcp-null-scan**

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

In these packets, all TCP flags are 0.

Example

```
Console(config)#dos-protection tcp-null-scan
Console(config)#
```

dos-protection tcp-syn-fin-scan

This command protects against DoS TCP-SYN/FIN-scan attacks in which a TCP SYN/FIN scan message is used to identify listening TCP ports. The scan uses a series of strangely configured TCP packets which contain SYN (synchronize) and FIN (finish) flags. If the target's TCP port is closed, the target replies with a TCP RST (reset) packet. If the target TCP port is open, it simply discards the TCP SYN FIN scan. Use the **no** form to disable this feature.

Syntax

[no] dos-protection tcp-syn-fin-scan

Default Setting

Disabled

Command Mode

Global Configuration

Example

```
Console(config)#dos-protection tcp-syn-fin-scan
Console(config)#
```

dos-protection tcp-udp-port-zero

This command protects against DoS attacks in which the TCP or UDP source port or destination port is set to zero. This technique may be used as a form of DoS attack, or it may just indicate a problem with the source device. When this command is enabled, the switch will drop these packets. Use the **no** form to restore the default setting.

Syntax

[no] dos-protection tcp-udp-port-zero

Default Setting

Disabled

Command Mode

Global Configuration

Example

```
Console(config)#dos-protection tcp-udp-port-zero
Console(config)#
```

dos-protection tcp-xmas-scan

This command protects against DoS TCP-xmas-scan in which a so-called TCP XMAS scan message is used to identify listening TCP ports. This scan uses a series of strangely configured TCP packets which contain a sequence number of 0 and the URG, PSH and FIN flags. If the target's TCP port is closed, the target replies with a TCP RST packet. If the target TCP port is open, it simply discards the TCP XMAS scan. Use the **no** form to disable this feature.

Syntax

[no] dos-protection tcp-xmas-scan

Default Setting

Disabled

Command Mode

Global Configuration

Example

```
Console(config)#dos-protection tcp-xmas-scan
Console(config)#
```

dos-protection udp-flooding

This command protects against DoS UDP-flooding attacks in which a perpetrator sends a large number of UDP packets (with or without a spoofed-Source IP) to random ports on a remote host. The target will determine that application is listening at that port, and reply with an ICMP Destination Unreachable packet. It will be forced to send many ICMP packets, eventually leading it to be unreachable by other clients. Use the **no** form without the bit rate parameter to disable this feature, or with the bit rate parameter to restore the default rate limit.

Syntax

dos-protection udp-flooding [bit-rate-in-kilo *rate*]

no dos-protection udp-flooding [bit-rate-in-kilo]

rate – Maximum allowed rate. (Range: 64-2000 kbits/second)

Default Setting

Disabled, 1000 kbits/second

Command Mode

Global Configuration

Example

```
Console(config)#dos-protection udp-flooding bit-rate-in-kilo 65
Console(config)#
```

dos-protection win-nuke

This command protects against DoS WinNuke attacks in which affected the Microsoft Windows 3.1x/95/NT operating systems. In this type of attack, the perpetrator sends the string of OOB out-of-band (OOB) packets contained a TCP URG flag to the target computer on TCP port 139 (NetBIOS), casing it to lock up and display a "Blue Screen of Death." This did not cause any damage to, or change data on, the computer's hard disk, but any unsaved data would be lost. Microsoft made patches to prevent the WinNuke attack, but the OOB packets still put the service in a tight loop that consumed all available CPU time. Use the **no** form without the bit rate parameter to disable this feature, or with the bit rate parameter to restore the default rate limit.

Syntax

dos-protection win-nuke [**bit-rate-in-kilo** *rate*]

no dos-protection win-nuke [**bit-rate-in-kilo**]

rate – Maximum allowed rate. (Range: 64-2000 kbits/second)

Default Setting

Disabled, 1000 kbits/second

Command Mode

Global Configuration

Example

```
Console(config)#dos-protection win-nuke bit-rate-in-kilo 65
Console(config)#
```

show dos-protection

This command shows the configuration settings for the DoS protection commands.

Command Mode

Privileged Exec

Example

```
Console#show dos-protection
Global DoS Protection:

 Echo/Chargen Attack         : Disabled, 1000 kilobits per second
 LAND Attack                 : Disabled
 Smurf Attack                : Enabled
 TCP Flooding Attack         : Disabled, 1000 kilobits per second
 TCP Null Scan               : Enabled
 TCP SYN/FIN Scan            : Enabled
 TCP/UDP Packets with Port 0 : Enabled
 TCP XMAS Scan               : Enabled
 UDP Flooding Attack         : Disabled, 1000 kilobits per second
 WinNuke Attack              : Disabled, 1000 kilobits per second
Console#
```

Port-based Traffic Segmentation

If tighter security is required for passing traffic from different clients through downlink ports on the local network and over uplink ports to the service provider, port-based traffic segmentation can be used to isolate traffic for individual clients.

Traffic belonging to each client is isolated to the allocated downlink ports. But the switch can be configured to either isolate traffic passing across a client's allocated uplink ports from the uplink ports assigned to other clients, or to forward traffic through the uplink ports used by other clients, allowing different clients to share access to their uplink ports where security is less likely to be compromised.

Table 55: Commands for Configuring Traffic Segmentation

Command	Function	Mode
traffic-segmentation	Enables traffic segmentation	GC
traffic-segmentation session	Creates a client session	GC
traffic-segmentation uplink/ downlink	Configures uplink/downlink ports for client sessions	GC
traffic-segmentation uplink-to-uplink	Specifies whether or not traffic can be forwarded between uplink ports assigned to different client sessions	GC
show traffic-segmentation	Displays the configured traffic segments	PE

traffic-segmentation

This command enables traffic segmentation. Use the **no** form to disable traffic segmentation.

Syntax

[no] traffic-segmentation

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- Traffic segmentation provides port-based security and isolation between ports within the VLAN. Data traffic on the downlink ports can only be forwarded to, and from, the designated uplink port(s). Data cannot pass between downlink ports in the same segmented group, nor to ports which do not belong to the same group.

- Traffic segmentation and normal VLANs can exist simultaneously within the same switch. Traffic may pass freely between uplink ports in segmented groups and ports in normal VLANs.

- When traffic segmentation is enabled, the forwarding state for the uplink and downlink ports assigned to different client sessions is shown below.

Table 56: Traffic Segmentation Forwarding

Destination Source	Session #1 Downlinks	Session #1 Uplinks	Session #2 Downlinks	Session #2 Uplinks	Normal Ports
Session #1 Downlink Ports	Blocking	Forwarding	Blocking	Blocking	Blocking
Session #1 Uplink Ports	Forwarding	Forwarding	Blocking	Blocking/ Forwarding*	Forwarding
Session #2 Downlink Ports	Blocking	Blocking	Blocking	Forwarding	Blocking
Session #2 Uplink Ports	Blocking	Blocking/ Forwarding*	Forwarding	Forwarding	Forwarding
Normal Ports	Forwarding	Forwarding	Forwarding	Forwarding	Forwarding

* The forwarding state for uplink-to-uplink ports is configured by the traffic-segmentation uplink-to-uplink command.

- When traffic segmentation is disabled, all ports operate in normal forwarding mode based on the settings specified by other functions such as VLANs and spanning tree protocol.
- Enter the **traffic-segmentation** command without any parameters to enable traffic segmentation. Then set the interface members for segmented groups using the traffic-segmentation uplink/downlink command.
- Enter **no traffic-segmentation** to disable traffic segmentation.

Example

This example enables traffic segmentation globally on the switch.

```
Console(config)#traffic-segmentation
Console(config)#
```

traffic-segmentation session

This command creates a traffic-segmentation client session. Use the **no** form to remove a client session.

Syntax

[**no**] **traffic-segmentation session** *session-id*

session-id – Traffic segmentation session. (Range: 1-4)

Default Setting

None

Command Mode
Global Configuration

Command Usage
- Use this command to create a new traffic-segmentation client session.
- Using the **no** form of this command will remove any assigned uplink or downlink ports, restoring these interfaces to normal operating mode.

Example
```
Console(config)#traffic-segmentation session 1
Console(config)#
```

traffic-segmentation uplink/downlink

This command configures the uplink and down-link ports for a segmented group of ports. Use the **no** form to remove a port from the segmented group.

Syntax
[**no**] **traffic-segmentation** [**session** *session-id*] {**uplink** *interface-list* [**downlink** *interface-list*] | **downlink** *interface-list*}

session-id – Traffic segmentation session. (Range: 1-4)

uplink – Specifies an uplink interface.

downlink – Specifies a downlink interface.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
Session 1 if not defined
No segmented port groups are defined.

Command Mode
Global Configuration

Command Usage
- A port cannot be configured in both an uplink and downlink list.
- A port can only be assigned to one traffic-segmentation session.
- When specifying an uplink or downlink, a list of ports may be entered by using a hyphen or comma in the *port* field. Note that lists are not supported for the *channel-id* field.

- A downlink port can only communicate with an uplink port in the same session. Therefore, if an uplink port is not configured for a session, the assigned downlink ports will not be able to communicate with any other ports.
- If a downlink port is not configured for the session, the assigned uplink ports will operate as normal ports.

Example

This example enables traffic segmentation, and then sets port 10 as the uplink and ports 5-8 as downlinks.

```
Console(config)#traffic-segmentation
Console(config)#traffic-segmentation uplink ethernet 1/10
  downlink ethernet 1/5-8
Console(config)#
```

traffic-segmentation uplink-to-uplink

This command specifies whether or not traffic can be forwarded between uplink ports assigned to different client sessions, or between uplink ports assigned to the same session. Use the **no** form to restore the default.

Syntax

traffic-segmentation [**session** *session-id*] **uplink-to-uplink** {**blocking** | **forwarding**}

no traffic-segmentation uplink-to-uplink

session-id – Traffic segmentation session. (Range: 1-4)

blocking – Blocks traffic between uplink ports.

forwarding – Forwards traffic between uplink ports.

Default Setting

Blocking if session-id is not defined
Forwarding if session-id is defined

Command Mode

Global Configuration

Example

This example enables forwarding of traffic between uplink ports.

```
Console(config)#traffic-segmentation uplink-to-uplink forwarding
Console(config)#
```

show traffic-segmentation

This command displays the configured traffic segments.

Syntax

show traffic-segmentation [**session** *session-id*]

session-id – Traffic segmentation session. (Range: 1-4)

Command Mode

Privileged Exec

Example

```
Console#show traffic-segmentation session 1

  Traffic segmentation Status :            Enabled
  Uplink-to-Uplink Mode       :            Forwarding

 Session   Uplink Ports                   Downlink Ports
--------- ------------------------------ ------------------------------
    1      Ethernet  1/1                 Ethernet  1/2
                                         Ethernet  1/3
                                         Ethernet  1/4
Console#
```

11 Access Control Lists

Access Control Lists (ACL) provide packet filtering for IPv4 frames (based on address, protocol, Layer 4 protocol port number or TCP control code), IPv6 frames (based on address, DSCP traffic class, or next header type), or any frames (based on MAC address or Ethernet type). To filter packets, first create an access list, add the required rules, and then bind the list to a specific port. This section describes the Access Control List commands.

Table 57: Access Control List Commands

Command Group	Function
IPv4 ACLs	Configures ACLs based on IPv4 addresses, TCP/UDP port number, protocol type, and TCP control code
IPv6 ACLs	Configures ACLs based on IPv6 addresses, DSCP traffic class, or next header type
MAC ACLs	Configures ACLs based on hardware addresses, packet format, and Ethernet type
ARP ACLs	Configures ACLs based on ARP messages addresses
ACL Information	Displays ACLs and associated rules; shows ACLs assigned to each port

IPv4 ACLs

The commands in this section configure ACLs based on IPv4 addresses, TCP/UDP port number, protocol type, and TCP control code. To configure IPv4 ACLs, first create an access list containing the required permit or deny rules, and then bind the access list to one or more ports.

Table 58: IPv4 ACL Commands

Command	Function	Mode
access-list ip	Creates an IP ACL and enters configuration mode for standard or extended IPv4 ACLs	GC
permit, deny	Filters packets matching a specified source IPv4 address	IPv4-STD-ACL
permit, deny	Filters packets meeting the specified criteria, including source and destination IPv4 address, TCP/UDP port number, protocol type, and TCP control code	IPv4-EXT-ACL
ip access-group	Binds an IPv4 ACL to a port	IC
show ip access-group	Shows port assignments for IPv4 ACLs	PE
show ip access-list	Displays the rules for configured IPv4 ACLs	PE

access-list ip

This command adds an IP access list and enters configuration mode for standard or extended IPv4 ACLs. Use the **no** form to remove the specified ACL.

Syntax

[**no**] **access-list ip** {**standard** | **extended**} *acl-name*

standard – Specifies an ACL that filters packets based on the source IP address.

extended – Specifies an ACL that filters packets based on the source or destination IP address, and other more specific criteria.

acl-name – Name of the ACL. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- When you create a new ACL or enter configuration mode for an existing ACL, use the **permit** or **deny** command to add new rules to the bottom of the list.
- To remove a rule, use the **no permit** or **no deny** command followed by the exact text of a previously configured rule.
- An ACL can contain up to 1K rules.

Example

```
Console(config)#access-list ip standard david
Console(config-std-acl)#
```

permit, deny (Standard IP ACL)

This command adds a rule to a Standard IPv4 ACL. The rule sets a filter condition for packets emanating from the specified source. Use the **no** form to remove a rule.

Syntax

{**permit** | **deny**} {**any** | *source bitmask* | **host** *source*}
[**time-range** *time-range-name*]

no {**permit** | **deny**} {**any** | *source bitmask* | **host** *source*}

any – Any source IP address.

source – Source IP address.

bitmask – Dotted decimal number representing the address bits to match.

host – Keyword followed by a specific IP address.

time-range-name - Name of the time range. (Range: 1-32 characters)

Default Setting
None

Command Mode
Standard IPv4 ACL

Command Usage
- New rules are appended to the end of the list.
- Address bit masks are similar to a subnet mask, containing four integers from 0 to 255, each separated by a period. The binary mask uses 1 bits to indicate "match" and 0 bits to indicate "ignore." The bitmask is bitwise ANDed with the specified source IP address, and then compared with the address for each IP packet entering the port(s) to which this ACL has been assigned.

Example
This example configures one permit rule for the specific address 10.1.1.21 and another rule for the address range 168.92.16.x – 168.92.31.x using a bitmask.

```
Console(config-std-acl)#permit host 10.1.1.21
Console(config-std-acl)#permit 168.92.16.0 255.255.240.0
Console(config-std-acl)#
```

permit, deny (Extended IPv4 ACL)

This command adds a rule to an Extended IPv4 ACL. The rule sets a filter condition for packets with specific source or destination IP addresses, protocol types, source or destination protocol ports, or TCP control codes. Use the **no** form to remove a rule.

Syntax

{permit | deny} [*protocol-number*]
{any | *source address-bitmask* | **host** *source}*
{any | *destination address-bitmask* | **host** *destination}*
[**precedence** *precedence*] [**dscp** *dscp*]
[**time-range** *time-range-name*]

no {permit | deny} [*protocol-number*]
{any | *source address-bitmask* | **host** *source}*
{any | *destination address-bitmask* | **host** *destination}*
[**precedence** *precedence*] [**dscp** *dscp*]
[**source-port** *sport* [*bitmask*]]
[**destination-port** *dport* [*port-bitmask*]]

{permit | deny} [**icmp** | **tcp | udp**]
{any | *source address-bitmask* | **host** *source}*
{any | *destination address-bitmask* | **host** *destination}*
[**precedence** *precedence*] [**dscp** *dscp*]
[**source-port** *sport* [*bitmask*]]
[**destination-port** *dport* [*port-bitmask*]]

[**icmp-type** *icmp-type*]
[**control-flag** *control-flags flag-bitmask*]
[**time-range** *time-range-name*]

no {**permit** | **deny**} [**icmp** | **tcp** | **udp**]
{**any** | *source address-bitmask* | **host** *source*}
{**any** | *destination address-bitmask* | **host** *destination*}
[**precedence** *precedence*] [**dscp** *dscp*]
[**source-port** *sport* [*bitmask*]]
[**destination-port** *dport* [*port-bitmask*]]
[**icmp-type** *icmp-type*]
[**control-flag** *control-flags flag-bitmask*]

protocol-number – A specific protocol number. (Range: 0-255)

source – Source IP address.

destination – Destination IP address.

address-bitmask – Decimal number representing the address bits to match.

host – Keyword followed by a specific IP address.

dscp – DSCP priority level. (Range: 0-63)

precedence – IP precedence level. (Range: 0-7)

sport – Protocol[2] source port number. (Range: 0-65535)

dport – Protocol[2] destination port number. (Range: 0-65535)

port-bitmask – Decimal number representing the port bits to match. (Range: 0-65535)

icmp-type – The ICMP protocol number. (Range: 0-255)

control-flags – Decimal number (representing a bit string) that specifies flag bits in byte 14 of the TCP header. (Range: 0-63)

flag-bitmask – Decimal number representing the code bits to match.

time-range-name - Name of the time range. (Range: 1-32 characters)

Default Setting
None

Command Mode
Extended IPv4 ACL

Command Usage
- All new rules are appended to the end of the list.
- Address bit masks are similar to a subnet mask, containing four integers from 0 to 255, each separated by a period. The binary mask uses 1 bits to indicate "match" and 0 bits to indicate "ignore." The bit mask is bitwise ANDed with the

2. Includes TCP, UDP or other protocol types.

specified source IP address, and then compared with the address for each IP packet entering the port(s) to which this ACL has been assigned.

- The control-code bitmask is a decimal number (representing an equivalent bit mask) that is applied to the control code. Enter a decimal number, where the equivalent binary bit "1" means to match a bit and "0" means to ignore a bit. The following bits may be specified:
  - 1 (fin) – Finish
  - 2 (syn) – Synchronize
  - 4 (rst) – Reset
  - 8 (psh) – Push
  - 16 (ack) – Acknowledgement
  - 32 (urg) – Urgent pointer

  For example, use the code value and mask below to catch packets with the following flags set:
  - SYN flag valid, use "control-code 2 2"
  - Both SYN and ACK valid, use "control-code 18 18"
  - SYN valid and ACK invalid, use "control-code 2 18"
- If an Extended IPv4 rule and MAC rule match the same packet, and these rules specify a "permit" entry and "deny" entry, the "deny" action takes precedence.

Example

This example accepts any incoming packets if the source address is within subnet 10.7.1.x. For example, if the rule is matched; i.e., the rule (10.7.1.0 & 255.255.255.0) equals the masked address (10.7.1.2 & 255.255.255.0), the packet passes through.

```
Console(config-ext-acl)#permit 10.7.1.1 255.255.255.0 any
Console(config-ext-acl)#
```

This allows TCP packets from class C addresses 192.168.1.0 to any destination address when set for destination TCP port 80 (i.e., HTTP).

```
Console(config-ext-acl)#permit tcp 192.168.1.0 255.255.255.0 any destination-
  port 80
Console(config-ext-acl)#
```

This permits all TCP packets from class C addresses 192.168.1.0 with the TCP control code set to "SYN."

```
Console(config-ext-acl)#permit tcp 192.168.1.0 255.255.255.0 any control-
  flag 2 2
Console(config-ext-acl)#
```

ip access-group

This command binds an IPv4 ACL to a port. Use the **no** form to remove the port.

Syntax

ip access-group *acl-name* {**in** | **out**}
[**time-range** *time-range-name*] [**counter**]

no ip access-group *acl-name* **in**

acl-name – Name of the ACL. (Maximum length: 32 characters)

in – Indicates that this list applies to ingress packets.

out – Indicates that this list applies to egress packets.

time-range-name - Name of the time range. (Range: 1-32 characters)

counter – Enables counter for ACL statistics.

Default Setting

None

Command Mode

Interface Configuration (Ethernet)

Command Usage

If an ACL is already bound to a port and you bind a different ACL to it, the switch will replace the old binding with the new one.

Example

```
Console(config)#int eth 1/2
Console(config-if)#ip access-group david in
Console(config-if)#
```

show ip access-group

This command shows the ports assigned to IP ACLs.

Command Mode

Privileged Exec

Example

```
Console#show ip access-group
Interface ethernet 1/2
 IP access-list david in
Console#
```

show ip access-list

This command displays the rules for configured IPv4 ACLs.

Syntax

show ip access-list {**standard** | **extended**} [*acl-name*]

standard – Specifies a standard IP ACL.

extended – Specifies an extended IP ACL.

acl-name – Name of the ACL. (Maximum length: 32 characters)

Command Mode

Privileged Exec

Example

```
Console#show ip access-list standard
IP standard access-list david:
  permit host 10.1.1.21
  permit 168.92.0.0 255.255.15.0
Console#
```

IPv6 ACLs

The commands in this section configure ACLs based on IPv6 addresses, DSCP traffic class, or next header type. To configure IPv6 ACLs, first create an access list containing the required permit or deny rules, and then bind the access list to one or more ports.

Table 59: IPv6 ACL Commands

Command	Function	Mode
access-list ipv6	Creates an IPv6 ACL and enters configuration mode for standard or extended IPv6 ACLs	GC
permit, deny	Filters packets matching a specified source IPv6 address	IPv6- STD-ACL
permit, deny	Filters packets meeting the specified criteria, including source or destination IPv6 address, DSCP traffic class, or next header type	IPv6- EXT-ACL
ipv6 access-group	Binds an IPv6 ACL to a port	IC
show ipv6 access-group	Shows port assignments for IPv6 ACLs	PE
show ipv6 access-list	Displays the rules for configured IPv6 ACLs	PE

access-list ipv6

This command adds an IP access list and enters configuration mode for standard or extended IPv6 ACLs. Use the **no** form to remove the specified ACL.

Syntax

[no] **access-list ipv6** {**standard** | **extended**} *acl-name*

standard – Specifies an ACL that filters packets based on the source IP address.

extended – Specifies an ACL that filters packets based on the destination IP address, and other more specific criteria.

acl-name – Name of the ACL. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- When you create a new ACL or enter configuration mode for an existing ACL, use the **permit** or **deny** command to add new rules to the bottom of the list. To create an ACL, you must add at least one rule to the list.
- To remove a rule, use the **no permit** or **no deny** command followed by the exact text of a previously configured rule.
- An ACL can contain up to 64 rules.

Example

```
Console(config)#access-list ipv6 standard david
Console(config-std-ipv6-acl)#
```

permit, deny (Standard IPv6 ACL)

This command adds a rule to a Standard IPv6 ACL. The rule sets a filter condition for packets emanating from the specified source. Use the **no** form to remove a rule.

Syntax

{**permit** | **deny**} {**any** | **host** *source-ipv6-address* | *source-ipv6-address*[*/prefix-length*]}
[**time-range** *time-range-name*]

no {**permit** | **deny**} {**any** | **host** *source-ipv6-address* | *source-ipv6-address*[*/prefix-length*]}

any – Any source IP address.

host – Keyword followed by a specific IP address.

source-ipv6-address - An IPv6 source address or network class. The address must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

prefix-length - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix; i.e., the network portion of the address. (Range: 0-128)

time-range-name - Name of the time range. (Range: 1-32 characters)

Default Setting
None

Command Mode
Standard IPv6 ACL

Command Usage
New rules are appended to the end of the list.

Example
This example configures one permit rule for the specific address 2009:DB9:2229::79 and another rule for the addresses with the network prefix 2009:DB9:2229:5::/64.

```
Console(config-std-ipv6-acl)#permit host 2009:DB9:2229::79
Console(config-std-ipv6-acl)#permit 2009:DB9:2229:5::/64
Console(config-std-ipv6-acl)#
```

permit, deny (Extended IPv6 ACL)

This command adds a rule to an Extended IPv6 ACL. The rule sets a filter condition for packets with specific source or destination IP addresses, or next header type. Use the **no** form to remove a rule.

Syntax

{**permit** | **deny**} [*next-header* | **icmp** | **tcp** | **udp**]
{**any** | **host** *source-ipv6-address* | *source-ipv6-address*[*/prefix-length*]}
{**any** | *destination-ipv6-address*[*/prefix-length*]}
[**next-header** *next-header* [[**source-port** *sport* [*bitmask*]] | [**destination-port** *dport* [*port-bitmask*]] | [**time-range** *time-range-name*] | [**dscp** *dscp*]]
[**icmp-type** *icmp-type*}
[**time-range** *time-range-name*]
[**dscp** *dscp*]

no {**permit** | **deny**} [*next-header* | **icmp** | **tcp** | **udp**]
{**any** | **host** *source-ipv6-address* | *source-ipv6-address*[*/prefix-length*]}
{**any** | *destination-ipv6-address*[*/prefix-length*]}
[**next-header** *next-header* [[**source-port** *sport* [*bitmask*]] | [**destination-port** *dport* [*port-bitmask*]] | [**time-range** *time-range-name*] | [**dscp** *dscp*]]
[**icmp-type** *icmp-type*}
[**time-range** *time-range-name*]
[**dscp** *dscp*]

next-header - The type of header immediately following the IPv6 header. (Range: 0-255)

icmp – Specifies the next header as ICMP.

tcp – Specifies the next header as TCP.

udp – Specifies the next header as UDP.

any – Any IP address (an abbreviation for the IPv6 prefix ::/0).

host – Keyword followed by a specific source IP address.

source-ipv6-address - An IPv6 source address or network class. The address must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

destination-ipv6-address - An IPv6 destination address or network class. The address must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields. (The switch only checks the first 128 bits of the destination address.)

prefix-length - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix; i.e., the network portion of the address. (Range: 0-128 for source prefix, 0-128 for destination prefix)

dscp – DSCP traffic class. (Range: 0-63)

next-header – Identifies the type of header immediately following the IPv6 header. (Range: 0-255)

sport – Protocol[3] source port number. (Range: 0-65535)

dport – Protocol[2] destination port number. (Range: 0-65535)

port-bitmask – Decimal number representing the port bits to match. (Range: 0-65535)

icmp-type – The ICMP protocol number. (Range: 0-255)

time-range-name - Name of the time range. (Range: 1-32 characters)

Default Setting
None

Command Mode
Extended IPv6 ACL

Command Usage
- All new rules are appended to the end of the list.
- Optional internet-layer information is encoded in separate headers that may be placed between the IPv6 header and the upper-layer header in a packet. There are a small number of such extension headers, each identified by a distinct Next Header value. IPv6 supports the values defined for the IPv4 Protocol field in RFC 1700, including these commonly used headers:

0	: Hop-by-Hop Options	(RFC 2460)
6	: TCP Upper-layer Header	(RFC 1700)
17	: UDP Upper-layer Header	(RFC 1700)
43	: Routing	(RFC 2460)
44	: Fragment	(RFC 2460)
51	: Authentication	(RFC 2402)
50	: Encapsulating Security Payload	(RFC 2406)
60	: Destination Options	(RFC 2460)

Example
This example accepts any incoming packets if the destination address is 2009:DB9:2229::79/8.

```
Console(config-ext-ipv6-acl)#permit any 2009:db90:2229::79/8
Console(config-ext-ipv6-acl)#
```

This allows packets to any destination address when the DSCP value is 5.

```
Console(config-ext-ipv6-acl)#permit any any dscp 5
Console(config-ext-ipv6-acl)#
```

3. Includes TCP and UDP.

This allows any packets sent from any source to any destination when the next header is 43."

```
Console(config-ext-ipv6-acl)#permit any any next-header 43
Console(config-ext-ipv6-acl)#
```

ipv6 access-group

This command binds an IPv6 ACL to a port. Use the **no** form to remove the port.

Syntax

ipv6 access-group *acl-name* {**in** | **out**}
[**time-range** *time-range-name*] [**counter**]

no ipv6 access-group *acl-name* {**in** | **out**}

acl-name – Name of the ACL. (Maximum length: 32 characters)

in – Indicates that this list applies to ingress packets.

out – Indicates that this list applies to egress packets.

time-range-name - Name of the time range. (Range: 1-32 characters)

counter – Enables counter for ACL statistics.

Default Setting

None

Command Mode

Interface Configuration (Ethernet)

Command Usage

If a port is already bound to an ACL and you bind it to a different ACL, the switch will replace the old binding with the new one.

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#ipv6 access-group standard david in
Console(config-if)#
```

show ipv6 access-group

This command shows the ports assigned to IPv6 ACLs.

Command Mode

Privileged Exec

Example

```
Console#show ipv6 access-group
Interface ethernet 1/2
```

```
 IPv6 standard access-list david in
Console#
```

show ipv6 access-list

This command displays the rules for configured IPv6 ACLs.

Syntax

show ipv6 access-list {**standard** | **extended**} [*acl-name*]

standard – Specifies a standard IPv6 ACL.

extended – Specifies an extended IPv6 ACL.

acl-name – Name of the ACL. (Maximum length: 32 characters)

Command Mode

Privileged Exec

Example

```
Console#show ipv6 access-list standard
IPv6 standard access-list david:
  permit host 2009:DB9:2229::79
  permit 2009:DB9:2229:5::/64
Console#
```

MAC ACLs

The commands in this section configure ACLs based on hardware addresses, packet format, and Ethernet type. The ACLs can further specify optional IP and IPv6 addresses including protocol type and upper layer ports. To configure MAC ACLs, first create an access list containing the required permit or deny rules, and then bind the access list to one or more ports.

Table 60: MAC ACL Commands

Command	Function	Mode
access-list mac	Creates a MAC ACL and enters configuration mode	GC
permit, deny	Filters packets matching a specified source and destination address, packet format, and Ethernet type. They can be further specified using optional IP and IPv6 addresses including protocol type and upper layer ports.	MAC-ACL
mac access-group	Binds a MAC ACL to a port	IC
show mac access-group	Shows port assignments for MAC ACLs	PE
show mac access-list	Displays the rules for configured MAC ACLs	PE

access-list mac

This command enters MAC ACL configuration mode. Rules can be added to filter packets matching a specified MAC source or destination address (i.e., physical layer address), or Ethernet protocol type. Rules can also be used to filter packets based on IPv4/v6 addresses, including Layer 4 ports and protocol types. Use the **no** form to remove the specified ACL.

Syntax

[**no**] **access-list mac** *acl-name*

acl-name – Name of the ACL. (Maximum length: 32 characters,)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- When you create a new ACL or enter configuration mode for an existing ACL, use the **permit** or **deny** command to add new rules to the bottom of the list.
- To remove a rule, use the **no permit** or **no deny** command followed by the exact text of a previously configured rule.
- An ACL can contain up to 2048 rules.

Example

```
Console(config)#access-list mac jerry
Console(config-mac-acl)#
```

permit, deny (MAC ACL)

This command adds a rule to a MAC ACL. The rule filters packets matching a specified MAC source or destination address (i.e., physical layer address), or Ethernet protocol type. Rules can also filter packets based on IPv4/v6 addresses, including Layer 4 ports and protocol types. Use the **no** form to remove a rule.

Syntax

{**permit** | **deny**}
{**any** | **host** *source* | *source addres*}
{**any** | **host** *destination* | *destination address*}
[**ip** {**any** | **host** *source-ip* | *source-ip network-mask*}
{**any** | **host** *destination-ip* | *destination-ip network-mask*}]
[**ipv6** {**any** | **host** *source-ipv6* | *source-ipv6/prefix-length*}
{**any** | **host** *destination-ipv6* | *destination-ipv6/prefix-length*}]
[**cos** *cos cos-bitmask*]

[vid *vid vid-bitmask*]
[ethertype *ethertype* [*ethertype-bitmask*]]
[protocol *protocol*]
[l4-source-port *sport* [*port-bitmask*]]
[l4-destination-port *dport* [*port-bitmask*]]
[time-range *time-range-name*]

no {permit | deny}
{any | host *source* | *source address*}
{any | host *destination* | *destination address*}
[ip {any | host *source-ip* | *source-ip network-mask*}
{any | host *destination-ip* | *destination-ip network-mask*}]
[ipv6 {any | host *source-ipv6* | *source-ipv6/prefix-length*}
{any | host *destination-ipv6* | *destination-ipv6/prefix-length*}]
[cos *cos cos-bitmask*]
[vid *vid vid-bitmask*]
[ethertype *ethertype* [*ethertype-bitmask*]]
[protocol *protocol*]
[l4-source-port *sport* [*port-bitmask*]]
[l4-destination-port *dport* [*port-bitmask*]]

Note: The default is for Ethernet II packets.

{permit | deny} tagged-eth2
{any | host *source* | *source address*}
{any | host *destination* | *destination address*}
[ip {any | host *source-ip* | *source-ip network-mask*}
{any | host *destination-ip* | *destination-ip network-mask*}]
[ipv6 {any | host *source-ipv6* | *source-ipv6/prefix-length*}
{any | host *destination-ipv6* | *destination-ipv6/prefix-length*}]
[cos *cos cos-bitmask*] [vid *vid vid-bitmask*]
[ethertype *ethertype* [*ethertype-bitmask*]]
[protocol *protocol*]
[l4-source-port *sport* [*port-bitmask*]]
[l4-destination-port *dport* [*port-bitmask*]]
[time-range *time-range-name*]

no {permit | deny} tagged-eth2
{any | host *source* | *source address*}
{any | host *destination* | *destination address*}
[ip {any | host *source-ip* | *source-ip network-mask*}
{any | host *destination-ip* | *destination-ip network-mask*}]
[ipv6 {any | host *source-ipv6* | *source-ipv6/prefix-length*}
{any | host *destination-ipv6* | *destination-ipv6/prefix-length*}]
[cos *cos cos-bitmask*] [vid *vid vid-bitmask*]
[ethertype *ethertype* [*ethertype-bitmask*]]
[protocol *protocol*]
[l4-source-port *sport* [*port-bitmask*]]
[l4-destination-port *dport* [*port-bitmask*]]

{permit | deny} untagged-eth2
{any | host *source* | *source address*}
{any | host *destination* | *destination address*}
[ip {any | host *source-ip* | *source-ip network-mask*}
{any | host *destination-ip* | *destination-ip network-mask*}]
[ipv6 {any | host *source-ipv6* | *source-ipv6/prefix-length*}
{any | host *destination-ipv6* | *destination-ipv6/prefix-length*}]
[ethertype *ethertype* [*ethertype-bitmask*]]
[protocol *protocol*]
[l4-source-port *sport* [*port-bitmask*]]
[l4-destination-port *dport* [*port-bitmask*]]
[time-range *time-range-name*]

no {permit | deny} untagged-eth2
{any | host *source* | *source address*}
{any | host *destination* | *destination address*}
[ip {any | host *source-ip* | *source-ip network-mask*}
{any | host *destination-ip* | *destination-ip network-mask*}]
[ipv6 {any | host *source-ipv6* | *source-ipv6/prefix-length*}
{any | host *destination-ipv6* | *destination-ipv6/prefix-length*}]
[ethertype *ethertype* [*ethertype-bitmask*]]
[protocol *protocol*]
[l4-source-port *sport* [*port-bitmask*]]
[l4-destination-port *dport* [*port-bitmask*]]

{permit | deny} tagged-802.3
{any | host *source* | *source address*}
{any | host *destination* | *destination address*}
[cos *cos cos-bitmask*] [vid *vid vid-bitmask*]
[time-range *time-range-name*]

no {permit | deny} tagged-802.3
{any | host *source* | *source address*}
{any | host *destination* | *destination address*}
[cos *cos cos-bitmask*] [vid *vid vid-bitmask*]

{permit | deny} untagged-802.3
{any | host *source* | *source address*}
{any | host *destination* | *destination address*}
[time-range *time-range-name*]

no {permit | deny} untagged-802.3
{any | host *source* | *source address*}
{any | host *destination* | *destination address*}

tagged-eth2 – Tagged Ethernet II packets.

untagged-eth2 – Untagged Ethernet II packets.

tagged-802.3 – Tagged Ethernet 802.3 packets.

untagged-802.3 – Untagged Ethernet 802.3 packets.

any – Any MAC, IPv4 or IPv6 source or destination address.

host – A specific MAC, IPv4 or IPv6 address.

source – Source MAC, IPv4 or IPv6 address.

destination – Destination MAC, IPv4 or IPv6 address.

network-mask – Network mask for IP subnet. This mask identifies the host address bits used for routing to specific subnets.

prefix-length - Length of IPv6 prefix. A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix; i.e., the network portion of the address. (Range: 0-128)

cos – Class-of-Service value (Range: 0-7)

cos-bitmask[4] – Class-of-Service bitmask. (Range: 0-7)

vid – VLAN ID. (Range: 1-4094)

vid-bitmask[4] – VLAN bitmask. (Range: 1-4095)

ethertype – A specific Ethernet protocol number. (Range: 0-ffff hex)

ethertype-bitmask[4] – Protocol bitmask. (Range: 0-ffff hex)

protocol - IP protocol or IPv6 next header. (Range: 0-255)
For information on next headers, see permit, deny (Extended IPv6 ACL).

sport[5] – Protocol source port number. (Range: 0-65535)

dport[5] – Protocol destination port number. (Range: 0-65535)

port-bitmask – Decimal number representing the port bits to match. (Range: 0-65535)

time-range-name - Name of the time range. (Range: 1-32 characters)

Default Setting
None

Command Mode
MAC ACL

Command Usage
- New rules are added to the end of the list.
- The **ethertype** option can only be used to filter Ethernet II formatted packets.
- A detailed listing of Ethernet protocol types can be found in RFC 1060. A few of the more common types include the following:
  - 0800 - IP
  - 0806 - ARP
  - 8137 - IPX
- If an Extended IPv4 rule and MAC rule match the same packet, and these rules specify a "permit" entry and "deny" entry, the "deny" action takes precedence.

4. For all bitmasks, "1" means relevant and "0" means ignore.
5. Includes TCP, UDP or other protocol types.

Example

This rule permits packets from any source MAC address to the destination address 00-e0-29-94-34-de where the Ethernet type is 0800.

```
Console(config-mac-acl)#permit any host 00-e0-29-94-34-de ethertype 0800
Console(config-mac-acl)#
```

mac access-group

This command binds a MAC ACL to a port. Use the **no** form to remove the port.

Syntax

mac access-group *acl-name* {**in** | **out**}
[**time-range** *time-range-name*] [**counter**]

no mac access-group *acl-name* {**in** | **out**}

acl-name – Name of the ACL. (Maximum length: 32 characters)

in – Indicates that this list applies to ingress packets.

out – Indicates that this list applies to egress packets.

time-range-name - Name of the time range. (Range: 1-32 characters)

counter – Enables counter for ACL statistics.

Default Setting

None

Command Mode

Interface Configuration (Ethernet)

Command Usage

If an ACL is already bound to a port and you bind a different ACL to it, the switch will replace the old binding with the new one.

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#mac access-group jerry in
Console(config-if)#
```

show mac access-group

This command shows the ports assigned to MAC ACLs.

Command Mode

Privileged Exec

Example

```
Console#show mac access-group
Interface ethernet 1/5
 MAC access-list M5 in
Console#
```

show mac access-list

This command displays the rules for configured MAC ACLs.

Syntax

show mac access-list [*acl-name*]

acl-name – Name of the ACL. (Maximum length: 32 characters)

Command Mode

Privileged Exec

Example

```
Console#show mac access-list
MAC access-list jerry:
  permit any 00-e0-29-94-34-de ethertype 0800
Console#
```

ARP ACLs

The commands in this section configure ACLs based on the IP or MAC address contained in ARP request and reply messages. To configure ARP ACLs, first create an access list containing the required permit or deny rules, and then bind the access list to one or more VLANs using the ip arp inspection vlan command.

Table 61: ARP ACL Commands

Command	Function	Mode
access-list arp	Creates a ARP ACL and enters configuration mode	GC
permit, deny	Filters packets matching a specified source or destination address in ARP messages	ARP-ACL
show access-list arp	Displays the rules for configured ARP ACLs	PE

access-list arp

This command adds an ARP access list and enters ARP ACL configuration mode. Use the **no** form to remove the specified ACL.

Syntax

[no] **access-list arp** *acl-name*

acl-name – Name of the ACL. (Maximum length: 32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- When you create a new ACL or enter configuration mode for an existing ACL, use the **permit** or **deny** command to add new rules to the bottom of the list. To create an ACL, you must add at least one rule to the list.
- To remove a rule, use the **no permit** or **no deny** command followed by the exact text of a previously configured rule.
- An ACL can contain up to 128 rules.

Example

```
Console(config)#access-list arp factory
Console(config-arp-acl)#
```

permit, deny (ARP ACL)

This command adds a rule to an ARP ACL. The rule filters packets matching a specified source or destination address in ARP messages. Use the **no** form to remove a rule.

Syntax

[no] {**permit** | **deny**}
ip {**any** | **host** *source-ip* | *source-ip ip-address-bitmask*}
{**any** | **host** *destination-ip* | *destination-ip ip-address-bitmask*}
mac {**any** | **host** *source-mac* | *source-mac mac-address-bitmask*}
[**any** | **host** *destination-mac* | *destination-mac mac-address-bitmask*] [**log**]

This form indicates either request or response packets.

[no] {**permit** | **deny**} **request**
ip {**any** | **host** *source-ip* | *source-ip ip-address-bitmask*}
{**any** | **host** *destination-ip* | *destination-ip ip-address-bitmask*}
mac {**any** | **host** *source-mac* | *source-mac mac-address-bitmask*}
[**any** | **host** *destination-mac* | *destination-mac mac-address-bitmask*] [**log**]

[no] {**permit** | **deny**} **response**
ip {**any** | **host** *source-ip* | *source-ip ip-address-bitmask*}
{**any** | **host** *destination-ip* | *destination-ip ip-address-bitmask*}
mac {**any** | **host** *source-mac* | *source-mac mac-address-bitmask*}
[**any** | **host** *destination-mac* | *destination-mac mac-address-bitmask*] [**log**]

source-ip – Source IP address.

destination-ip – Destination IP address with bitmask.

ip-address-bitmask[6] – IPv4 number representing the address bits to match.

source-mac – Source MAC address.

destination-mac – Destination MAC address range with bitmask.

mac-address-bitmask[6] – Bitmask for MAC address (in hexadecimal format).

log - Logs a packet when it matches the access control entry.

Default Setting

None

Command Mode

ARP ACL

Command Usage

New rules are added to the end of the list.

6. For all bitmasks, binary "1" means relevant and "0" means ignore.

Example

This rule permits packets from any source IP and MAC address to the destination subnet address 192.168.0.0.

```
Console(config-arp-acl)#$permit response ip any 192.168.0.0 255.255.0.0 mac
  any any
Console(config-arp-acl)#
```

show access-list arp

This command displays the rules for configured ARP ACLs.

Syntax

show access-list arp [*acl-name*]

acl-name – Name of the ACL. (Maximum length: 32 characters)

Command Mode

Privileged Exec

Example

```
Console#show access-list arp
ARP access-list factory:
  permit response ip any 192.168.0.0 255.255.0.0 mac any any
Console#
```

ACL Information

This section describes commands used to display ACL information.

Table 62: ACL Information Commands

Command	Function	Mode
clear access-list hardware counters	Clears hit counter for rules in all ACLs, or in a specified ACL	PE
show access-group	Shows the ACLs assigned to each port	PE
show access-list	Show all ACLs and associated rules	PE

clear access-list hardware counters

This command clears the hit counter for the rules in all ACLs, or for the rules in a specified ACL.

Syntax

clear access-list hardware counters
[**direction in** [**interface** *interface*]] |
[**interface** *interface*] | [**name** *acl-name*[**direction in**]]

in – Clears counter for ingress rules.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

acl-name – Name of the ACL. (Maximum length: 32 characters)

Command Mode
Privileged Exec

Example

```
Console#clear access-list hardware counters
Console#
```

show access-group

This command shows the port assignments of ACLs.

Command Mode
Privileged Executive

Example

```
Console#show access-group
Interface ethernet 1/1
 IP access-list ex1 in
 IP access-list ex1 out
Interface ethernet 1/2
 IPv6 access-list i6ex in
 IPv6 access-list i6ex out
Console#
```

show access-list

This command shows all ACLs and associated rules.

Syntax

show access-list
[[**arp** [*acl-name*]] |
[**ip** [**extended** [*acl-name*] | **standard** [*acl-name*]] |
[**ipv6** [**extended** [*acl-name*] | **standard** [*acl-name*]] |
[**mac** [*acl-name*]] | [**tcam-utilization**] | [**hardware counters**]]

arp – Shows ingress or egress rules for ARP ACLs.

hardware counters – Shows statistics for all ACLs.[7]

ip extended – Shows ingress or egress rules for Extended IPv4 ACLs.

ip standard – Shows ingress or egress rules for Standard IPv4 ACLs.

7. Due to a hardware limitation, this option only displays statistics for permit rules.

ipv6 extended – Shows ingress or egress rules for Extended IPv6 ACLs.

ipv6 standard – Shows ingress or egress rules for Standard IPv6 ACLs.

mac – Shows ingress or egress rules for MAC ACLs.

tcam-utilization – Shows the percentage of user configured ACL rules as a percentage of total ACL rules

acl-name – Name of the ACL. (Maximum length: 32 characters)

Command Mode

Privileged Exec

Example

```
Console#show access-list
IP standard access-list david:
  permit host 10.1.1.21
  permit 168.92.0.0 255.255.15.0
IP extended access-list bob:
  permit TCP 192.168.1.0 255.255.255.0 any destination-port 80
  permit TCP 192.168.1.0 255.255.255.0 any control-flag 2 2
  permit 10.7.1.1 255.255.255.0 any
MAC access-list jerry:
  permit any host 00-30-29-94-34-de ethertype 800 800
  permit any any VID 1 ethertype 0000 cos 1 1
IP extended access-list A6:
   permit any any DSCP 5
  permit any any next-header 43
  permit any 2009:db90:2229::79/8
ARP access-list arp1:
  permit response ip any 192.168.0.0 255.255.0.0 mac any any
  permit ip any any mac any any
  permit ip any any mac any host 12-12-12-12-12-12 log
Console#
```

12 Interface Commands

These commands are used to display or set communication parameters for an Ethernet port, aggregated link, or VLAN.

Table 63: Interface Commands

Command	Function	Mode
Interface Configuration		
interface	Configures an interface type and enters interface configuration mode	GC
alias	Configures an alias name for the interface	IC
description	Adds a description to an interface configuration	IC
discard	Discards CDP or PVST packets	IC
flowcontrol	Enables flow control on a given interface	IC
history	Configures a periodic sampling of statistics, specifying the sampling interval and number of samples	IC
media-type	Forces transceiver mode to use for SFP/SFP+ ports, or the port type to use for combination RJ-45/SFP ports	IC
fec	Configures the Forward Error Correction (FEC) mode on 100G QSFP28 ports	IC
shutdown	Disables an interface	IC
link-delay	Sets a time delay for an interface to transition to an up or down state	IC
reset configuration	Restores all interface configuration to defaults	IC
clear counters	Clears statistics on an interface	PE
hardware profile portmode	Configures port settings for 1x100G, 4x10G, or 4x25G operation	PE
show hardware profile portmode	Displays the configuration settings for 40G operation	PE
show discard	Displays if CDP and PVST packets are being discarded	PE
show interfaces brief	Displays a summary of key information, including operational status, native VLAN ID, default priority, speed/duplex mode, and port type	PE
show interfaces counters	Displays statistics for the specified interfaces	NE, PE
show interfaces history	Displays periodic sampling of statistics, including the sampling interval, number of samples, and counter values	NE, PE
show interfaces status	Displays status for the specified interface	NE, PE
show interfaces switchport	Displays the administrative and operational status of an interface	NE, PE

Table 63: Interface Commands (Continued)

Command	Function	Mode
Transceiver Threshold Configuration		
transceiver-monitor	Sends a trap when any of the transceiver's operational values fall outside specified thresholds	IC
transceiver-threshold-auto	Uses default threshold settings obtained from the transceiver to determine when an alarm or trap message should be sent	IC
transceiver-threshold current	Sets thresholds for transceiver current which can be used to trigger an alarm or warning message	IC
transceiver-threshold rx-power	Sets thresholds for the transceiver power level of the received signal which can be used to trigger an alarm or warning message	IC
transceiver-threshold temperature	Sets thresholds for the transceiver temperature which can be used to trigger an alarm or warning message	IC
transceiver-threshold tx-power	Sets thresholds for the transceiver power level of the transmitted signal which can be used to trigger an alarm or warning message	IC
transceiver-threshold voltage	Sets thresholds for the transceiver voltage which can be used to trigger an alarm or warning message	IC
show interfaces transceiver	Displays the temperature, voltage, bias current, transmit power, and receive power	PE
show interfaces transceiver-threshold	Displays the alarm/warning thresholds for temperature, voltage, bias current, transmit power, and receive power	PE
Port Diagnostics		
test loop internal	Performs internal loop back test on the specified port	PE
show loop internal	Shows the results of a loop back test	PE

Interface Configuration

interface

This command configures an interface type and enters interface configuration mode. Use the **no** form with a trunk to remove an inactive interface. Use the **no** form with a Layer 3 VLAN (normal type) to change it back to a Layer 2 interface.

Syntax

interface *interface*

no interface *interface* [**port-channel** *channel-id* | **vlan** *vlan-id*]

interface

craft - Management port on the front panel.

ethernet *unit/port-list*

unit - Unit identifier.

port-list - Physical port number or list of port numbers. Separate nonconsecutive port numbers with a comma and no spaces; or use a hyphen to designate a range of port numbers.

port-channel *channel-id*

vlan *vlan-id* (Range: 1-4094)

Default Setting
None

Command Mode
Global Configuration

Example
To specify several different ports, enter the following command:

```
Console(config)#interface ethernet 1/7-12,15
Console(config-if)#
```

alias
This command configures an alias name for the interface. Use the **no** form to remove the alias name.

Syntax
alias *string*

no alias

string - A mnemonic name to help you remember what is attached to this interface. (Range: 1-64 characters)

Default Setting
None

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
The alias is displayed in the running-configuration file. An example of the value which a network manager might store in this object for a WAN interface is the (Telco's) circuit number/identifier of the interface.

Example
The following example adds an alias to port 4.

```
Console(config)#interface ethernet 1/4
Console(config-if)#alias finance
Console(config-if)#
```

description

This command adds a description to an interface. Use the **no** form to remove the description.

Syntax

description *string*

no description

string - Comment or a description to help you remember what is attached to this interface. (Range: 1-128 characters)

Default Setting

None

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

The description is displayed by the show interfaces status command and in the running-configuration file. An example of the value which a network manager might store in this object is the name of the manufacturer, and the product name.

Example

The following example adds a description to port 4.

```
Console(config)#interface ethernet 1/4
Console(config-if)#description RD-SW#3
Console(config-if)#
```

discard

This command discards CDP or PVST packets. Use the **no** form to forward the specified packet type to other ports configured the same way.

Syntax

[**no**] **discard** {**cdp** | **pvst**}

cdp – Cisco Discovery Protocol

pvst – Per-VLAN Spanning Tree

Default Setting

Default - Forward CDP and PVST packets

Command Mode

Interface Configuration (Ethernet)

Command Usage
Use the **no discard** command to allow CDP or PVST packets to be forwarded to other ports in the same VLAN which are also configured to forward the specified packet type.

Example
The following example forwards CDP packets entering port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#discard cdp
Console(config-if)#
```

flowcontrol
This command enables flow control. Use the **no** form to disable flow control.

Syntax
[no] **flowcontrol**

Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
Flow control can eliminate frame loss by "blocking" traffic from end stations or segments connected directly to the switch when its buffers fill. When enabled, back pressure is used for half-duplex operation and IEEE 802.3-2002 (formally IEEE 802.3x) for full-duplex operation.

Example
The following example enables flow control on port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#flowcontrol
Console(config-if)#
```

history

This command configures a periodic sampling of statistics, specifying the sampling interval and number of samples. Use the **no** form to remove a named entry from the sampling table.

Syntax

history *name interval buckets*

no history [*name*]

name - A symbolic name for this entry in the sampling table. (Range: 1-31 characters)

interval - The interval for sampling statistics. (Range: 1-86400 seconds.

buckets - The number of samples to take. (Range: 1-96)

Default Setting

15min - 15 minute interval, 96 buckets
1day - 1 day interval, 7 buckets

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

This example sets a interval of 15 minutes for sampling standard statistical values on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#history 15min 15 10
Console(config-if)#
```

media-type

This command forces the transceiver mode to use for SFP+/QSFP28 ports. Use the **no** form to restore the default mode.

Syntax

media-type sfp-forced [*mode*]

no media-type

sfp-forced - Forces transceiver mode for the SFP+/QSFP28 port.

mode

1000sfp - Always uses 1000BASE SFP mode.

100gsfp - Always uses 100GBASE SFP mode.

10gsfp - Always uses 10GBASE SFP mode.

2500sfp - Always uses 2500BASE SFP mode.

40gsfp - Always uses 40GBASE SFP mode.

ifmode - Sets a specific interface mode when the media type is not automatically recognized.

kr - Sets the mode for DAC copper media.

sr_lr - Sets the mode for optical/AOC fiber media.

Default Setting
SFP+/QSFP28 ports: None

Command Mode
Interface Configuration (Ethernet)

Example
This forces the switch to use the 1000sfp mode for SFP port 8.

```
Console(config)#interface ethernet 1/8
Console(config-if)#media-type sfp-forced 1000sfp
Console(config-if)#
```

fec
This command configures the Forward Error Correction (FEC) mode of 100G QSFP28 ports. Use the **no** form to disable FEC mode.

Syntax
fec {**rs**}

no fec

rs - Enables Reed-Solomon FEC (RS-FEC) on the port.

Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet)

Command Usage
- Forward Error Correction (FEC) is a technique used for correcting data errors in transmission links. The use of Reed-Solomon FEC (RS-FEC) on noisy network

links can improve reliability and performance. The RS-FEC mode must be enabled on both ends of a link.

- If negotiation is enabled (auto mode), this command has no effect.

Example

```
Console(config)#interface ethernet 1/50
Console(config-if)#fec rs
Console(config-if)#
```

shutdown

This command disables an interface. To restart a disabled interface, use the **no** form.

Syntax

[**no**] **shutdown**

Default Setting

All interfaces are enabled.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This command allows you to disable a port due to abnormal behavior (e.g., excessive collisions), and then re-enable it after the problem has been resolved. You may also want to disable a port for security reasons.

Example

The following example disables port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#shutdown
Console(config-if)#
```

link-delay

This command delays an interface transitioning to an up or down state. Use the **no** form to restore the default.

Syntax

link-delay {**up** | **down**} *delay-time*

no link-delay {**up** | **down**}

up - Set a time delay before transitioning to an up state.

down - Set a time delay before transitioning to a down state.

delay-time - Sets the delay time in seconds. (Range: 1-30 seconds)

Default Setting
No delay

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
On the same interface, the delay time from up to down can be set to a different value to that of down to up.

Example

```
Console(config)#interface ethernet 1/2
Console(config-if)#link-delay up 3
Console(config-if)#
```

reset configuration

This command restores all configuration on an interface to default settings.

Syntax

reset configuration

Command Mode
Interface Configuration (Ethernet, Port Channel)

Example
The following example restores all configuration on port 5 to default values.

```
Console(config)#interface ethernet 1/5
Console(config-if)#reset configuration
Console(config-if)#
```

clear counters

This command clears statistics on an interface.

Syntax

clear counters *interface*

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
None

Command Mode
Privileged Exec

Command Usage
Statistics are only initialized for a power reset. This command sets the base value for displayed statistics to zero for the current management session. However, if you log out and back into the management interface, the statistics displayed will show the absolute value accumulated since the last power reset.

Example
The following example clears statistics on port 5.

```
Console#clear counters ethernet 1/5
Console#
```

hardware profile portmode

This command configures settings for QSFP28 port operation.

Syntax

hardware profile portmode *interface* {**1x100g** | **1x40g** | **4x10g** | **4x25g** | **reset**}

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

1x100g - Configures the port as a single 100G port.

1x40g - Configures the port as a single 40G port.

4x10g - Configures the port as four 10G ports.

4x25g - Configures the port as four 25G ports.

reset - Configures port mode to the default setting.

Default Setting
The example under the show hardware profile portmode command shows the default settings for this switch.

Command Mode
Privileged Exec

Command Usage

- The 100G ports can be configured as a single port connected with 100G QSFP28 fiber cable, 40G DAC (direct attach) cable, or breakout cable that connects a 100G port to four 25G or 10G ports.
- Any changes made with this command will not take effect until after the system is reloaded.

Example

This example sets the cabling option for Port 50.

```
Console#hardware profile portmode ethernet 1/50 4x10g
Console#
```

show hardware profile portmode

This command displays the port configuration settings for QSFP28 port operation.

Command Mode

Privileged Exec

Example

This example shows the default port settings.

```
Console#show hardware profile portmode

40G          10G          Config  Oper
Interfaces   Interfaces   Mode    Mode
-----------  -----------  ------  ------
1/1          1/1-4        -       4x10g
1/5          1/5-8        -       4x10g
1/9          1/9-12       -       4x10g
1/13         1/13-16      -       4x10g
1/17         1/17-20      -       4x10g
  .
  .
  .
1/49         1/55-58      -       1x100g
1/50         1/59-62      -       1x100g
1/51         1/63-66      -       1x100g
1/52         1/67-70      -       1x100g
1/53         1/71-74      -       1x100g
1/54         1/75-78      -       1x100g
Console#
```

show discard

This command displays whether or not CDP and PVST packets are being discarded.

Command Mode

Privileged Exec

Example

In this example, "Default" means that the packets are not discarded.

```
Console#show discard
Port     CDP     PVST
-------- ------- -------
Eth 1/ 1 No      No
Eth 1/ 2 No      No
Eth 1/ 3 No      No
Eth 1/ 4 No      No
Eth 1/ 5 No      No
Eth 1/ 6 No      No
:
```

show interfaces brief

This command displays a summary of key information, including operational status, native VLAN ID, default priority, speed/duplex mode, and port type for all ports.

Command Mode

Privileged Exec

Command Usage

- If an SFP transceiver is inserted in a port, the Type field will show the SFP type as interpreted from Ethernet Compliance Codes (Data Byte 6 in Address A0h). The Ethernet Compliance Code is a bitmap value, of which one bit is supposedly turned on. However, if the read-out is not recognizable (e.g., 2 or more bits on, or all 0s), the Type field just displays the raw data (hexadecimal value).

- If link status is down due to an administrative setting or the result of a protocol state, the reason will be listed in the Status field (i.e., Disabled, STP LBD, BpduGuard, LinkDet, DynQoS, PortSec, LBD, ATC Bcast, ATC Mcast, UDLD, License).

Example

```
Console#show interfaces brief
Interface Name              Status    PVID Pri Speed/Duplex  Type         Trunk
--------- ----------------- --------- ---- --- ------------- ------------ -----
Eth 1/ 1                    Down         1   0 10Gfull       10GBASE SFP+ None
Eth 1/ 2                    Down         1   0 10Gfull       10GBASE SFP+ None
Eth 1/ 3                    Down         1   0 10Gfull       10GBASE SFP+ None
Eth 1/ 4                    Down         1   0 10Gfull       10GBASE SFP+ None
Eth 1/ 5                    Down         1   0 10Gfull       10GBASE SFP+ None
Eth 1/ 6                    Down         1   0 10Gfull       10GBASE SFP+ None

:
```

show interfaces counters

This command displays interface statistics.

Syntax

show interfaces counters [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting

Shows the counters for all interfaces.

Command Mode

Normal Exec, Privileged Exec

Command Usage

If no interface is specified, information on all interfaces is displayed.

Example

```
Console#show interfaces counters ethernet 1/1
Ethernet 1/ 1
 ===== IF table Stats =====
                2166458 Octets Input
               14734059 Octets Output
                  14707 Unicast Input
                  19806 Unicast Output
                      0 Discard Input
                      0 Discard Output
                      0 Error Input
                      0 Error Output
 ===== Extended Iftable Stats =====
                     23 Multi-cast Input
                   5525 Multi-cast Output
                    170 Broadcast Input
                     11 Broadcast Output
 ===== Ether-like Stats =====
                      0 FCS Errors
                      0 Single Collision Frames
                      0 Multiple Collision Frames
                      0 Deferred Transmissions
                      0 Late Collisions
                      0 Excessive Collisions
                      0 Internal Mac Transmit Errors
                      0 Frames Too Long
                      0 Symbol Errors
                      0 Pause Frames Input
                      0 Pause Frames Output
 ===== RMON Stats =====
                      0 Drop Events
               16900558 Octets
                  40243 Packets
                    170 Broadcast PKTS
```

```
                      23 Multi-cast PKTS
                       0 Undersize PKTS
                       0 Oversize PKTS
                       0 Fragments
                       0 Jabbers
                       0 CRC Align Errors
                       0 Collisions
                     802 Packet Size <= 64 Octets
                      83 Packet Size 65 to 127 Octets
                      99 Packet Size 128 to 255 Octets
                      25 Packet Size 256 to 511 Octets
                       6 Packet Size 512 to 1023 Octets
                       0 Packet Size 1024 to 1518 Octets
 ===== Port Utilization (recent 300 seconds) =====
                     111 Octets Input in kbits per second
                       0 Packets Input per second
                    0.00 % Input Utilization
                     606 Octets Output in kbits per second
                       1 Packets Output per second
                    0.00 % Output Utilization
Console#
```

show interfaces history

This command displays periodic sampling of statistics, including the sampling interval, number of samples, and counter values.

Syntax

show interfaces history [*interface* [*name* [**current** | **previous** *index count*] [**input** | **output**]]]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* (Range: 1-4094)

name - Name of sample as defined in the history command. (Range: 1-31 characters)

current - Statistics recorded in current interval.

previous - Statistics recorded in previous intervals.

index - An index into the buckets containing previous samples. (Range: 1-96)

count - The number of historical samples to display. (Range: 1-96)

input - Ingress traffic.

output - Egress traffic.

Default Setting

Shows the historical settings and status for all interfaces.

Command Mode

Normal Exec, Privileged Exec

Command Usage

If no interface is specified, information on all interfaces is displayed.

Example

```
Console#show interfaces history ethernet 1/1 15min
Interface         : Eth 1/ 1
Name              : 15min
Interval          : 900 second(s)
Buckets Requested : 96
Buckets Granted   : 17
Status            : Active

Current Entries

 Start Time   %      Octets Input    Unicast       Multicast     Broadcast
 ------------ ------ --------------- ------------- ------------- ------------
  -
 00d 04:15:00   0.00            3201             0            31             6

              Errors
              -------------
                          0

              %      Octets Output   Unicast       Multicast     Broadcast
              ------ --------------- ------------- ------------- -------------
                0.00             716             4             2             0

              Discards      Errors
              ------------- -------------
                          0             0

Previous Entries

 Start Time   %      Octets Input    Unicast       Multicast     Broadcast
 ------------ ------ --------------- ------------- ------------- ------------
  -
 00d 00:00:00   0.00           52248             0           560           120
 00d 00:15:00   0.00           51278             0           549            99
 00d 00:30:00   0.00           51252             0           546           111
 00d 00:45:00   0.00           51076             0           547            99
 00d 01:00:00   0.00           51636             0           546           117
 00d 01:15:00   0.00           55632             0           571           108
 00d 01:30:00   0.00           51990             0           546           120
 00d 01:45:00   0.00           51616             0           549           102
 00d 02:00:00   0.00           51444             0           546           114
 00d 02:15:00   0.00           51424             0           549            99
 00d 02:30:00   0.00           51168             0           543           114
 00d 02:45:00   0.00           51548             0           553            99
 00d 03:00:00   0.00           50602             0           545           102
 00d 03:15:00   0.00           52768             0           549           120
 00d 03:30:00   0.00           50272             0           543           100
 00d 03:45:00   0.00           52238             0           548           116
 00d 04:00:00   0.00           50602             0           545           102

 Start Time   Discards      Errors
 ------------ ------------- -------------
 00d 00:00:00             0             0
 00d 00:15:00             0             0
```

```
 00d 00:30:00              0              0
 00d 00:45:00              0              0
 00d 01:00:00              0              0
 00d 01:15:00              0              0
 00d 01:30:00              0              0
 00d 01:45:00              0              0
 00d 02:00:00              0              0
 00d 02:15:00              0              0
 00d 02:30:00              0              0
 00d 02:45:00              0              0
 00d 03:00:00              0              0
 00d 03:15:00              0              0
 00d 03:30:00              0              0
 00d 03:45:00              0              0
 00d 04:00:00              0              0

Console#
```

show interfaces status

This command displays the status for an interface.

Syntax

show interfaces status [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* (Range: 1-4094)

Default Setting

Shows the status for all interfaces.

Command Mode

Normal Exec, Privileged Exec

Command Usage

- If no interface is specified, information on all interfaces is displayed.
- For port channels, this command displays the total bandwidth of active trunk members. For example, if ports 1 and 2 are active members of a trunk with 10G full-duplex links, the total bandwidth is displayed as “20000 Mb/second” (20G).

Example

```
Console#show interfaces status ethernet 1/1
Information of Eth 1/1
 Basic Information:
  Port Type              : 10GBASE SFP+
  MAC Address            : B4-6A-D4-B2-EE-6A
```

```
 Configuration:
  Name                    :
  Port Admin              : Up
  Speed-duplex            : 10Gfull
  Interface Mode          : KR
  Broadcast Storm         : Disabled
  Broadcast Storm Limit   : 500 packets/second
  Multicast Storm         : Disabled
  Multicast Storm Limit   : 500 packets/second
  Unknown Unicast Storm       : Disabled
  Unknown Unicast Storm Limit : 500 kbits/second
  Flow Control            : Disabled
  VLAN Trunking           : Disabled
  LACP                    : Disabled
  MAC Learning            : Enabled
  Media Type              : None
  Link-delay up           : 0
  Link-delay down         : 0
 Current Status:
  Link Status             : Down
  Operation Speed-duplex  : 10Gfull
  Flow Control Type       : None
  Max Frame Size          : 1522 bytes (1522 bytes for tagged frames)
  MAC Learning Status     : Enabled
Console#
```

show interfaces switchport

This command displays the administrative and operational status of the specified interfaces.

Syntax

show interfaces switchport [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting

Shows all interfaces.

Command Mode

Normal Exec, Privileged Exec

Command Usage

If no interface is specified, information on all interfaces is displayed.

Example

This example shows the configuration setting for port 1.

```
Console#show interfaces switchport ethernet 1/1
Information of Eth 1/1
 Broadcast Threshold           : Disabled
 Multicast Threshold           : Disabled
 Unknown Unicast Threshold     : Disabled
 LACP Status                   : Disabled
 Ingress Rate Limit            : Disabled, 10000000 kbits/second
 Egress Rate Limit             : Disabled, 10000000 kbits/second
 VLAN Membership Mode          : Hybrid
 Ingress Rule                  : Enabled
 Acceptable Frame Type         : All frames
 Native VLAN                   : 1
 Priority for Untagged Traffic : 0
 GVRP Status                   : Disabled
 Allowed VLAN                  :     1(u)
 Forbidden VLAN                :
 802.1Q Tunnel Status          : Disabled
 802.1Q Tunnel Mode            : Normal
 802.1Q Tunnel TPID            : 8100 (Hex)
 Layer 2 Protocol Tunnel       : None
Console#
```

Transceiver Threshold Configuration

transceiver-monitor

This command sends a trap when any of the transceiver's operational values fall outside of specified thresholds. Use the **no** form to disable trap messages.

Syntax

[no] transceiver-monitor

Default Setting

Disabled

Command Mode

Interface Configuration

Example

```
Console(config)interface ethernet 1/1
Console(config-if)#transceiver-monitor
Console#
```

transceiver-threshold-auto

This command uses default threshold settings obtained from the transceiver to determine when an alarm or warning message should be sent. Use the **no** form to disable this feature.

Syntax

[no] transceiver-threshold-auto

Default Setting

Enabled

Command Mode

Interface Configuration

Example

```
Console(config)interface ethernet 1/12
Console(config-if)#transceiver-threshold-auto
Console#
```

transceiver-threshold current

This command sets thresholds for transceiver current which can be used to trigger an alarm or warning message. Use the **no** form to restore the default settings.

Syntax

transceiver-threshold current {high-alarm | high-warning | low-alarm | low-warning} *threshold-value*

high-alarm – Sets the high current threshold for an alarm message.

high-warning – Sets the high current threshold for a warning message.

low-alarm – Sets the low current threshold for an alarm message.

low-warning – Sets the low current threshold for a warning message.

threshold-value – The threshold of the transceiver current. (Range: 0-13100 in units of 0.01 mA)

Default Setting

Defaults are transceiver dependent.

Command Mode

Interface Configuration

Command Usage

- If trap messages are enabled with the transceiver-monitor command, and a high-threshold alarm or warning message is sent if the current value is greater than or equal to the threshold, and the last sample value was less than the threshold. After a rising event has been generated, another such event will not

be generated until the sampled value has fallen below the high threshold and reaches the low threshold.

- If trap messages are enabled with the transceiver-monitor command, and a low-threshold alarm or warning message is sent if the current value is less than or equal to the threshold, and the last sample value was greater than the threshold. After a falling event has been generated, another such event will not be generated until the sampled value has risen above the low threshold and reaches the high threshold.
- Threshold events are triggered as described above to avoid a hysteresis effect which would continuously trigger event messages if the power level were to fluctuate just above and below either the high threshold or the low threshold.
- Trap messages enabled by the transceiver-monitor command are sent to any management station configured by the snmp-server host command.
- Transceiver-Threshold Auto must be disabled.

Example

The following example sets alarm thresholds for the transceiver current at port 9.

```
Console(config)interface ethernet 1/9
Console(config-if)#transceiver-threshold current low-alarm 100
Console(config-if)#transceiver-threshold rx-power high-alarm 700
Console#
```

transceiver-threshold rx-power

This command sets thresholds for the transceiver power level of the received signal which can be used to trigger an alarm or warning message. Use the **no** form to restore the default settings.

Syntax

transceiver-threshold rx-power {**high-alarm** | **high-warning** | **low-alarm** | **low-warning**} *threshold-value*

no transceiver-threshold rx-power

high-alarm – Sets the high power threshold for an alarm message.

high-warning – Sets the high power threshold for a warning message.

low-alarm – Sets the low power threshold for an alarm message.

low-warning – Sets the low power threshold for a warning message.

threshold-value – The power threshold of the received signal. (Range: -4000 - 820 in units of 0.01 dBm)

Default Setting

Defaults are transceiver dependent.

Command Mode
Interface Configuration

Command Usage
- The threshold value is the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW).
- Refer to the Command Usage section under the transceiver-threshold current command for more information on configuring transceiver thresholds.
- Trap messages enabled by the transceiver-monitor command are sent to any management station configured by the snmp-server host command.

Example
The following example sets alarm thresholds for the signal power received at port 1.

```
Console(config)interface ethernet 1/1
Console(config-if)#transceiver-threshold rx-power low-alarm -21
Console(config-if)#transceiver-threshold rx-power high-alarm -3
Console#
```

transceiver-threshold temperature

This command sets thresholds for the transceiver temperature which can be used to trigger an alarm or warning message. Use the **no** form to restore the default settings.

Syntax

transceiver-threshold temperature {**high-alarm** | **high-warning** | **low-alarm** | **low-warning**} *threshold-value*

no transceiver-threshold temperature

high-alarm – Sets the high temperature threshold for an alarm message.

high-warning – Sets the high temperature threshold for a warning message.

low-alarm – Sets the low temperature threshold for an alarm message.

low-warning – Sets the low temperature threshold for a warning message.

threshold-value – The threshold of the transceiver temperature. (Range: -12800 - 12800 in units of 0.01 Celsius)

Default Setting
Defaults are transceiver dependent.

Command Mode
Interface Configuration

Command Usage

- Refer to the Command Usage section under the transceiver-threshold current command for more information on configuring transceiver thresholds.
- Trap messages enabled by the transceiver-monitor command are sent to any management station configured by the snmp-server host command.

Example

The following example sets alarm thresholds for the transceiver temperature at port 1.

```
Console(config)interface ethernet 1/1
Console(config-if)#transceiver-threshold temperature low-alarm 97
Console(config-if)#transceiver-threshold temperature high-alarm -83
Console#
```

transceiver-threshold tx-power

This command sets thresholds for the transceiver power level of the transmitted signal which can be used to trigger an alarm or warning message. Use the **no** form to restore the default settings.

Syntax

transceiver-threshold tx-power {**high-alarm** | **high-warning** | **low-alarm** | **low-warning**} *threshold-value*

no transceiver-threshold tx-power

high-alarm – Sets the high power threshold for an alarm message.

high-warning – Sets the high power threshold for a warning message.

low-alarm – Sets the low power threshold for an alarm message.

low-warning – Sets the low power threshold for a warning message.

threshold-value – The power threshold of the transmitted signal. (Range: -4000 - 820 in units of 0.01 dBm)

Default Setting

Defaults are transceiver dependent.

Command Mode

Interface Configuration

Command Usage

- The threshold value is the power ratio in decibels (dB) of the measured power referenced to one milliwatt (mW).
- Refer to the Command Usage section under the transceiver-threshold current command for more information on configuring transceiver thresholds.

- Trap messages enabled by the transceiver-monitor command are sent to any management station configured by the snmp-server host command.

Example

The following example sets alarm thresholds for the signal power transmitted at port 9.

```
Console(config)interface ethernet 1/9
Console(config-if)#transceiver-threshold tx-power low-alarm -4000
Console(config-if)#transceiver-threshold tx-power high-alarm 820
Console#
```

transceiver-threshold voltage

This command sets thresholds for the transceiver voltage which can be used to trigger an alarm or warning message. Use the **no** form to restore the default settings.

Syntax

transceiver-threshold voltage {**high-alarm** | **high-warning** | **low-alarm** | **low-warning**} *threshold-value*

no transceiver-threshold voltage

high-alarm – Sets the high voltage threshold for an alarm message.

high-warning – Sets the high voltage threshold for a warning message.

low-alarm – Sets the low voltage threshold for an alarm message.

low-warning – Sets the low voltage threshold for a warning message.

threshold-value – The threshold of the transceiver voltage.
(Range: 0-655 in units of 0.01 Volt)

Default Setting

Defaults are transceiver dependent.

Command Mode

Interface Configuration

Command Usage

- Refer to the Command Usage section under the transceiver-threshold current command for more information on configuring transceiver thresholds.

- Trap messages enabled by the transceiver-monitor command are sent to any management station configured by the snmp-server host command.

Example

The following example sets alarm thresholds for the transceiver voltage at port 9.

```
Console(config)interface ethernet 1/9
Console(config-if)#transceiver-threshold voltage low-alarm 100
Console(config-if)#transceiver-threshold voltage high-alarm 500
Console#
```

show interfaces transceiver

This command displays identifying information for the specified transceiver, including connector type and vendor-related parameters, as well as the temperature, voltage, bias current, transmit power, and receive power.

Syntax

show interfaces transceiver [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Default Setting

Shows all interfaces.

Command Mode

Privileged Exec

Command Usage

The switch can display diagnostic information for SFP modules which support the SFF-8472 Specification for Diagnostic Monitoring Interface for Optical Transceivers. This information allows administrators to remotely diagnose problems with optical devices. This feature, referred to as Digital Diagnostic Monitoring (DDM) in the command display, provides information on transceiver parameters including temperature, supply voltage, laser bias current, laser power, and received optical power, and related alarm thresholds.

Example

```
Console#show interfaces transceiver ethernet 1/1
Information of Eth 1/1
 Connector Type        : LC
 Fiber Type            : Multimode Mode
 Eth Compliance Codes  : 10GBASE-SR
 Wavelength            : 850 nm
 Baud Rate             : 10300 MBd
 Link length           : 300 m
 Vendor OUI            : 00-00-00
 Vendor Name           : Edgecore
 Vendor PN             : ET5402-SR
 Vendor Rev            :
 Vendor SN             : F121950005
```

```
 Date Code             : 12-05-10
 DDM Information
   Temperature         : 19.93 degree C
   Vcc                 : 3.32 V
   Bias Current        : 0.00 mA
   TX Power            : -40.00 dBm
   RX Power            : -33.01 dBm
 DDM Thresholds
                           Low Alarm   Low Warning  High Warning    High Alarm
   -----------           ------------  ------------  ------------  ------------
   Temperature(Celsius)        -25.00        -20.00         90.00         95.00
   Voltage(Volts)                2.80          2.90          3.70          3.80
   Current(mA)                   0.50          1.00         18.00         20.00
   TxPower(dBm)                 -7.96         -6.99          1.00          2.01
   RxPower(dBm)                -20.00        -19.00          0.00          1.00
Console#
```

show interfaces transceiver-threshold

This command Displays the alarm/warning thresholds for temperature, voltage, bias current, transmit power, and receive power.

Syntax

show interfaces transceiver-threshold [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Default Setting

Shows all interfaces.

Command Mode

Privileged Exec

Command Usage

- The switch can display diagnostic information for SFP modules which support the SFF-8472 Specification for Diagnostic Monitoring Interface for Optical Transceivers. This information allows administrators to remotely diagnose problems with optical devices. This feature, referred to as Digital Diagnostic Monitoring (DDM) in the command display, provides information on transceiver parameters including temperature, supply voltage, laser bias current, laser power, received optical power, and related alarm thresholds.

- The DDM thresholds displayed by this command only apply to ports which have a DDM-compliant transceiver inserted.

Example

```
Console#show interfaces transceiver-threshold ethernet 1/5
Information of Eth 1/5
 DDM Thresholds
```

```
 Transceiver-monitor        : Disabled
 Transceiver-threshold-auto : Enabled
                            Low Alarm   Low Warning  High Warning    High Alarm
   -----------           ------------  ------------  ------------  ------------
   Temperature(Celsius)       -123.00          0.00         70.00         75.00
   Voltage(Volts)                3.10          3.15          3.45          3.50
   Current(mA)                   6.00          7.00         90.00        100.00
   TxPower(dBm)                -12.00        -11.50         -9.50         -9.00
   RxPower(dBm)                -21.50        -21.00         -3.50         -3.00
Console#
```

Port Diagnostics

test loop internal

This command performs an internal loop back test on the specified port.

Syntax

test loop internal interface *interface*

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode

Privileged Exec

Command Usage

- Loopback testing can only be performed on a port that is not linked up. The internal loopback makes it possible to check that an interface is working properly without having to make any network connections.
- When performing an internal loopback test, packets from the specified interface are looped back into its internal PHY. Outgoing data is looped back to the receiver without actually being transmitted.

Example

```
Console#test loop internal interface ethernet 1/1
Internal loopback test: succeeded
Console#
```

show loop internal

This command shows the results of a loop back test.

Syntax

show loop internal interface [*interface*]

interface

ethernet *unit/port*

unit - Stack unit.

port - Port number.

Command Mode

Privileged Exec

Example

```
Console#show loop internal interface ethernet 1/1

 Port      Test Result     Last Update
 --------  --------------  --------------------
 Eth 1/1         Succeeded  2024-07-15 15:26:56
Console#
```

13 Link Aggregation Commands

Ports can be statically grouped into an aggregate link (i.e., trunk) to increase the bandwidth of a network connection or to ensure fault recovery. Or you can use the Link Aggregation Control Protocol (LACP) to automatically negotiate a trunk link between this switch and another network device. For static trunks, the switches have to comply with the Cisco EtherChannel standard. For dynamic trunks, the switches have to comply with LACP. For example, a trunk consisting of two 1000 Mbps ports can support an aggregate bandwidth of 4 Gbps when operating at full duplex.

Table 64: Link Aggregation Commands

Command	Function	Mode
Manual Configuration Commands		
interface port-channel	Configures a trunk and enters interface configuration mode for the trunk	GC
port-channel load-balance	Sets the load-distribution method among ports in aggregated links	GC
channel-group	Adds a port to a trunk	IC (Ethernet)
Dynamic Configuration Commands		
lacp	Configures LACP for the current interface	IC (Ethernet)
lacp actor/partner mode (Ethernet Interface)	Configures the port's LACP actor or partner negotiation activity mode	IC (Ethernet)
lacp admin-key	Configures a port's administration key	IC (Ethernet)
lacp port-priority	Configures a port's LACP port priority	IC (Ethernet)
lacp system-priority	Configures a port's LACP system priority	IC (Ethernet)
lacp admin-key	Configures an port channel's administration key	IC (Port Channel)
lacp timeout	Configures the timeout to wait for next LACPDU	IC (Port Channel)
Trunk Status Display Commands		
show interfaces status port-channel	Shows trunk information	NE, PE
show lacp	Shows LACP information	PE
show port-channel load-balance	Shows the load-distribution method used on aggregated links	PE
Multi-Chassis Link Aggregation Group Commands		
mlag	Enables MLAG globally	GC
mlag domain peer-link	Configures the MLAG domain peer link	GC
mlag group member	Configures MLAG domain member ports	GC

Table 64: Link Aggregation Commands

Command	Function	Mode
show mlag	Shows MLAG configuration settings	PE
show mlag group	Shows MLAG group settings	PE
show mlag group	Shows MLAG domain settings	PE

Guidelines for Creating Trunks

General Guidelines –

- Finish configuring trunks before you connect the corresponding network cables between switches to avoid creating a loop.
- A trunk can have up to 8 ports.
- The ports at both ends of a connection must be configured as trunk ports.
- All ports in a trunk must be configured in an identical manner, including communication mode (i.e., speed and duplex mode), VLAN assignments, and CoS settings.
- Any of the Gigabit ports on the front panel can be trunked together, including ports of different media types.
- All the ports in a trunk have to be treated as a whole when moved from/to, added or deleted from a VLAN via the specified port-channel.
- STP, VLAN, and IGMP settings can only be made for the entire trunk via the specified port-channel.

Dynamically Creating a Port Channel –

Ports assigned to a common port channel must meet the following criteria:

- Ports must have the same LACP system priority.
- Ports must have the same port admin key (Ethernet Interface).
- If the port channel admin key (lacp admin key - Port Channel) is not set when a channel group is formed (i.e., it has the null value of 0), the operational key is set to the same value as the operational key of the first member port.
- However, if the port channel admin key is set, then the port admin key must be set to the same value for a port to be allowed to join a channel group.
- If a link goes down, LACP port priority is used to select the backup link.

Manual Configuration Commands

port-channel load-balance

This command sets the load-distribution method among ports in aggregated links (for both static and dynamic trunks). Use the **no** form to restore the default setting.

Syntax

port-channel load-balance {**dst-ip** | **dst-mac** | **src-dst-ip** | **src-dst-mac** | **src-ip** | **src-mac**}

no port-channel load-balance

dst-ip - Load balancing based on destination IP address.

dst-mac - Load balancing based on destination MAC address.

src-dst-ip - Load balancing based on source and destination IP address.

src-dst-mac - Load balancing based on source and destination MAC address.

src-ip - Load balancing based on source IP address.

src-mac - Load balancing based on source MAC address.

Default Setting

src-dst-mac

Command Mode

Global Configuration

Command Usage

- This command applies to all static and dynamic trunks on the switch.
- To ensure that the switch traffic load is distributed evenly across all links in a trunk, select the source and destination addresses used in the load-balance calculation to provide the best result for trunk connections:
  - **dst-ip**: All traffic with the same destination IP address is output on the same link in a trunk. This mode works best for switch-to-router trunk links where traffic through the switch is destined for many different hosts. Do not use this mode for switch-to-server trunk links where the destination IP address is the same for all traffic.
  - **dst-mac**: All traffic with the same destination MAC address is output on the same link in a trunk. This mode works best for switch-to-switch trunk links where traffic through the switch is destined for many different hosts. Do not use this mode for switch-to-router trunk links where the destination MAC address is the same for all traffic.
  - **src-dst-ip**: All traffic with the same source and destination IP address is output on the same link in a trunk. This mode works best for switch-to-

router trunk links where traffic through the switch is received from and destined for many different hosts.

- **src-dst-mac**: All traffic with the same source and destination MAC address is output on the same link in a trunk. This mode works best for switch-to-switch trunk links where traffic through the switch is received from and destined for many different hosts.
- **src-ip**: All traffic with the same source IP address is output on the same link in a trunk. This mode works best for switch-to-router or switch-to-server trunk links where traffic through the switch is received from many different hosts.
- **src-mac**: All traffic with the same source MAC address is output on the same link in a trunk. This mode works best for switch-to-switch trunk links where traffic through the switch is received from many different hosts.

Example

```
Console(config)#port-channel load-balance dst-ip
Console(config)#
```

channel-group

This command adds a port to a trunk. Use the **no** form to remove a port from a trunk.

Syntax

channel-group *channel-id*

no channel-group

channel-id - Trunk index

Default Setting

The current port is not a member of any trunk.

Command Mode

Interface Configuration (Ethernet)

Command Usage

- When configuring static trunks, the switches must comply with the Cisco EtherChannel standard.
- Use **no channel-group** to remove a port group from a trunk.
- Use no interface port-channel to remove a trunk from the switch.

Example

The following example creates trunk 1 and then adds port 10:

```
Console(config)#interface port-channel 1
Console(config-if)#exit
Console(config)#interface ethernet 1/10
Console(config-if)#channel-group 1
Console(config-if)#
```

Dynamic Configuration Commands

lacp This command enables 802.3ad Link Aggregation Control Protocol (LACP) for the current interface. Use the **no** form to disable it.

Syntax

[no] lacp

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

Command Usage

- The ports on both ends of an LACP trunk must be configured for full duplex.
- A trunk formed with another switch using LACP will automatically be assigned the next available port-channel ID.
- If the target switch has also enabled LACP on the connected ports, the trunk will be activated automatically.
- If more than eight ports attached to the same target switch have LACP enabled, the additional ports will be placed in standby mode, and will only be enabled if one of the active links fails.

Example

The following shows LACP enabled on ports 1-3. Because LACP has also been enabled on the ports at the other end of the links, the show interfaces status port-channel 1 command shows that Trunk1 has been established.

```
Console(config)#interface ethernet 1/1
Console(config-if)#lacp
Console(config-if)#interface ethernet 1/2
Console(config-if)#lacp
Console(config-if)#interface ethernet 1/3
Console(config-if)#lacp
Console(config-if)#end
```

```
Console#show interfaces status port-channel 1
Information of Trunk 1
 Basic Information:
  Port Type              : 10GBASE SFP+
  MAC Address            : 12-34-12-34-12-3F
Configuration:
  Name                   :
  Port Admin             : Up
  Speed-duplex           : 10Gfull
  Broadcast Storm        : Enabled
  Broadcast Storm Limit  : 500 packets/second
  Multicast Storm        : Disabled
  Multicast Storm Limit  : 500 packets/second
  Unknown Unicast Storm       : Disabled
  Unknown Unicast Storm Limit : 500 packets/second
  Storm Threshold Resolution  : 1 packets/second
  Flow Control           : Disabled
  MAC Learning           : Enabled
  Link-up-down Trap      : Enabled
 Current status:
  Created By             : LACP
  Link Status            : Up
  Port Operation Status  : Up
  Operation Speed-duplex : 10Gfull
  Up Time                : 0w 0d 0h 0m 53s (53 seconds)
  Flow Control Type      : None
  Max Frame Size         : 1518 bytes (1522 bytes for tagged frames)
  MAC Learning Status    : Enabled
  Member Ports           : Eth1/1, Eth1/2, Eth1/3,
  Active Member Ports    : Eth1/1, Eth1/2, Eth1/3,
Console#
```

lacp actor/partner mode (Ethernet Interface)

This command configures a port's LACP actor or partner negotiation activity mode. Use the **no** form to restore to the default setting.

Syntax

lacp {**actor** | **partner**} **mode** {**active** | **passive**}

no lacp {**actor** | **partner**} **mode**

actor - The local side an aggregate link.

partner - The remote side of an aggregate link.

mode - Configures the negotiation activity mode.

active - Specifies the port's activity mode to initiate and transmit LACP negotiation packets.

passive - Specifies the port's activity mode to only respond to LACP negotiation packets.

Default Setting

Actor: Active, Partner: Passive

Command Mode

Interface Configuration (Ethernet)

Command Usage
An LACP trunk cannot be instantiated if both sides are set to passive.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#lacp actor mode passive
Console(config-if)#
```

lacp admin-key (Ethernet Interface)

This command configures a port's LACP administration key. Use the **no** form to restore the default setting.

Syntax

lacp {**actor** | **partner**} **admin-key** *key*

no lacp {**actor** | **partner**} **admin-key**

actor - The local side an aggregate link.

partner - The remote side of an aggregate link.

key - The port admin key must be set to the same value for ports that belong to the same link aggregation group (LAG). (Range: 0-65535)

Default Setting
Partner: 0

Command Mode
Interface Configuration (Ethernet)

Command Usage
- Ports are only allowed to join the same LAG if (1) the LACP system priority matches, (2) the LACP port admin key matches, and (3) the LACP port channel key matches (if configured).
- If the port channel admin key (lacp admin key - Port Channel) is not set when a channel group is formed (i.e., it has the null value of 0), the operational key is set to the same value as the operational key of the first member port.
- Once the remote side of a link has been established, LACP operational settings are already in use on that side. Configuring LACP settings for the partner only applies to its administrative state, not its operational state.

Note: Configuring the partner admin-key does not affect remote or local switch operation. The local switch just records the partner admin-key for user reference.

- If the admin key is not set, the actor's operational key is determined by port's link speed (100G - 9, 25G - 8, 40G - 7, 2.5G - 6, 10G - 5).

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#lacp actor admin-key 120
Console(config-if)#
```

lacp port-priority

This command configures LACP port priority. Use the **no** form to restore the default setting.

Syntax

lacp {**actor** | **partner**} **port-priority** *priority*

no lacp {**actor** | **partner**} **port-priority**

actor - The local side an aggregate link.

partner - The remote side of an aggregate link.

priority - LACP port priority is used to select a backup link. (Range: 0-65535)

Default Setting

32768

Command Mode

Interface Configuration (Ethernet)

Command Usage

- Setting a lower value indicates a higher effective priority.
- If an active port link goes down, the backup port with the highest priority is selected to replace the downed link. However, if two or more ports have the same LACP port priority, the port with the lowest physical port number will be selected as the backup port.
- If an LAG already exists with the maximum number of allowed port members, and LACP is subsequently enabled on another port using a higher priority than an existing member, the newly configured port will replace an existing port member that has a lower priority.
- Once the remote side of a link has been established, LACP operational settings are already in use on that side. Configuring LACP settings for the partner only applies to its administrative state, not its operational state, and will only take effect the next time an aggregate link is established with the partner.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#lacp actor port-priority 128
```

lacp system-priority

This command configures a port's LACP system priority. Use the **no** form to restore the default setting.

Syntax

lacp {**actor** | **partner**} **system-priority** *priority*

no lacp {**actor** | **partner**} **system-priority**

actor - The local side an aggregate link.

partner - The remote side of an aggregate link.

priority - This priority is used to determine link aggregation group (LAG) membership, and to identify this device to other switches during LAG negotiations. (Range: 0-65535)

Default Setting

32768

Command Mode

Interface Configuration (Ethernet)

Command Usage

- Port must be configured with the same system priority to join the same LAG.
- System priority is combined with the switch's MAC address to form the LAG identifier. This identifier is used to indicate a specific LAG during LACP negotiations with other systems.
- Once the remote side of a link has been established, LACP operational settings are already in use on that side. Configuring LACP settings for the partner only applies to its administrative state, not its operational state, and will only take effect the next time an aggregate link is established with the partner.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#lacp actor system-priority 3
Console(config-if)#
```

lacp admin-key (Port Channel)

This command configures a port channel's LACP administration key. Use the **no** form to restore the default setting.

Syntax

lacp admin-key *key*

no lacp admin-key

key - The port channel admin key is used to identify a specific link aggregation group (LAG) during local LACP setup on this switch. (Range: 0-65535)

Default Setting
None

Command Mode
Interface Configuration (Port Channel)

Command Usage
- Ports are only allowed to join the same LAG if (1) the LACP system priority matches, (2) the LACP port admin key matches, and (3) the LACP port channel key matches (if configured).

- If the port channel admin key (**lacp admin key** - Port Channel) is not set when a channel group is formed (i.e., it has the null value of 0), the operational key is set to the same value as the operational key of the first member port. Note that when the LAG is no longer used, the port channel admin key is reset to 0.

Example

```
Console(config)#interface port-channel 1
Console(config-if)#lacp admin-key 3
Console(config-if)#
```

lacp timeout

This command configures the timeout to wait for the next LACP data unit (LACPDU).

Syntax

lacp timeout {**long** | **short**}

long - Specifies a slow timeout of 90 seconds.

short - Specifies a fast timeout of 3 seconds.

Default Setting
long

Command Mode
Interface Configuration (Port Channel)

Command Usage
- The timeout configured by this command is set in the LACP timeout bit of the Actor State field in transmitted LACPDUs. When the partner switch receives an LACPDU set with a short timeout from the actor switch, the partner adjusts the transmit LACPDU interval to 1 second. When it receives an LACPDU set with a long timeout from the actor, it adjusts the transmit LACPDU interval to 30 seconds.

- If the actor does not receive an LACPDU from its partner before the configured timeout expires, the partner port information will be deleted from the LACP group.
- When a dynamic port-channel member leaves a port-channel, the default timeout value will be restored on that port.
- When a dynamic port-channel is torn down, the configured timeout value will be retained. When the dynamic port-channel is constructed again, that timeout value will be used.

Example

```
Console(config)#interface port-channel 1
Console(config-if)#lacp timeout short
Console(config-if)#
```

Trunk Status Display Commands

show lacp

This command displays LACP information.

Syntax

show lacp [*port-channel*] {**counters** | **internal** | **neighbors** }

port-channel - Local identifier for a link aggregation group. (Range: 1-12)

counters - Statistics for LACP protocol messages.

internal - Configuration settings and operational state for local side.

neighbors - Configuration settings and operational state for remote side.

Default Setting

Port Channel: all

Command Mode

Privileged Exec

Example

```
Console#show lacp 1 counters
Port Channel: 1
 Member Port                : Eth 1/14
 LACPDU Sent                : 7
 LACPDU Received            : 6
 MarkerPDU Sent             : 0
 MarkerPDU Received         : 0
 MarkerResponsePDU Sent     : 0
 MarkerResponsePDU Received : 0
 Unknown Packet Received    : 0
 Illegal Packet Received    : 0
:
```

```
Console#show lacp 1 internal
Port Channel : 1
Admin Key    : 0
Oper Key     : 4
Timeout      : Long
 ------------------------------------------------------------
 Member Port     : Eth 1/14
 Periodic Time   : 30 seconds
 System Priority : 32768
 Port Priority   : 32768
 Admin Key       : 4
 Oper Key        : 4
 Admin State     : Defaulted, Aggregatable, Long Timeout, Actvie LACP
 Oper State      : Distributing, Collecting, Synchronization, Aggregatable,
                   Long Timeout, Actvie LACP
⋮
```

```
Console#show lacp 1 neighbors
Port Channel : 1
 ------------------------------------------------------------
 Member Port             : Eth 1/14
 Partner Admin System ID : 32768, 00-00-00-00-00-00
 Partner Oper System ID  : 32768, FC-0A-81-B7-C7-E0
 Partner Admin Port ID   : 32768, 14
 Partner Oper Port ID    : 32768, 14
 Partner Admin Key       : 0
 Partner Oper Key        : 4
 Partner Admin State     : Defaulted, Distributing, Collecting,
                           Synchronization, Long Timeout, Passive LACP
 Partner Oper State      : Distributing, Collecting, Synchronization,
                           Aggregatable, Long Timeout, Actvie LACP
⋮
```

```
 Console#show lacp sysid
Port Channel     System Priority    System MAC Address
--------------------------------------------------------------------------------
           1              32768     00-30-F1-8F-2C-A7
           2              32768     00-30-F1-8F-2C-A7
           3              32768     00-30-F1-8F-2C-A7
           4              32768     00-30-F1-8F-2C-A7
           5              32768     00-30-F1-8F-2C-A7
           6              32768     00-30-F1-8F-2C-A7
           7              32768     00-30-F1-D4-73-A0
           8              32768     00-30-F1-D4-73-A0
           9              32768     00-30-F1-D4-73-A0
          10              32768     00-30-F1-D4-73-A0
          11              32768     00-30-F1-D4-73-A0
          12              32768     00-30-F1-D4-73-A0
⋮
```

show port-channel load-balance

This command shows the load-distribution method used on aggregated links.

Command Mode

Privileged Exec

Example

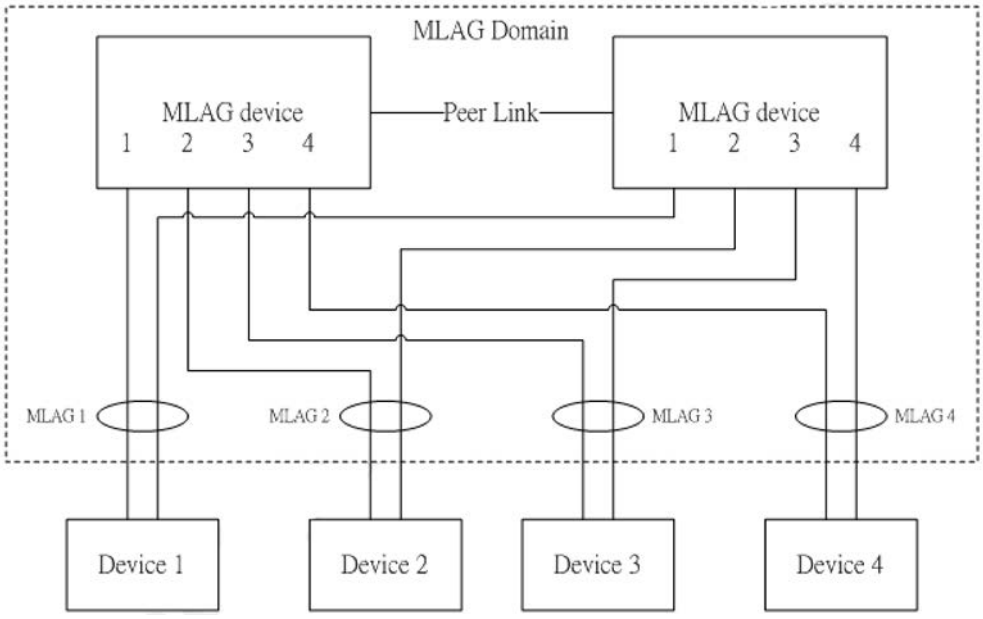
```
Console#show port-channel load-balance
Trunk Load Balance Mode: Destination IP address

Console
```

MLAG Commands

A multi-chassis link aggregation group (MLAG) is a pair of links that terminate on two cooperating switches and appear as an ordinary link aggregation group (LAG). The cooperating switches are MLAG peer switches and communicate through an interface called a peer link. While the peer link's primary purpose is exchanging MLAG control information between peer switches, but also carries data traffic from devices that are attached to only one MLAG peer and have no alternative path. An MLAG domain consists of the peer switches and the control links that connect these switches.

Figure 1: MLAG Domain Topology



MLAG Configuration

- MLAG must be enabled globally using the mlag command.
- The MLAG domain ID and peer link must be set using the mlag domain peer-link command.

- The MLAG ID, associated MLAG domain ID and MLAG member must be configured using the mlag group member command. The associated MLAG domain may be nonexistent, which causes MLAG to be inactive locally.
- For a port to be configured as MLAG peer link or member:
  - STP status of the port must be disabled.
  - LACP status of the port must be disabled.
  - The port must not be any type of traffic segmentation port.

MLAG Restrictions

- Traffic segmentation up-link/down-link port cannot be configured on an MLAG member or peer link.
- All actions which cause a port to become nonexistent, such as deleting a trunk port, adding a port to a trunk, or enabling LACP, are not allowed for an MLAG member or peer link. Also, a trunk member port is not allowed to be an MLAG member or peer link.
- STP cannot be enabled on a peer link or an MLAG member. An STP enabled port cannot be configured as a peer link or an MLAG member.

mlag

This command enables MLAG globally on the switch. Use the **no** form to disable MLAG.

Syntax

[no] mlag

Default Setting

Enabled

Command Mode

Global Configuration

Example

```
Console(config)#mlag
Console(config)#
```

mlag domain peer-link

This command configures an MLAG domain. Use the **no** form to remove the MLAG domain.

Syntax

mlag domain *domain-id* **peer-link** *interface*

no mlag domain *domain-id*

domain-id – Domain identifier. (Range: 1-16 characters)

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Usage

- There shall be one and only one peer link for a pair of MLAG devices in the same MLAG domain. (See Figure 1.)
- The peer link can be a normal port or a static trunk.
- MAC learning is automatically disabled for the peer link.
- An MLAG domain is active if the domain ID and a peer link are set.

Command Mode

Global Configuration

Example

```
Console(config)#mlag domain 1 peer-link ethernet 1/1
Console(config)#
```

mlag group member

This command configures MLAG domain member ports. Use the **no** form to remove member ports.

Syntax

mlag group *mlag-id* **domain** *domain-id* **member** *interface*

no domain *domain-id*

mlag-id – MLAG identifier. (Range: 1-1000)

domain-id – Domain identifier. (Range: 1-16 characters)

interface

ethernet *unit/port*

unit - Unit identifier.

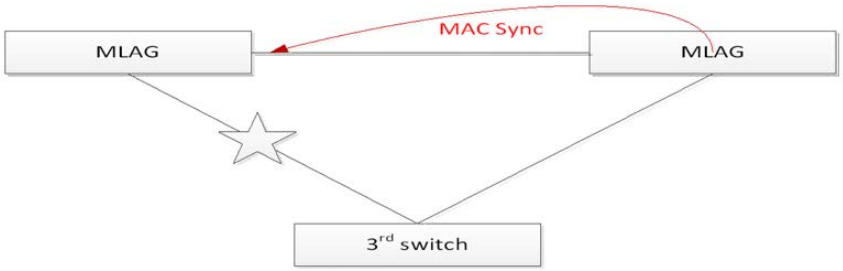
port - Port number.

port-channel *channel-id*

Command Mode
Global Configuration

Command Usage
- An MLAG domain can have two and only two MLAG devices. (See Figure 1.)
- An MLAG domain may have many MLAGs.
- An MLAG can belong to one and only one MLAG domain.
- The associated MLAG domain may be nonexistent, which causes the MLAG to be inactive locally.
- There can be one and only one MLAG member for each MLAG on an MLAG device.
- The MLAG member can be a normal port or a static trunk.
- An MLAG member is active if the MLAG ID is set and the associated MLAG domain is active.
- An MLAG is formed when the peer MLAG members are both active.
- The following items apply when an MLAG is formed.
  - When an MLAG member is operationally up and the MLAG peer member is not operationally down, all traffic from the peer link can not be forwarded to the MLAG member.
  - When an MLAG member is operationally up and the MLAG peer member is operationally down, all traffic from the peer link can be forwarded to the MLAG member.
  - When an MLAG member is operationally up, all updates for learned MAC addresses on the MLAG peer member will be synced to the MLAG member automatically.
  - When an MLAG member is operationally down, all updates for learned MAC addresses on the MLAG peer member will be synced through the peer link automatically.

Figure 2: MLAG Peer Operation



- When the MLAG peer member is down or nonexistent, learned MAC addresses are synced through the peer link for the MLAG will be removed automatically.

Example

```
Console(config)#mlag group 1 domain 1 member ethernet 1/1
Console(config)#
```

show mlag

This command shows MLAG configuration settings.

Command Mode

Privileged Exec

Example

```
Console#show mlag
 Global Status : Enabled
 Domain List   : 1,2
 MLAG List     : 10,20,30-35,50
Console#
```

show mlag group

The command shows MLAG group settings.

Command Mode

Privileged Exec

Syntax

show mlag group *mlag-id*

mlag-id – MLAG identifier. (Range: 1-1000)

Example

```
Console#show mlag group 1


Console#
```

show mlag domain

The command shows MLAG domain settings.

Command Mode

Privileged Exec

Syntax

show mlag domain *domain-id*

domain-id – Domain identifier. (Range: 1-16 characters)

Example

```
Console#show mlag domain 1
 Peer Link : Eth 1/1
 MLAG List : 10,20,33-35
Console#
```

14 Port Mirroring Commands

Data can be mirrored from a local port on the same switch or from a remote port on another switch for analysis at the target port using software monitoring tools or a hardware probe. This switch supports the following mirroring modes.

Table 65: Port Mirroring Commands

Command	Function
Local Port Mirroring	Mirrors data to another port for analysis without affecting the data passing through or the performance of the monitored port
RSPAN Mirroring	Mirrors data from remote switches over a dedicated VLAN

Local Port Mirroring Commands

This section describes how to mirror traffic from a source port to a target port.

Table 66: Mirror Port Commands

Command	Function	Mode
port monitor	Configures a mirror session	IC
show port monitor	Shows the configuration for a mirror port	PE

port monitor

This command configures a mirror session. Use the **no** form to clear a mirror session.

Syntax

port monitor {*interface* [**rx** | **tx** | **both**] | **vlan** *vlan-id* | **mac-address** *mac-address* | **access-list** *acl-name*}

no port monitor {*interface* | **vlan** *vlan-id* | **mac-address** *mac-address* | **access-list** *acl-name*}

interface

ethernet *unit/port* (source port)

unit - Unit identifier.

port - Port number.

rx - Mirror received packets.

tx - Mirror transmitted packets.

both - Mirror both received and transmitted packets.

vlan-id - VLAN ID (Range: 1-4094)

mac-address - MAC address in the form of xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.

acl-name – Name of the ACL. (Maximum length: 32 characters, no spaces or other special characters)

Default Setting

- No mirror session is defined.
- When enabled for an interface, default mirroring is for both received and transmitted packets.
- When enabled for a VLAN or a MAC address, mirroring is restricted to received packets.

Command Mode

Interface Configuration (Ethernet, destination port)

Command Usage

- You can mirror traffic from any source port to a destination port for real-time analysis. You can then attach a logic analyzer or RMON probe to the destination port and study the traffic crossing the source port in a completely unobtrusive manner.
- Set the destination port by specifying an Ethernet interface with the interface configuration command, and then use the port monitor command to specify the source of the traffic to mirror. Note that the destination port cannot be a trunk or trunk member port.
- When mirroring traffic from a port, the mirror port and monitor port speeds should match, otherwise traffic may be dropped from the monitor port. When mirroring traffic from a VLAN, traffic may also be dropped under heavy loads.
- When VLAN mirroring and port mirroring are both enabled, the target port can receive a mirrored packet twice; once from the source mirror port and again from the source mirror VLAN.
- When mirroring traffic from a MAC address, ingress traffic with the specified source address entering any port in the switch, other than the target port, will be mirrored to the destination port.
- Spanning Tree BPDU packets are not mirrored to the target port.
- When mirroring VLAN traffic or packets based on a source MAC address, the target port cannot be set to the same target port as that used for basic port mirroring.
- You can create multiple mirror sessions, but all sessions must share the same destination port.

- The destination port cannot be a trunk or trunk member port.
- ACL-based mirroring is only used for ingress traffic. To mirror an ACL, follow these steps:
  1. Use the **access-list** command to add an ACL.
  2. Use the **access-group** command to add a mirrored port to access control list.
  3. Use the **port monitor access-list** command to specify the destination port to which traffic matching the ACL will be mirrored.

Example

The following example configures the switch to mirror all packets from port 6 to 5:

```
Console(config)#interface ethernet 1/5
Console(config-if)#port monitor ethernet 1/6 both
Console(config-if)#
```

This example configures port 2 to monitor packets matching the MAC address 00-12-CF-XX-XX-XX received by port 1:

```
Console(config)#access-list mac m1
Console(config-mac-acl)#permit 00-12-cf-00-00-00 ff-ff-ff-00-00-00 any
Console(config-mac-acl)#exit
Console(config)#interface ethernet 1/1
Console(config-if)#mac access-group m1 in
Console(config-if)#interface ethernet 1/2
Console(config-if)#port monitor access-list m1
Console(config-if)#
```

show port monitor

This command displays mirror information.

Syntax

show port monitor [*interface*]

interface - **ethernet** *unit/port* (source port)

unit - Unit identifier.

port - Port number.

vlan-id - VLAN ID (Range: 1-4094)

mac-address - MAC address in the form of xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.

acl-name – Name of the ACL. (Maximum length: 32 characters, no spaces or other special characters)

Default Setting

Shows all sessions.

Command Mode
Privileged Exec

Command Usage
This command displays the currently configured source port, destination port, and mirror mode (i.e., RX, TX, RX/TX).

Example
The following shows mirroring configured from port 6 to port 5:

```
Console(config)#interface ethernet 1/5
Console(config-if)#port monitor ethernet 1/6
Console(config-if)#end
Console#show port monitor
Port Mirroring
-------------------------------------
 Destination Port (listen port)  : Eth 1/12
 Source Port (monitored Port)    : Eth 1/ 1
 Mode                            : RX/TX
Console#
```

RSPAN Mirroring Commands

Remote Switched Port Analyzer (RSPAN) allows you to mirror traffic from remote switches for analysis on a local destination port.

Table 67: RSPAN Commands

Command	Function	Mode
vlan rspan	Creates a VLAN dedicated to carrying RSPAN traffic	VC
rspan source	Specifies the source port and traffic type to be mirrored	GC
rspan destination	Specifies the destination port to monitor the mirrored traffic	GC
rspan remote vlan	Specifies the RSPAN VLAN, switch role (source, intermediate or destination), and the uplink ports	GC
no rspan session	Deletes a configured RSPAN session	GC
show rspan	Displays the configuration settings for an RSPAN session	PE

Configuration Guidelines

Take the following steps to configure an RSPAN session:

1. Use the vlan rspan command to configure a VLAN to use for RSPAN. (Default VLAN 1 and switch cluster VLAN 4093 are prohibited.)

2. Use the rspan source command to specify the interfaces and the traffic type (RX, TX or both) to be monitored.

3. Use the rspan destination command to specify the destination port for the traffic mirrored by an RSPAN session.

4. Use the rspan remote vlan command to specify the VLAN to be used for an RSPAN session, to specify the switch's role as a source, intermediate relay, or destination of the mirrored traffic, and to configure the uplink ports designated to carry this traffic.

RSPAN Limitations

The following limitations apply to the use of RSPAN on this switch:

- *RSPAN Ports* – Only ports can be configured as an RSPAN source, destination, or uplink; static and dynamic trunks are not allowed. A port can only be configured as one type of RSPAN interface – source, destination, or uplink. Also, note that the source port and destination port cannot be configured on the same switch.

  Only 802.1Q trunk or hybrid (i.e., general use) ports can be configured as an RSPAN uplink or destination port – access ports are not allowed (see switchport mode).

- *Local/Remote Mirror* – The destination of a local mirror session (created with the port monitor command) cannot be used as the destination for RSPAN traffic.

- *Spanning Tree* – If the spanning tree is disabled, BPDUs will not be flooded onto the RSPAN VLAN.

  MAC address learning is not supported on RSPAN uplink ports when RSPAN is enabled on the switch. Therefore, even if spanning tree is enabled after RSPAN has been configured, MAC address learning will still not be re-started on the RSPAN uplink ports.

- *IEEE 802.1X* – RSPAN and 802.1X are mutually exclusive functions. When 802.1X is enabled globally, RSPAN uplink ports cannot be configured, even though RSPAN source and destination ports can still be configured. When RSPAN uplink ports are enabled on the switch, 802.1X cannot be enabled globally.

RSPAN uplink ports cannot be configured to use IEEE 802.1X Port Authentication, but RSPAN source ports and destination ports can be configured to use it

- *Port Security* – If port security is enabled on any port, that port cannot be set as an RSPAN uplink port, even though it can still be configured as an RSPAN source or destination port. Also, when a port is configured as an RSPAN uplink port, port security cannot be enabled on that port.

rspan source

Use this command to specify the source port and traffic type to be mirrored remotely. Use the **no** form to disable RSPAN on the specified port, or with a traffic type keyword to disable mirroring for the specified type.

Syntax

[**no**] **rspan session** *session-id* **source interface** *interface-list* [**rx** | **tx** | **both**]

session-id – A number identifying this RSPAN session. (Range: 1)

Three sessions are allowed, including both local and remote mirroring, using different VLANs for RSPAN sessions.

interface-list – One or more source ports. Use a hyphen to indicate a consecutive list of ports or a comma between non-consecutive ports.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

rx - Mirror received packets.

tx - Mirror transmitted packets.

both - Mirror both received and transmitted packets.

Default Setting

Both TX and RX traffic is mirrored

Command Mode

Global Configuration

Command Usage

- One or more source ports can be assigned to the same RSPAN session, either on the same switch or on different switches.
- Only ports can be configured as an RSPAN source – static and dynamic trunks are not allowed.
- Only 802.1Q trunk or hybrid (i.e., general use) ports can be configured as an RSPAN source port – access ports are not allowed (see switchport mode).

- The source port and destination port cannot be configured on the same switch.

Example

The following example configures the switch to mirror received packets from port 2 and 3:

```
Console(config)#rspan session 1 source interface ethernet 1/2
Console(config)#rspan session 1 source interface ethernet 1/3
Console(config)#
```

rspan destination

Use this command to specify the destination port to monitor the mirrored traffic. Use the **no** form to disable RSPAN on the specified port.

Syntax

rspan session *session-id* **destination interface** *interface* [**tagged** | **untagged**]

no rspan session *session-id* **destination interface** *interface*

session-id – A number identifying this RSPAN session. (Range: 1)

Three sessions are allowed, including both local and remote mirroring, using different VLANs for RSPAN sessions.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

tagged - Traffic exiting the destination port carries the RSPAN VLAN tag.

untagged - Traffic exiting the destination port is untagged.

Default Setting

Traffic exiting the destination port is untagged.

Command Mode

Global Configuration

Command Usage

- Only one destination port can be configured on the same switch per session, but a destination port can be configured on more than one switch for the same session.
- Only 802.1Q trunk or hybrid (i.e., general use) ports can be configured as an RSPAN destination port – access ports are not allowed (see switchport mode).
- Only ports can be configured as an RSPAN destination – static and dynamic trunks are not allowed.

- The source port and destination port cannot be configured on the same switch.
- A destination port can still send and receive switched traffic, and participate in any Layer 2 protocols to which it has been assigned.

Example

The following example configures port 4 to receive mirrored RSPAN traffic:

```
Console(config)#rspan session 1 destination interface ethernet 1/2
Console(config)#
```

rspan remote vlan

Use this command to specify the RSPAN VLAN, switch role (source, intermediate or destination), and the uplink ports. Use the **no** form to disable the RSPAN on the specified VLAN.

Syntax

[no] **rspan session** *session-id* **remote vlan** *vlan-id*
{**source** | **intermediate** | **destination**} **uplink** *interface*

session-id – A number identifying this RSPAN session. (Range: 1)

Three sessions are allowed, including both local and remote mirroring, using different VLANs for RSPAN sessions.

vlan-id - ID of configured RSPAN VLAN. (Range: 1-4094)
Use the vlan rspan command to reserve a VLAN for RSPAN mirroring before enabling RSPAN with this command.

source - Specifies this device as the source of remotely mirrored traffic.

intermediate - Specifies this device as an intermediate switch, transparently passing mirrored traffic from one or more sources to one or more destinations.

destination - Specifies this device as a switch configured with a destination port which is to receive mirrored traffic for this session.

uplink - A port configured to receive or transmit remotely mirrored traffic.

interface - **ethernet** *unit/port*

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Only 802.1Q trunk or hybrid (i.e., general use) ports can be configured as an RSPAN uplink port – access ports are not allowed (see switchport mode).
- Only one uplink port can be configured on a source switch, but there is no limitation on the number of uplink ports configured on an intermediate or destination switch.
- Only destination and uplink ports will be assigned by the switch as members of this VLAN. Ports cannot be manually assigned to an RSPAN VLAN with the switchport allowed vlan command. Nor can GVRP dynamically add port members to an RSPAN VLAN. Also, note that the show vlan command will not display any members for an RSPAN VLAN, but will only show configured RSPAN VLAN identifiers.

Example

The following example enables RSPAN on VLAN 2, specifies this device as an RSPAN destination switch, and the uplink interface as port 3:

```
Console(config)#rspan session 1 remote vlan 2 destination uplink ethernet 1/3
Console(config)#
```

no rspan session

Use this command to delete a configured RSPAN session.

Syntax

no rspan session *session-id*

session-id – A number identifying this RSPAN session. (Range: 1-3)

Three sessions are allowed, including both local and remote mirroring, using different VLANs for RSPAN sessions.

Command Mode

Global Configuration

Command Usage

The **no rspan session** command must be used to disable an RSPAN VLAN before it can be deleted from the VLAN database (see the vlan command).

Example

```
Console(config)#no rspan session 1
Console(config)#
```

show rspan

Use this command to displays the configuration settings for an RSPAN session.

Syntax

show rspan session [*session-id*]

session-id – A number identifying this RSPAN session. (Range: 1-3)

Three sessions are allowed, including both local and remote mirroring, using different VLANs for RSPAN sessions.

Command Mode

Privileged Exec

Example

```
Console#show rspan session
RSPAN Session ID                : 1
Source Ports (mirrored ports)   : None
  RX Only                       : None
  TX Only                       : None
  BOTH                          : None
Destination Port (monitor port) : Eth 1/2
Destination Tagged Mode         : Untagged
Switch Role                     : Destination
RSPAN VLAN                      : 2
RSPAN Uplink Ports              : Eth 1/3
Operation Status                : Up
Console#
```

15 Congestion Control Commands

The switch can set the maximum upload or download data transfer rate for any port. It can control traffic storms by setting a maximum threshold for broadcast traffic or multicast traffic. It can also set bounding thresholds for broadcast and multicast storms which can be used to automatically trigger rate limits or to shut down a port.

Table 68: Congestion Control Commands

Command Group	Function
Rate Limiting	Sets the input and output rate limits for a port.
Storm Control	Sets the traffic storm threshold for each port.
Automatic Traffic Control Commands	Sets thresholds for broadcast and multicast storms which can be used to trigger configured rate limits or to shut down a port.

Rate Limit Commands

Rate limit commands allow the network manager to control the maximum rate for traffic transmitted or received on an interface. Rate limiting is configured on interfaces at the edge of a network to limit traffic into or out of the network. Packets that exceed the acceptable amount of traffic are dropped.

Rate limiting can be applied to individual ports or trunks. When an interface is configured with this feature, the traffic rate will be monitored by the hardware to verify conformity. Non-conforming traffic is dropped.

Table 69: Rate Limit Commands

Command	Function	Mode
rate-limit	Configures the maximum input or output rate for an interface	IC

rate-limit

This command defines the rate limit for a specific interface. Use this command without specifying a rate to enable rate limiting. Use the **no** form to disable rate limiting.

Syntax

rate-limit {**input** | **output**} [*rate*]

no rate-limit {**input** | **output**}

input – Input rate for specified interface

output – Output rate for specified interface

rate – Maximum value in kbps.
(Range: 64 - 1,000,000 kbits per second for Gigabit Ethernet ports;
64 - 10,000,000 kbits per second for 10 Gigabit Ethernet ports;
64 - 25,000,000 kbits per second for 25 Gigabit Ethernet ports)
64 - 40,000,000 kbits per second for 40 Gigabit Ethernet ports;
64 - 100,000,000 kbits per second for 100 Gigabit Ethernet ports

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Using both rate limiting and storm control on the same interface may lead to unexpected results. It is therefore not advisable to use both of these commands on the same interface.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#rate-limit input 64
Console(config-if)#
```

Storm Control Commands

Storm control commands can be used to configure broadcast, multicast, and unknown unicast storm control thresholds. Traffic storms may occur when a device on your network is malfunctioning, or if application programs are not well designed or properly configured. If there is too much traffic on your network, performance can be severely degraded or everything can come to complete halt.

You can protect your network from traffic storms by setting a threshold for broadcast, multicast or unknown unicast traffic. Any packets exceeding the specified threshold will then be dropped.

Table 70: Rate Limit Commands

Command	Function	Mode
switchport packet-rate	Configures broadcast, multicast, and unknown unicast storm control thresholds	IC
show interfaces switchport	Displays the administrative and operational status of an interface	NE, PE

switchport packet-rate

This command configures broadcast, multicast and unknown unicast storm control. Use the **no** form to restore the default setting.

Syntax

switchport {**broadcast** | **multicast** | **unknown-unicast**} **packet-rate** *rate*

no switchport {**broadcast** | **multicast** | **unknown-unicast**}

broadcast - Specifies storm control for broadcast traffic.

multicast - Specifies storm control for multicast traffic.

unknown-unicast - Specifies storm control for unknown unicast traffic.

rate - Threshold level as a rate; i.e. (Range: 500–148810000 pps)

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- When traffic exceeds the threshold specified for broadcast and multicast or unknown unicast traffic, packets exceeding the threshold are dropped until the rate falls back down beneath the threshold.

- Using both rate limiting and storm control on the same interface may lead to unexpected results. It is therefore not advisable to use both of these commands on the same interface.

Example

The following shows how to configure broadcast storm control at 600 packets per second:

```
Console(config)#interface ethernet 1/5
Console(config-if)#switchport broadcast packet-rate 600
Console(config-if)#
```

Automatic Traffic Control Commands

Automatic Traffic Control (ATC) configures bounding thresholds for broadcast and multicast storms which can be used to trigger configured rate limits or to shut down a port.

Table 71: ATC Commands

Command	Function	Mode
Threshold Commands		
auto-traffic-control apply-timer	Sets the time at which to apply the control response after ingress traffic has exceeded the upper threshold	GC
auto-traffic-control release-timer	Sets the time at which to release the control response after ingress traffic has fallen beneath the lower threshold	GC
auto-traffic-control*	Enables automatic traffic control for broadcast or multicast storms	IC (Port)
auto-traffic-control action	Sets the control action to limit ingress traffic or shut down the offending port	IC (Port)
auto-traffic-control alarm-clear-threshold	Sets the lower threshold for ingress traffic beneath which a cleared storm control trap is sent	IC (Port)
auto-traffic-control alarm-fire-threshold	Sets the upper threshold for ingress traffic beyond which a storm control response is triggered after the apply timer expires	IC (Port)
auto-traffic-control auto-control-release	Automatically releases a control response	IC (Port)
auto-traffic-control auto-control-release-shutdown	Automatically releases a port shutdown response	IC (Port)
auto-traffic-control control-release	Manually releases a control response	PE
ATC Trap Commands		
snmp-server enable port-traps atc broadcast-alarm-clear	Sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered	IC (Port)
snmp-server enable port-traps atc broadcast-alarm-fire	Sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control	IC (Port)

Table 71: ATC Commands (Continued)

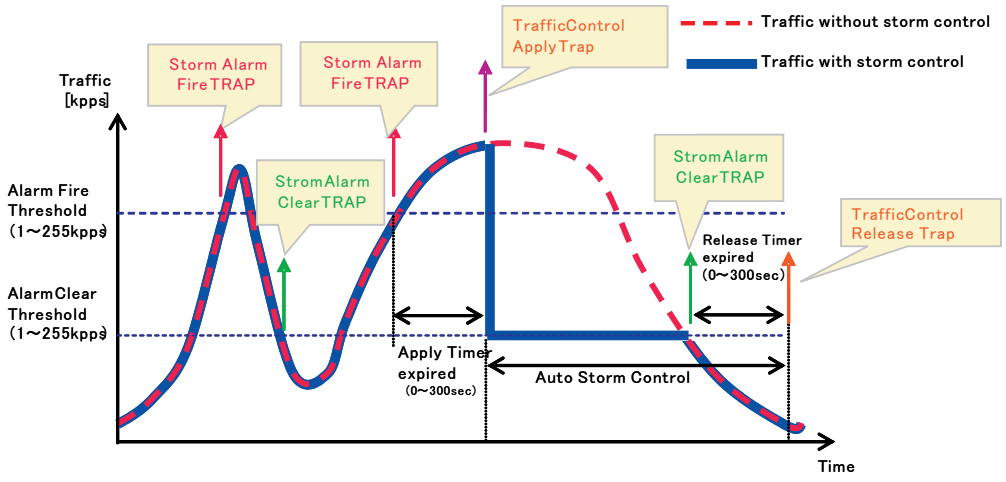
Command	Function	Mode
snmp-server enable port-traps atc broadcast-control-apply	Sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control and the apply timer expires	IC (Port)
snmp-server enable port-traps atc broadcast-control-release	Sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires	IC (Port)
snmp-server enable port-traps atc multicast-alarm-clear	Sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered	IC (Port)
snmp-server enable port-traps atc multicast-alarm-fire	Sends a trap when multicast traffic exceeds the upper threshold for automatic storm control	IC (Port)
snmp-server enable port-traps atc multicast-control-apply	Sends a trap when multicast traffic exceeds the upper threshold for automatic storm control and the apply timer expires	IC (Port)
snmp-server enable port-traps atc multicast-control-release	Sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires	IC (Port)
ATC Display Commands		
show auto-traffic-control	Shows global configuration settings for automatic storm control	PE
show auto-traffic-control interface	Shows interface configuration settings and storm control status for the specified port	PE

* Enabling automatic storm control on a port will disable hardware-level storm control on the same port if configured by the switchport packet-rate command.

Usage Guidelines

ATC includes storm control for broadcast or multicast traffic. The control response for either of these traffic types is the same, as shown in the following diagrams.

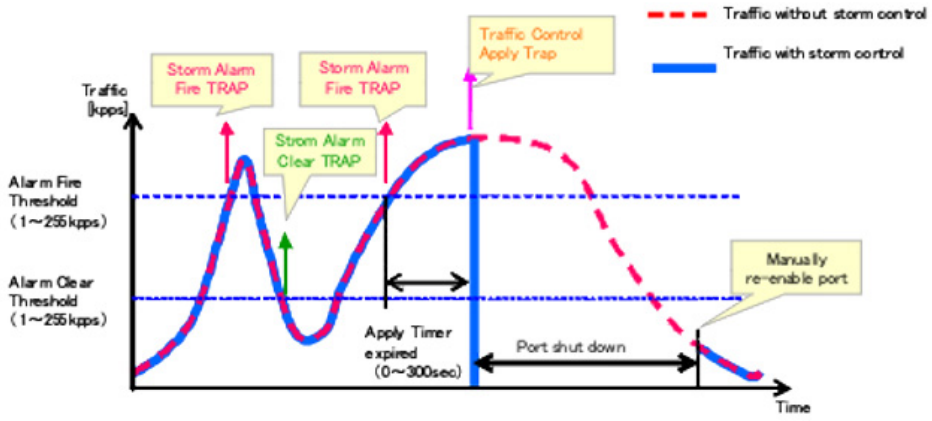
Figure 3: Storm Control by Limiting the Traffic Rate



The key elements of this diagram are described below:

- Alarm Fire Threshold – The highest acceptable traffic rate. When ingress traffic exceeds the threshold, ATC sends a Storm Alarm Fire Trap and logs it.
- When traffic exceeds the alarm fire threshold and the apply timer expires, a traffic control response is applied, and a Traffic Control Apply Trap is sent and logged.
- Alarm Clear Threshold – The lower threshold beneath which a control response can be automatically terminated after the release timer expires. When ingress traffic falls below this threshold, ATC sends a Storm Alarm Clear Trap and logs it.
- When traffic falls below the alarm clear threshold after the release timer expires, traffic control (for rate limiting) will be stopped and a Traffic Control Release Trap sent and logged. Note that if the control action has shut down a port, it can only be manually re-enabled using the auto-traffic-control control-release command).
- The traffic control response of rate limiting can be released automatically or manually. The control response of shutting down a port can be released automatically or manually.

Figure 4: Storm Control by Shutting Down a Port



The key elements of this diagram are the same as that described in the preceding diagram, except that automatic release of the control response is not provided. When traffic control is applied, you must manually re-enable the port.

Functional Limitations

Automatic storm control is a software level control function. Traffic storms can also be controlled at the hardware level using the switchport packet-rate command. However, only one of these control types can be applied to a port. Enabling automatic storm control on a port will disable hardware-level storm control on that port.

Threshold Commands

auto-traffic-control apply-timer

This command sets the time at which to apply the control response after ingress traffic has exceeded the upper threshold. Use the **no** form to restore the default setting.

Syntax

auto-traffic-control {**broadcast** | **multicast**} **apply-timer** *seconds*

no auto-traffic-control {**broadcast** | **multicast**} **apply-timer**

broadcast - Specifies automatic storm control for broadcast traffic.

multicast - Specifies automatic storm control for multicast traffic.

seconds - The interval after the upper threshold has been exceeded at which to apply the control response. (Range: 5-300 seconds)

Default Setting

300 seconds

Command Mode

Global Configuration

Command Usage

After the apply timer expires, a control action may be triggered as specified by the auto-traffic-control action command and a trap message sent as specified by the snmp-server enable port-traps atc broadcast-control-apply command or snmp-server enable port-traps atc multicast-control-apply command.

Example

This example sets the apply timer to 200 seconds for all ports.

```
Console(config)#auto-traffic-control broadcast apply-timer 200
Console(config)#
```

auto-traffic-control release-timer

This command sets the time at which to release the control response after ingress traffic has fallen beneath the lower threshold. Use the **no** form to restore the default setting.

Syntax

auto-traffic-control {**broadcast** | **multicast**} **release-timer** *seconds*

no auto-traffic-control {**broadcast** | **multicast**} **release-timer**

broadcast - Specifies automatic storm control for broadcast traffic.

multicast - Specifies automatic storm control for multicast traffic.

seconds - The time at which to release the control response after ingress traffic has fallen beneath the lower threshold. (Range: 5-900 seconds)

Default Setting
900 seconds

Command Mode
Global Configuration

Command Usage
This command sets the delay after which the control response can be terminated. The auto-traffic-control auto-control-release command must be used to enable or disable the automatic release of a control response of rate-limiting. To re-enable a port which has been shut down by automatic traffic control, you must manually re-enable the port using the auto-traffic-control control-release command.

Example
This example sets the release timer to 800 seconds for all ports.

```
Console(config)#auto-traffic-control broadcast release-timer 800
Console(config)#
```

auto-traffic-control

This command enables automatic traffic control for broadcast or multicast storms. Use the **no** form to disable this feature.

Syntax

[no] **auto-traffic-control** {**broadcast** | **multicast**}

broadcast - Specifies automatic storm control for broadcast traffic.

multicast - Specifies automatic storm control for multicast traffic.

Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet)

Command Usage
- Automatic storm control can be enabled for either broadcast or multicast traffic. It cannot be enabled for both of these traffic types at the same time.
- Automatic storm control is a software level control function. Traffic storms can also be controlled at the hardware level using the switchport packet-rate command. However, only one of these control types can be applied to a port. Enabling automatic storm control on a port will disable hardware-level storm control on that port.

Example

This example enables automatic storm control for broadcast traffic on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#auto-traffic-control broadcast
Console(config-if)#
```

auto-traffic-control action

This command sets the control action to limit ingress traffic or shut down the offending port. Use the **no** form to restore the default setting.

Syntax

auto-traffic-control {**broadcast** | **multicast**} **action** {**rate-control** | **shutdown**}

no auto-traffic-control {**broadcast** | **multicast**} **action**

broadcast - Specifies automatic storm control for broadcast traffic.

multicast - Specifies automatic storm control for multicast traffic.

rate-control - If a control response is triggered, the rate of ingress traffic is limited based on the threshold configured by the auto-traffic-control alarm-clear-threshold command.

shutdown - If a control response is triggered, the port is administratively disabled. A port disabled by automatic traffic control can only be manually re-enabled.

Default Setting

rate-control

Command Mode

Interface Configuration (Ethernet)

Command Usage

- When the upper threshold is exceeded and the apply timer expires, a control response will be triggered based on this command.
- When the control response is set to rate limiting by this command, the rate limits are determined by the auto-traffic-control alarm-clear-threshold command.
- If the control response is to limit the rate of ingress traffic, it can be automatically terminated once the traffic rate has fallen beneath the lower threshold and the release timer has expired.
- If a port has been shut down by a control response, it will not be re-enabled by automatic traffic control. It can only be manually re-enabled using the auto-traffic-control control-release command.

Example

This example sets the control response for broadcast traffic on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#auto-traffic-control broadcast action shutdown
Console(config-if)#
```

auto-traffic-control alarm-clear-threshold

This command sets the lower threshold for ingress traffic beneath which a control response for rate limiting will be released after the Release Timer expires, if so configured by the auto-traffic-control auto-control-release command. Use the **no** form to restore the default setting.

Syntax

auto-traffic-control {**broadcast** | **multicast**} **alarm-clear-threshold** *threshold*

no auto-traffic-control {**broadcast** | **multicast**} **alarm-clear-threshold**

broadcast - Specifies automatic storm control for broadcast traffic.

multicast - Specifies automatic storm control for multicast traffic.

threshold - The lower threshold for ingress traffic beneath which a cleared storm control trap is sent. (Range: 1-255 kilo-packets per second)

Default Setting

128 kilo-packets per second

Command Mode

Interface Configuration (Ethernet)

Command Usage

- Once the traffic rate falls beneath the lower threshold, a trap message may be sent if configured by the snmp-server enable port-traps atc broadcast-alarm-clear command or snmp-server enable port-traps atc multicast-alarm-clear command.

- If rate limiting has been configured as a control response, it will be discontinued after the traffic rate has fallen beneath the lower threshold, and the release timer has expired. Note that if a port has been shut down by a control response, it will not be re-enabled by automatic traffic control. It can only be manually re-enabled using the auto-traffic-control control-release command.

Example

This example sets the clear threshold for automatic storm control for broadcast traffic on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#auto-traffic-control broadcast alarm-clear-threshold 155
Console(config-if)#
```

auto-traffic-control alarm-fire-threshold

This command sets the upper threshold for ingress traffic beyond which a storm control response is triggered after the apply timer expires. Use the **no** form to restore the default setting.

Syntax

auto-traffic-control {**broadcast** | **multicast**} **alarm-fire-threshold** *threshold*

no auto-traffic-control {**broadcast** | **multicast**} **alarm-fire-threshold**

broadcast - Specifies automatic storm control for broadcast traffic.

multicast - Specifies automatic storm control for multicast traffic.

threshold - The upper threshold for ingress traffic beyond which a storm control response is triggered after the apply timer expires. (Range: 1-255 kilo-packets per second)

Default Setting

128 kilo-packets per second

Command Mode

Interface Configuration (Ethernet)

Command Usage

- Once the upper threshold is exceeded, a trap message may be sent if configured by the snmp-server enable port-traps atc broadcast-alarm-fire command or snmp-server enable port-traps atc multicast-alarm-fire command.

- After the upper threshold is exceeded, the control timer must first expire as configured by the auto-traffic-control apply-timer command before a control response is triggered if configured by the auto-traffic-control action command.

Example

This example sets the trigger threshold for automatic storm control for broadcast traffic on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#auto-traffic-control broadcast alarm-fire-threshold 255
Console(config-if)#
```

auto-traffic-control auto-control-release

This command automatically releases a control response of rate-limiting after the time specified in the auto-traffic-control release-timer command has expired.

Syntax

auto-traffic-control {broadcast | multicast} auto-control-release

broadcast - Specifies automatic storm control for broadcast traffic.

multicast - Specifies automatic storm control for multicast traffic.

Command Mode

Interface Configuration (Ethernet)

Command Usage

- This command can be used to automatically stop a control response of rate-limiting after the specified action has been triggered and the release timer has expired.
- To release a control response which has shut down a port after the specified action has been triggered and the release timer has expired, use the auto-traffic-control control-release command.

Example

```
Console(config-if)#auto-traffic-control broadcast auto-control-release
Console(config-if)#
```

auto-traffic-control auto-control-release-shutdown

This command automatically releases a port shutdown response after the time specified in the auto-traffic-control release-timer command has expired.

Syntax

auto-traffic-control {broadcast | multicast} auto-control-release-shutdown

broadcast - Specifies automatic storm control for broadcast traffic.

multicast - Specifies automatic storm control for multicast traffic.

Command Mode

Interface Configuration (Ethernet)

Command Usage

This command can be used to automatically release a port shutdown response after the action has been triggered and the release timer has expired.

Example

```
Console(config-if)#auto-traffic-control broadcast auto-control-release-
  shutdown
Console(config-if)#
```

auto-traffic-control control-release

This command manually releases a control response for the specified Ethernet port.

Syntax

auto-traffic-control {broadcast | multicast} control-release interface *interface*

broadcast - Specifies automatic storm control for broadcast traffic.

multicast - Specifies automatic storm control for multicast traffic.

interface

ethernet *unit/port-list*

unit - Unit identifier.

port-list - Physical port number or list of port numbers. Separate nonconsecutive port numbers with a comma and no spaces; or use a hyphen to designate a range of port numbers.

Command Mode

Privileged Exec

Command Usage

This command can be used to manually stop a control response of rate-limiting or port shutdown any time after the specified action has been triggered.

Example

```
Console#auto-traffic-control broadcast control-release interface ethernet 1/1
Console#
```

SNMP Trap Commands

snmp-server enable port-traps atc broadcast-alarm-clear

This command sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered. Use the no form to disable this trap.

Syntax

[no] snmp-server enable port-traps atc broadcast-alarm-clear

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc broadcast-alarm-clear
Console(config-if)#
```

snmp-server enable port-traps atc broadcast-alarm-fire

This command sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control. Use the **no** form to disable this trap.

Syntax

[no] snmp-server enable port-traps atc broadcast-alarm-fire

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc broadcast-alarm-fire
Console(config-if)#
```

snmp-server enable port-traps atc broadcast-control-apply

This command sends a trap when broadcast traffic exceeds the upper threshold for automatic storm control and the apply timer expires. Use the **no** form to disable this trap.

Syntax

[no] snmp-server enable port-traps atc broadcast-control-apply

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc broadcast-control-apply
Console(config-if)#
```

snmp-server enable port-traps atc broadcast-control-release

This command sends a trap when broadcast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires. Use the **no** form to disable this trap.

Syntax

[no] snmp-server enable port-traps atc broadcast-control-release

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc broadcast-control-
  release
Console(config-if)#
```

snmp-server enable port-traps atc multicast-alarm-clear

This command sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered. Use the **no** form to disable this trap.

Syntax

[no] snmp-server enable port-traps atc multicast-alarm-clear

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc multicast-alarm-clear
Console(config-if)#
```

snmp-server enable port-traps atc multicast-alarm-fire

This command sends a trap when multicast traffic exceeds the upper threshold for automatic storm control. Use the **no** form to disable this trap.

Syntax

[no] snmp-server enable port-traps atc multicast-alarm-fire

Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet)

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc multicast-alarm-fire
Console(config-if)#
```

snmp-server enable port-traps atc multicast-control-apply

This command sends a trap when multicast traffic exceeds the upper threshold for automatic storm control and the apply timer expires. Use the **no** form to disable this trap.

Syntax

[no] snmp-server enable port-traps atc multicast-control-apply

Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet)

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc multicast-control-apply
Console(config-if)#
```

snmp-server enable port-traps atc multicast-control-release

This command sends a trap when multicast traffic falls beneath the lower threshold after a storm control response has been triggered and the release timer expires. Use the **no** form to disable this trap.

Syntax

[no] snmp-server enable port-traps atc multicast-control-release

Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet)

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#snmp-server enable port-traps atc multicast-control-
  release
Console(config-if)#
```

ATC Display Commands

show auto-traffic-control

This command shows global configuration settings for automatic storm control.

Command Mode

Privileged Exec

Example

```
Console#show auto-traffic-control

Storm-control: Broadcast
 Apply-timer (sec)    : 300
 release-timer (sec) : 900

Storm-control: Multicast
 Apply-timer(sec)     : 300
 release-timer(sec)   : 900
Console#
```

show auto-traffic-control interface

This command shows interface configuration settings and storm control status for the specified port.

Syntax

show auto-traffic-control interface [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode

Privileged Exec

Example

```
Console#show auto-traffic-control interface ethernet 1/1
Eth 1/1 Information
Eth 1/1 Information
------------------------------------------------------------------------
Storm Control                  : Broadcast             Multicast
State                          : Disabled              Disabled
Action                         : Rate Control          Rate Control
```

```
Auto Release Control            : Disabled              Disabled
Auto Release Control-Shutdown   : Disabled              Disabled
Alarm Fire Threshold (kpps)     : 128                   128
Alarm Clear Threshold (kpps)    : 128                   128
Trap Storm Fire                 : Disabled              Disabled
Trap Storm Clear                : Disabled              Disabled
Trap Traffic Apply              : Disabled              Disabled
Trap Traffic Release            : Disabled              Disabled
-------------------------------------------------------------------------

Console#
```

16 Loopback Detection Commands

The switch can be configured to detect general loopback conditions caused by hardware problems or faulty protocol settings. When enabled, a control frame is transmitted on the participating ports, and the switch monitors inbound traffic to see if the frame is looped back.

Table 72: Loopback Detection Commands

Command	Function	Mode
loopback-detection	Enables loopback detection globally on the switch or on a specified interface	GC, IC
loopback-detection action	Specifies the response to take for a detected loopback condition	GC
loopback-detection recover-time	Specifies the interval to wait before releasing an interface from shutdown state	GC
loopback-detection transmit-interval	Specifies the interval at which to transmit loopback detection control frames	GC
loopback detection trap	Configures the switch to send a trap when a loopback condition is detected or the switch recover from a loopback	GC
loopback-detection release	Manually releases all interfaces currently shut down by the loopback detection feature	PE
show loopback-detection	Shows loopback detection configuration settings for the switch or for a specified interface	PE

Usage Guidelines

- The default settings for the control frame transmit interval and recover time may be adjusted to improve performance for your specific environment. The shutdown mode may also need to be changed once you determine what kind of packets are being looped back.

- When a loopback event is detected on an interface or when a interface is released from a shutdown state caused by a loopback event, a trap message is sent and the event recorded in the system log.

- Loopback detection must be enabled both globally and on an interface for loopback detection to take effect.

loopback-detection

This command enables loopback detection globally on the switch or on a specified interface. Use the **no** form to disable loopback detection.

Syntax

[no] loopback-detection

Default Setting

Enabled

Command Mode

Global Configuration
Interface Configuration (Ethernet, Port Channel)

Command Usage

- Loopback detection must be enabled globally for the switch by this command and enabled for a specific interface for this function to take effect.
- Loopback detection cannot be enabled globally if ingress filtering of any port whose loopback detection is enabled cannot be enabled.
- Loopback detection cannot be enabled for a port if ingress filtering cannot be enabled.
- When loopback detection is enabled globally and for a port, the ingress filtering of the port is automatically enabled. The ingress filtering setting is restored after loopback detection is disabled globally or for the port.

Example

This example enables general loopback detection on the switch, disables loopback detection provided for the spanning tree protocol on port 1, and then enables general loopback detection for that port.

```
Console(config)#loopback-detection
Console(config)#interface ethernet 1/1
Console(config-if)#loopback-detection
Console(config)#
```

loopback-detection action

This command specifies the protective action the switch takes when a loopback condition is detected. Use the **no** form to restore the default setting.

Syntax

loopback-detection action {none | shutdown}

no loopback-detection action

none - No action is taken.

shutdown - Shuts down the interface.

Default Setting
Shut down

Command Mode
Global Configuration

Command Usage
- When a port receives a control frame sent by itself, this means that the port is in a looped state, and the VLAN in the frame payload is also in looped state. The looped port is therefore shut down.

- Use the loopback-detection recover-time command to set the time to wait before re-enabling an interface shut down by the loopback detection process.

Example
This example sets the loopback detection mode to shut down user traffic.

```
Console(config)#loopback-detection action shutdown
Console(config)#
```

loopback-detection recover-time

This command specifies the interval to wait before the switch automatically releases an interface from shutdown state. Use the **no** form to restore the default setting.

Syntax

loopback-detection recover-time *seconds*

no loopback-detection recover-time

seconds - Recovery time from shutdown state. (Range: 60-1,000,000 seconds, or 0 to disable automatic recovery)

Default Setting
60 seconds

Command Mode
Global Configuration

Command Usage
If the recovery time is set to zero, all ports placed in shutdown state can be restored to operation using the loopback-detection release command. To restore a specific port, use the no shutdown command.

Example

```
Console(config)#loopback-detection recover-time 120
Console(config-if)#
```

loopback-detection transmit-interval

This command specifies the interval at which to transmit loopback detection control frames. Use the **no** form to restore the default setting.

Syntax

loopback-detection transmit-interval *seconds*

no loopback-detection transmit-interval

seconds - The transmission interval for loopback detection control frames. (Range: 1-32767 seconds)

Default Setting

10 seconds

Command Mode

Global Configuration

Example

```
Console(config)#loopback-detection transmit-interval 60
Console(config)#
```

loopback detection trap

This command sends a trap when a loopback condition is detected, or when the switch recovers from a loopback condition. Use the **no** form to restore the default state.

Syntax

loopback-detection trap [**both** | **detect** | **none** | **recover**]

no loopback-detection trap

both - Sends an SNMP trap message when a loopback condition is detected, or when the switch recovers from a loopback condition.

detect - Sends an SNMP trap message when a loopback condition is detected.

none - Does not send an SNMP trap for loopback detection or recovery.

recover - Sends an SNMP trap message when the switch recovers from a loopback condition.

Default Setting

None

Command Mode

Global Configuration

Command Usage
Refer to the loopback-detection recover-time command for information on conditions which constitute loopback recovery.

Example
```
Console(config)#loopback-detection trap both
Console(config)#
```

loopback-detection release
This command releases all interfaces currently shut down by the loopback detection feature.

Syntax
loopback-detection release

Command Mode
Privileged Exec

Example
```
Console#loopback-detection release
Console#
```

show loopback-detection
This command shows loopback detection configuration settings for the switch or for a specified interface.

Syntax
show loopback-detection [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

channel-id - Port-channel interface number.

Command Mode
Privileged Exec

Command Usage
Although global action may be set to None, this command will still display the configured Detection Port Admin State and Information Oper State.

Example

```
Console#show loopback-detection
Loopback Detection Global Information
 Global Status     : Enabled
 Transmit Interval : 10
 Recover Time      : 60
 Action            : Shutdown
 Trap              : None
Loopback Detection Port Information
 Port      Admin State  Oper State
 --------  -----------  ----------
 Eth 1/ 1  Enabled      Normal
 Eth 1/ 2  Disabled     Normal
 Eth 1/ 3  Disabled     Normal
⋮
Console#show loopback-detection ethernet 1/1
Loopback Detection Information of Eth 1/1
 Admin State : Enabled
 Oper State  : Normal
 Looped VLAN : None
Console#
```

17 UniDirectional Link Detection Commands

The switch can be configured to detect and disable unidirectional Ethernet fiber or copper links. When enabled, the protocol advertises a port's identity and learns about its neighbors on a specific LAN segment; and stores information about its neighbors in a cache. It can also send out a train of echo messages under circumstances that require fast notifications or re-synchronization of the cached information.

Table 73: UniDirectional Link Detection Commands

Command	Function	Mode
udld detection-interval	Sets the amount of time the switch remains in detection state after discovering a neighbor	GC
udld message-interval	Configures the message interval between UDLD probe messages	GC
udld recovery	Automatically recovers from UDLD disabled port state after a period specified by the udld recovery-interval command	GC
udld recovery-interval	Specifies the period after which to automatically recover from UDLD disabled port state	GC
udld aggressive	Sets UDLD to aggressive mode on an interface	IC
udld port	Enables UDLD on a port	IC
show udld	Shows UDLD configuration settings and operational status	PE

udld detection-interval

This command sets the amount of time the switch remains in detection state after discovering a neighbor. Use the **no** form to restore the default setting.

Syntax

udld detection-interval *detection-interval*

no udld detection-interval

detection-interval – The amount of time the switch remains in detection state after discovering a neighbor through UDLD. (Range: 5-255 seconds)

Default Setting

5 seconds

Command Mode

Global Configuration

Command Usage
When a neighbor device is discovered by UDLD, the switch enters "detection state" and remains in this state for specified detection-interval. After the detection-interval expires, the switch tries to decide whether or the link is unidirectional based on the information collected during "detection state."

Example
```
Console(config)#udld detection-interval 10
Console(config)#
```

udld message-interval
This command configures the message interval between UDLD probe messages for ports in the advertisement phase and determined to be bidirectional. Use the **no** form to restore the default setting.

Syntax
udld message-interval *message-interval*

no udld message-interval

message-interval – The interval at which a port sends UDLD probe messages after linkup or detection phases. (Range: 7-90 seconds)

Default Setting
15 seconds

Command Mode
Global Configuration

Command Usage
During the detection phase, messages are exchanged at the maximum rate of one per second. After that, if the protocol reaches a stable state and determines that the link is bidirectional, the message interval is increased to a configurable value based on a curve known as M1(t), a time-based function described in RFC 5171.

If the link is deemed anything other than bidirectional at the end of the detection phase, this curve becomes a flat line with a fixed value of Mfast (7 seconds).

If the link is instead deemed bidirectional, the curve will use Mfast for the first four subsequent message transmissions and then transition to an Mslow value for all other steady-state transmissions. Mslow is the value configured by this command.

Example
This example sets the message interval to 10 seconds.

```
Console(config)#udld message-interval 10
Console(config)#
```

udld recovery

This command configures the switch to automatically recover from UDLD disabled port state after a period specified by the udld recovery-interval command. Use the **no** form to disable this feature.

Syntax

[no] udld recovery

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

When automatic recovery state is changed by this command, any ports shut down by UDLD will be reset.

Example

```
Console(config)#udld recovery
Console(config)#
```

udld recovery-interval

This command specifies the period after which to automatically recover from UDLD disabled port state. Use the **no** form to restore the default setting.

udld recovery-interval *recovery-interval*

no udld recovery-interval

recovery-interval – The interval after which a port is reset after being placed in UDLD disabled state. (Range: 30-86400 seconds)

Default Setting

300 seconds

Command Mode

Global Configuration

Command Usage

- This command is only applicable when automatic recovery has been enabled with the udld recovery command.
- When the recovery interval is changed by this command, any ports shut down by UDLD will be reset.

Example

```
Console(config)#udld recovery-interval 30
Console(config)#
```

udld aggressive

This command sets UDLD to aggressive mode on an interface. Use the **no** form to restore the default setting.

Syntax

[no] udld aggressive

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet Port)

Command Usage

UDLD can function in two modes: normal mode and aggressive mode.

- In normal mode, determination of link status at the end of the detection process is always based on information received in UDLD messages: whether that's information about the exchange of proper neighbor identification or the absence of such. Hence, albeit bound by a timer, normal mode determinations are always based on gleaned information, and as such are "event-based." If no such information can be obtained (e.g., because of a bidirectional loss of connectivity), UDLD follows a conservative approach to minimize false positives during the detection process and deems a port to be in "undetermined" state. In other words, normal mode will shut down a port only if it can explicitly determine that the associated link is faulty for an extended period of time.

- In aggressive mode, UDLD will also shut down a port if it loses bidirectional connectivity with the neighbor for the same extended period of time (as that mentioned above for normal mode) and subsequently fails repeated last-resort attempts to re-establish communication with the other end of the link. This mode of operation assumes that loss of communication with the neighbor is a meaningful network event in itself, and a symptom of a serious connectivity problem. Because this type of detection can be event-less, and lack of information cannot always be associated to an actual malfunction of the link, this mode is recommended only in certain scenarios (typically only on point-to-point links where no communication failure between two neighbors is admissible).

Example
This example enables UDLD aggressive mode on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#udld aggressive
Console(config-if)#
```

udld port
This command enables UDLD on a port. Use the **no** form to disable UDLD on an interface.

Syntax
[no] udld port

Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet Port)

Command Usage
- UDLD requires that all the devices connected to the same LAN segment be running the protocol in order for a potential mis-configuration to be detected and for prompt corrective action to be taken.

- Whenever a UDLD device learns about a new neighbor or receives a resynchronization request from an out-of-synch neighbor, it (re)starts the detection process on its side of the connection and sends N echo messages in reply. (This mechanism implicitly assumes that N packets are sufficient to get through a link and reach the other end, even though some of them might get dropped during the transmission.)

  Since this behavior must be the same on all the neighbors, the sender of the echoes expects to receive an echo in reply. If the detection process ends without the proper echo information being received, the link is considered to be unidirectional.

Example
```
Console(config)#interface ethernet 1/1
Console(config-if)#udld port
Console(config-if)#
```

show udld

This command shows UDLD configuration settings and operational status for the switch or for a specified interface.

Syntax

show udld [**interface** *interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode

Privileged Exec

Example

```
Console#show udld
Message Interval   : 15
Detection Interval : 5 seconds
Recovery           : Disabled
Recovery Interval  : 300 seconds

Interface UDLD     Mode       Oper State                          Msg Invl
                              Port State                          Det Invl
--------- -------- ---------- ----------------------------------- --------
Eth 1/ 1  Disabled Normal     Disabled                                 7 s
                              Unknown                                  5 s
Eth 1/ 2  Disabled Normal     Disabled                                 7 s
                              Unknown                                  5 s
Eth 1/ 3  Disabled Normal     Disabled                                 7 s
                              Unknown                                  5 s
Eth 1/ 4  Disabled Normal     Disabled                                 7 s
                              Unknown                                  5 s
Eth 1/ 5  Disabled Normal     Disabled                                 7 s
                              Unknown                                  5 s

:
Console#show udld interface ethernet 1/1
Interface UDLD     Mode       Oper State                          Msg Invl
                              Port State                          Det Invl
--------- -------- ---------- ----------------------------------- --------
Eth 1/ 1  Disabled Normal     Disabled                                 7 s
                              Unknown                                  5 s

Console#
```

18 Address Table Commands

These commands are used to configure the address table for filtering specified addresses, displaying current entries, clearing the table, or setting the aging time.

Table 74: Address Table Commands

Command	Function	Mode
mac-address-table aging-time	Sets the aging time of the address table	GC
mac-address-table hash-lookup-depth	Sets the hash lookup depth of MAC address table	GC
mac-address-table static	Maps a static address to a port in a VLAN	GC
clear mac-address-table dynamic	Removes any learned entries from the forwarding database	PE
show mac-address-table	Displays entries in the bridge-forwarding database	PE
show mac-address-table aging-time	Shows the aging time for the address table	PE
show mac-address-table count	Shows the number of MAC addresses used and the number of available MAC addresses	PE
show mac-address-table hash-lookup-depth	Shows the hash lookup depth of MAC address table	PE

mac-address-table aging-time

This command sets the aging time for entries in the address table. Use the **no** form to restore the default aging time.

Syntax

mac-address-table aging-time *seconds*

no mac-address-table aging-time

seconds - Aging time. (Range: 6-7200 seconds; 0 to disable aging)

Default Setting

300 seconds

Command Mode

Global Configuration

Command Usage

The aging time is used to age out dynamically learned forwarding information.

Example

```
Console(config)#mac-address-table aging-time 100
Console(config)#
```

mac-address-table hash-lookup-depth

This command sets the hash lookup depth used when searching the MAC address table. Use the **no** form to restore the default setting.

Syntax

mac-address-table hash-lookup-depth *depth*

no mac-address-table hash-lookup-depth

depth - The depth used in the hash lookup process. (Range: 4-32, in multiples of 4)

Default Setting

4

Command Mode

Global Configuration

Command Usage

Using the default depth of 4, MAC address collisions tend to increase once more than 8K entries have been learned. Setting the depth to a larger value reduces the occurrence of hash collisions, but can also decrease forwarding performance.

Example

```
Console(config)#mac-address-table hash-lookup-depth 5
Console(config)#
```

mac-address-table static

This command maps a static address to a destination port in a VLAN. Use the **no** form to remove an address.

Syntax

mac-address-table static *mac-address* **interface** *interface* **vlan** *vlan-id* [*action*]

no mac-address-table static *mac-address* **vlan** *vlan-id*

mac-address - MAC address.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan-id - VLAN ID (Range: 1-4094)

action -

delete-on-reset - Assignment lasts until the switch is reset.

permanent - Assignment is permanent.

Default Setting

No static addresses are defined. The default lifetime is **permanent**.

Command Mode

Global Configuration

Command Usage

The static address for a host device can be assigned to a specific port within a specific VLAN. Use this command to add static addresses to the MAC Address Table. Static addresses have the following characteristics:

- Static addresses will not be removed from the address table when a given interface link is down.
- Static addresses are bound to the assigned interface and will not be moved. When a static address is seen on another interface, the address will be ignored and will not be written to the address table.
- A static address cannot be learned on another port until the address is removed with the **no** form of this command.

Example

```
Console(config)#mac-address-table static 00-e0-29-94-34-de interface ethernet
  1/1 vlan 1 delete-on-reset
Console(config)#
```

clear mac-address-table dynamic

This command removes any learned entries from the forwarding database.

Syntax

clear mac-address-table dynamic [[**all**] | [**address** *mac-address* [*mask*]] | [**interface** *interface*] | [**vlan** *vlan-id*]]

all - all learned entries

address *mac-address* - MAC address.

mask - Bits to match in the address.

interface *interface*

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* - VLAN ID (Range: 1-4094)

Default Setting
None

Command Mode
Privileged Exec

Example

```
Console#clear mac-address-table dynamic all
Console#
```

show mac-address-table

This command shows classes of entries in the bridge-forwarding database.

Syntax

show mac-address-table [**address** *mac-address* [*mask*]] [**interface** *interface*] [**vlan** *vlan-id*] [**sort** {**address** | **vlan** | **interface**}]

mac-address - MAC address.

mask - Bits to match in the address.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan-id - VLAN ID (Range: 1-4094)

sort - Sort by address, vlan or interface.

Default Setting
None

Command Mode
Privileged Exec

Command Usage
- The MAC Address Table contains the MAC addresses associated with each interface. Note that the Type field may include the following types:
  - Learn - Dynamic address entries

- Config - Static entry
- Security - Port Security

- The mask should be hexadecimal numbers (representing an equivalent bit mask) in the form xx-xx-xx-xx-xx-xx that is applied to the specified MAC address. Enter hexadecimal numbers, where an equivalent binary bit "0" means to match a bit and "1" means to ignore a bit. For example, a mask of 00-00-00-00-00-00 means an exact match, and a mask of FF-FF-FF-FF-FF-FF means "any."

- The maximum number of address entries is 16K.

Example

```
Console#show mac-address-table
 Interface MAC Address       VLAN Type     Life Time
 --------- ----------------- ---- -------- -----------------
  CPU      00-E0-00-00-00-01    1 CPU      Delete on Reset
  Eth 1/ 1 00-E0-0C-10-90-09    1 Learn    Delete on Timeout
  Eth 1/ 1 00-E0-29-94-34-64    1 Learn    Delete on Timeout
Console#
```

show mac-address-table aging-time

This command shows the aging time for entries in the address table.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show mac-address-table aging-time
 Aging Status : Enabled
 Aging Time: 300 sec.
Console#
```

show mac-address-table hash-algorithm

This command shows the hash table algorithm configured and activated by the switch.

Note: The switch must be rebooted for the activated hash algorithm to become the same as the configured hash algorithm.

Default Setting

None

Command Mode
Privileged Exec

Example

```
Console#show mac-address-table hash-algorithm
 Configured Hash Algorithm: 0
 Activated Hash Algorithm: 1
Console#
```

show mac-address-table count

This command shows the number of MAC addresses used and the number of available MAC addresses for the overall system or for an interface.

Syntax

show mac-address-table count [**interface** *interface* | **vlan** *vlan-id*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* (Range: 1-4094)

Default Setting
None

Command Mode
Privileged Exec

Example

```
Console#show mac-address-table count interface ethernet 1/1

MAC Entries for Eth 1/1
Total Address Count      :0
Static Address Count     :0
Dynamic Address Count    :0
Console#show mac-address-table count

Compute the number of MAC Address...

Maximum number of MAC Address which can be created in the system:
Total Number of MAC Address      : 16384
Number of Static MAC Address     : 1024

Current number of entries which have been created in the system:
Total Number of MAC Address      : 3
Number of Static MAC Address     : 1
Number of Dynamic MAC Address    : 2
Console#
```

show mac-address-table hash-lookup-depth

This command shows the hash lookup depth used when searching the MAC address table.

Syntax

show mac-address-table hash-lookup-depth

Command Mode

Privileged Exec

Example

```
Console#show mac-address-table hash-lookup-depth
 Configured Hash Lookup Depth: 4
 Activated Hash Lookup Depth: 4
Console#
```

19 Smart Pair Commands

Smart Pair Concept

A smart pair consists of two ports which are paired to provide layer 2 link redundancy, The pair consists of a primary port and a backup port. All traffic is forwarded through the primary port and the backup port will be set to standby. If the primary port link goes down, the backup port is activated and all traffic is forwarded through it. If the primary port recovers, all traffic will again be forwarded through the primary port after a configured delay. (wait-to-restore delay).

These commands are used to configure the smart pair ports, set the wait to restore delay, show the smart pairs configured on the switch and restore traffic manually to a configured smart pair.

Table 75: Address Table Commands

Command	Function	Mode
smart-pair	Creates a new Smart Pair with an ID and enters into smart pair configuration mode.	GC
smart-pair restore	Manually restores traffic to a smart pair link that is in the up conditions.	PE
primary-port	Configures the Primary Port of the Smart Pair	smart pair
backup-port	Configures the Backup Port of the Smart Pair	smart pair
wtr-delay	Configures the delay time to wait to restore traffic to a smart pair link after one of the links is restored.	smart pair
show smart-pair	Displays all the currently configured smart pairs and their associated information.	PE

smart-pair

This command creates a smart pair in the switch configuration distinguished by a unique identification number and enters the smart-pair configuration mode. Use the **no** form to delete the smart pair from the switch configuration.

Syntax

smart-pair *ID*

no smart-pair *ID*

ID - Identification Number. (Range: 1-1000)

Default Setting

None

Command Mode
Global Configuration

Command Usage
Use the command to create a new smart pair or to enter the smart-pair configuration mode of an existing smart pair.

Example

```
Console(config)#smart-pair 1
Console(config-smart-pair)#
```

smart-pair restore

Use the smart-pair restore command to manually restore traffic to the primary port of a specified smart pair.

Syntax

smart-pair restore *ID*

ID - Identification Number. (Range: 1-1000)

Default Setting
None

Command Mode
Privileged Exec.

Command Usage
The link of the primary port must be in the up condition for the command to succeed.

Example

```
Console#smart-pair restore 1
Console#
```

primary-port

This command configures the primary port of a specified smart pair. Use the no form of the command to remove the configured primary port from the smart pair.

Syntax

primary-port *interface*

no primary-port

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
None

Command Mode
Smart Pair Configuration Mode

Command Usage
When setting the primary-port of the smart pair the following limitations are enforced:

- Spanning-Tree must be disabled on the port.
- A configured primary port can only be a member of a single smart pair.
- Dynamic trunk ports cannot be configured as a smart pair port (only static trunk ports).
- When a trunk group is identified as a primary port of a smart pair, any members removed from the trunk group will not retain the smart pair settings.
- When all members of trunk group set as a primary port are removed, the primary port is also removed.
- The VLAN mode of the primary-port should not be changed after it is configured otherwise the behavior becomes unpredictable.

Example

```
Console(config-smart-pair)#primary-port ethernet 1/1
Console(config-smart-pair)#
```

backup-port

This command configures the backup port of a specified smart pair. Use the no form of the command to remove the configured backup port from the smart pair.

Syntax

backup-port *interface*

no backup

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
None

Command Mode
Smart Pair Configuration Mode

Command Usage
When setting the backup-port of the smart pair the following limitations are enforced:

- Spanning-Tree must be disabled on the port.
- A configured backup port can only be a member of a single smart pair.
- Dynamic trunk ports cannot be configured as a smart pair port (only static trunk ports).
- When a trunk group is identified as a backup port of a smart pair, any members removed from the trunk group will not retain the smart pair settings.
- When all members of trunk group set as a backup port are removed, the backup port is also removed.
- The VLAN mode of the backup port should not be changed after it is configured otherwise the behavior becomes unpredictable.

Example

```
Console(config-smart-pair)#backup-port ethernet 1/2
Console(config-smart-pair)#
```

wtr-delay

This command sets the wait-to-restore delay for a smart pair. Use the no form of the command to set the delay to the default value.

Syntax

wtr-delay *seconds*

seconds - delay in seconds (Range:0, 5-3600)

Default Setting
None

Command Mode
Smart Pair Configuration Mode

Command Usage
- If the wtr-delay parameter is set to 0, traffic will not be restored after a failed port is recovered.
- If the wtr-delay is set from 5 to 3600 (seconds) and a failed smart port recovers, traffic will be restored to the port after the configured delay in seconds.

Example
```
Console(config-smart-pair)#wtr-delay 120
Console(config-smart-pair)#
```

show smart-pair
This command shows the configured smart pairs on the switch.

Default Setting
None

Command Mode
Privileged Exec

Example
```
Console#show smart-pair
 ID   Primary Port Backup Port
 ---- ------------ -----------
 1    Eth 1/ 1     Eth 1/ 2
Console#
```

20 TWAMP Commands

The Two-Way Active Measurement Protocol (TWAMP) is defined by RFC 5357. TWAMP is an open protocol for measuring network performance between any two devices that support the TWAMP protocol.

TWAMP uses the methodology and architecture of OWAMP (One-Way Active Measurement Protocol, RFC 4656), which defines an open protocol for the measurement of one-way metrics, but extends it to two-way, or round-trip, metrics. TWAMP consists of two protocols; a control protocol and a test session protocol. When starting a performance measurement session, the TWAMP control protocol is used to initiate and set up the test session. The TWAMP test protocol then uses UDP for sending and receiving the test packets for performance measurement.

Table 76: TWAMP Commands

Command	Function	Mode
twamp reflector	Enables TWAMP Session-Reflector on the switch	GC
twamp reflector refwait	Sets the TWAMP Reflector timeout	GC
show twamp reflector	Displays the TWAMP Reflector configuration and sessions on the switch	PE

twamp reflector

This command enables the TWAMP Session-Reflector globally on the switch. Use the no form to disable the TWAMP reflector function.

Syntax

twamp reflector

no twamp reflector

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

The switch only supports the function of a Session-Reflector (RFC 5357). As a Reflector, the switch can receive test packets from a Session Sender and send test packet responses.

Example

```
Console(config)#twamp reflector
Console(config)#
```

twamp reflector refwait

This command sets the TWAMP session timeout on the switch. Use the no form to restore the default.

Syntax

twamp reflector refwait *seconds*

no twamp reflector refwait

seconds - The timeout value in seconds. (Range: 30-3600)

Default Setting

900 seconds

Command Mode

Global Configuration

Command Usage

The Session-Reflector will discontinue any session that has been started when no packet associated with that session has been received for the timeout period.

Example

```
Console(config)#twamp reflector refwait 300
Console(config)#
```

show twamp reflector

This command shows the configured TWAMP Reflector settings and sessions on the switch.

Command Mode

Privileged Exec

Example

```
Console#show twamp reflector
TWAMP Reflector Status: Enabled
TWAMP Reflector REFWAIT: 900 seconds
TWAMP Reflector Mode: Unauthenticated
Total number of sessions: 0

Sender Address     Sender Port  Reflector Address    Reflector Port
-----------------  -----------  -------------------  --------------
Console#
```

21 Spanning Tree Commands

This section includes commands that configure the Spanning Tree Algorithm (STA) globally for the switch, and commands that configure STA for the selected interface.

Table 77: Spanning Tree Commands

Command	Function	Mode
spanning-tree	Enables the spanning tree protocol	GC
spanning-tree cisco-prestandard	Configures spanning tree operation to be compatible with Cisco prestandard versions	GC
spanning-tree forward-time	Configures the spanning tree bridge forward time	GC
spanning-tree hello-time	Configures the spanning tree bridge hello time	GC
spanning-tree max-age	Configures the spanning tree bridge maximum age	GC
spanning-tree mode	Configures STP, RSTP or MSTP mode	GC
spanning-tree mst configuration	Changes to MSTP configuration mode	GC
spanning-tree pathcost method	Configures the path cost method for RSTP/MSTP	GC
spanning-tree priority	Configures the spanning tree bridge priority	GC
spanning-tree system-bpdu-flooding	Floods BPDUs to all other ports or just to all other ports in the same VLAN when global spanning tree is disabled	GC
spanning-tree tc-prop	Configures a topology change propagation domain	GC
spanning-tree transmission-limit	Configures the transmission limit for RSTP/MSTP	GC
max-hops	Configures the maximum number of hops allowed in the region before a BPDU is discarded	MST
mst priority	Configures the priority of a spanning tree instance	MST
mst vlan	Adds VLANs to a spanning tree instance	MST
name	Configures the name for the multiple spanning tree	MST
revision	Configures the revision number for the multiple spanning tree	MST
spanning-tree bpdu-filter	Filters BPDUs for edge ports	IC
spanning-tree bpdu-guard	Shuts down an edge port if it receives a BPDU	IC
spanning-tree cost	Configures the spanning tree path cost of an interface	IC
spanning-tree edge-port	Enables fast forwarding for edge ports	IC
spanning-tree link-type	Configures the link type for RSTP/MSTP	IC
spanning-tree loopback-detection	Enables BPDU loopback detection for a port	IC

Table 77: Spanning Tree Commands (Continued)

Command	Function	Mode
spanning-tree loopback-detection action	Configures the response for loopback detection to block user traffic or shut down the interface	IC
spanning-tree loopback-detection release-mode	Configures loopback release mode for a port	IC
spanning-tree loopback-detection trap	Enables BPDU loopback SNMP trap notification for a port	IC
spanning-tree restricted-tcn	Prevents a TCN from being propagated from an aggregation switch to the uplink port on access switches	IC
spanning-tree mst cost	Configures the path cost of an instance in the MST	IC
spanning-tree mst port-priority	Configures the priority of an instance in the MST	IC
spanning-tree port-bpdu-flooding	Floods BPDUs to other ports when global spanning tree is disabled	IC
spanning-tree port-priority	Configures the spanning tree priority of an interface	IC
spanning-tree root-guard	Prevents a designated port from passing superior BPDUs	IC
spanning-tree spanning-disabled	Disables spanning tree for an interface	IC
spanning-tree tc-prop-stop	Stops propagation of topology change information	IC
spanning-tree loopback-detection release	Manually releases a port placed in discarding state by loopback-detection	PE
spanning-tree protocol-migration	Re-checks the appropriate BPDU format	PE
show spanning-tree	Shows spanning tree configuration for the common spanning tree (i.e., overall bridge), a selected interface, or an instance within the multiple spanning tree	PE
show spanning-tree mst configuration	Shows the multiple spanning tree configuration	PE
show spanning-tree tc-prop	Shows configuration of topology change propagation domains	PE

spanning-tree

This command enables the Spanning Tree Algorithm globally for the switch. Use the **no** form to disable it.

Syntax

[no] spanning-tree

Default Setting

Spanning tree is disabled.

Command Mode

Global Configuration

Command Usage

- The Spanning Tree Algorithm (STA) can be used to detect and disable network loops, and to provide backup links between switches, bridges or routers. This allows the switch to interact with other bridging devices (that is, an STA-compliant switch, bridge or router) in your network to ensure that only one route exists between any two stations on the network, and provide backup links which automatically take over when a primary link goes down.

Example

This example shows how to enable the Spanning Tree Algorithm for the switch:

```
Console(config)#spanning-tree
Console(config)#
```

spanning-tree cisco-prestandard

This command configures spanning tree operation to be compatible with Cisco prestandard versions. Use the **no** form to restore the default setting.

[no] **spanning-tree cisco-prestandard**

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

Cisco prestandard versions prior to Cisco IOS Release 12.2(25)SEC do not fully follow the IEEE standard, causing some state machine procedures to function incorrectly. The command forces the spanning tree protocol to function in a manner compatible with Cisco prestandard versions.

Example

```
Console(config)#spanning-tree cisco-prestandard
Console(config)#
```

spanning-tree forward-time

This command configures the spanning tree bridge forward time globally for this switch. Use the **no** form to restore the default setting.

Syntax

spanning-tree forward-time *seconds*

no spanning-tree forward-time

seconds - Time in seconds. (Range: 4 - 30 seconds)
The minimum value is the higher of 4 or [(max-age / 2) + 1].

Default Setting
15 seconds

Command Mode
Global Configuration

Command Usage
This command sets the maximum time (in seconds) a port will wait before changing states (i.e., discarding to learning to forwarding). This delay is required because every device must receive information about topology changes before it starts to forward frames. In addition, each port needs time to listen for conflicting information that would make it return to the discarding state; otherwise, temporary data loops might result.

Example

```
Console(config)#spanning-tree forward-time 20
Console(config)#
```

spanning-tree hello-time

This command configures the spanning tree bridge hello time globally for this switch. Use the **no** form to restore the default.

Syntax

spanning-tree hello-time *time*

no spanning-tree hello-time

time - Time in seconds. (Range: 1-10 seconds).
The maximum value is the lower of 10 or [(max-age / 2) - 1].

Default Setting
2 seconds

Command Mode
Global Configuration

Command Usage
This command sets the time interval (in seconds) at which the root device transmits a configuration message.

Example

```
Console(config)#spanning-tree hello-time 5
Console(config)#
```

spanning-tree max-age

This command configures the spanning tree bridge maximum age globally for this switch. Use the **no** form to restore the default.

Syntax

spanning-tree max-age *seconds*

no spanning-tree max-age

seconds - Time in seconds. (Range: 6-40 seconds)
The minimum value is the higher of 6 or [2 x (hello-time + 1)].
The maximum value is the lower of 40 or [2 x (forward-time - 1)].

Default Setting

20 seconds

Command Mode

Global Configuration

Command Usage

This command sets the maximum time (in seconds) a device can wait without receiving a configuration message before attempting to reconverge. All device ports (except for designated ports) should receive configuration messages at regular intervals. Any port that ages out STA information (provided in the last configuration message) becomes the designated port for the attached LAN. If it is a root port, a new root port is selected from among the device ports attached to the network.

Example

```
Console(config)#spanning-tree max-age 40
Console(config)#
```

spanning-tree mode

This command selects the spanning tree mode for this switch. Use the **no** form to restore the default.

Syntax

spanning-tree mode {**stp** | **rstp** | **mstp**}

no spanning-tree mode

stp - Spanning Tree Protocol (IEEE 802.1D)

rstp - Rapid Spanning Tree Protocol (IEEE 802.1w)

mstp - Multiple Spanning Tree (IEEE 802.1s)

Default Setting

rstp

Command Mode
Global Configuration

Command Usage
- Spanning Tree Protocol
  This option uses RSTP set to STP forced compatibility mode. It uses RSTP for the internal state machine, but sends only 802.1D BPDUs. This creates one spanning tree instance for the entire network. If multiple VLANs are implemented on a network, the path between specific VLAN members may be inadvertently disabled to prevent network loops, thus isolating group members. When operating multiple VLANs, we recommend selecting the MSTP option.

- Rapid Spanning Tree Protocol
  RSTP supports connections to either STP or RSTP nodes by monitoring the incoming protocol messages and dynamically adjusting the type of protocol messages the RSTP node transmits, as described below:

  - STP Mode – If the switch receives an 802.1D BPDU after a port's migration delay timer expires, the switch assumes it is connected to an 802.1D bridge and starts using only 802.1D BPDUs.

  - RSTP Mode – If RSTP is using 802.1D BPDUs on a port and receives an RSTP BPDU after the migration delay expires, RSTP restarts the migration delay timer and begins using RSTP BPDUs on that port.

- Multiple Spanning Tree Protocol

  - To allow multiple spanning trees to operate over the network, you must configure a related set of bridges with the same MSTP configuration, allowing them to participate in a specific set of spanning tree instances.

  - A spanning tree instance can exist only on bridges that have compatible VLAN instance assignments.

  - Be careful when switching between spanning tree modes. Changing modes stops all spanning-tree instances for the previous mode and restarts the system in the new mode, temporarily disrupting user traffic.

Example
The following example configures the switch to use Rapid Spanning Tree:

```
Console(config)#spanning-tree mode rstp
Console(config)#
```

spanning-tree mst configuration

This command changes to Multiple Spanning Tree (MST) configuration mode.

Syntax

spanning-tree mst configuration

Default Setting

No VLANs are mapped to any MST instance.
The region name is set the switch's MAC address.

Command Mode

Global Configuration

Example

```
Console(config)#spanning-tree mst configuration
Console(config-mstp)#
```

spanning-tree pathcost method

This command configures the path cost method used for Rapid Spanning Tree and Multiple Spanning Tree. Use the no form to restore the default.

Syntax

spanning-tree pathcost method {long | short}

no spanning-tree pathcost method

long - Specifies 32-bit based values that range from 1-200,000,000. This method is based on the IEEE 802.1w Rapid Spanning Tree Protocol.

short - Specifies 16-bit based values that range from 1-65535. This method is based on the IEEE 802.1D Spanning Tree Protocol.

Default Setting

Long method

Command Mode

Global Configuration

Command Usage

- The path cost method is used to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media. Note that path cost (page 489) takes precedence over port priority (page 498).

- The path cost methods apply to all spanning tree modes (STP, RSTP and MSTP). Specifically, the long method can be applied to STP since this mode is supported by a backward compatible mode of RSTP.

Example

```
Console(config)#spanning-tree pathcost method long
Console(config)#
```

spanning-tree priority

This command configures the spanning tree priority globally for this switch. Use the **no** form to restore the default.

Syntax

spanning-tree priority *priority*

no spanning-tree priority

priority - Priority of the bridge. (Range – 0-61440, in steps of 4096; Options: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440)

Default Setting

32768

Command Mode

Global Configuration

Command Usage

Bridge priority is used in selecting the root device, root port, and designated port. The device with the highest priority (i.e., lower numeric value) becomes the STA root device. However, if all devices have the same priority, the device with the lowest MAC address will then become the root device.

Example

```
Console(config)#spanning-tree priority 40960
Console(config)#
```

spanning-tree system-bpdu-flooding

This command configures how the system floods BPDUs to other ports when spanning tree is disabled globally on the switch or disabled on specific ports. Use the **no** form to restore the default.

Syntax

spanning-tree system-bpdu-flooding {**to-all** | **to-vlan**}

no spanning-tree system-bpdu-flooding

to-all - Floods BPDUs to all other spanning-tree disabled ports on the switch.

to-vlan - Floods BPDUs to all other spanning-tree disabled ports within the receiving port's native VLAN (i.e., as determined by port's PVID).

Default Setting
Floods to all other spanning-tree disabled ports in the same VLAN.

Command Mode
Global Configuration

Command Usage
The **spanning-tree system-bpdu-flooding** command has no effect if BPDU flooding is disabled on a port (see the spanning-tree port-bpdu-flooding command).

Example
```
Console(config)#spanning-tree system-bpdu-flooding to-all
Console(config)#
```

spanning-tree tc-prop

This command configures a topology change propagation domain. Use the **no** form to remove a propagation domain.

Syntax
spanning-tree tc-prop group *group-id* {**ethernet** *interface* | **port-channel** *trunk-id*}

group-id - Group identifier. (Range: 1-255)

interface - *unit/port*

unit - Unit identifier.

port - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports.

trunk-id - Trunk index

Default Setting
All ports and trunks belong to a common group.

Command Mode
Global Configuration

Command Usage
A port can only belong to one group. When an interface is added to a group, it is removed from the default group. When a TCN BPDU or BPDU with the TC flag set is received on an interface, that interface will only notify members in same group to propagate this topology change.

Example
```
Console(config)#spanning-tree tc-prop group 1 ethernet 1/1-5
Console(config)#
```

spanning-tree transmission-limit

This command configures the maximum number of RSTP/MSTP BPDU transmissions permitted within the Hello Time interval. Use the **no** form to restore the default.

Syntax

spanning-tree transmission-limit *count*

no spanning-tree transmission-limit

count - The transmission limit number. (Range: 1-10)

Default Setting

3

Command Mode

Global Configuration

Command Usage

This command limits the number of BPDUs transmitted within the configured Hello Time interval.

Example

```
Console(config)#spanning-tree transmission-limit 4
Console(config)#
```

max-hops

This command configures the maximum number of hops in the region before a BPDU is discarded. Use the no form of the command to set the number of hops to the default value.

Syntax

max-hops *hop-number*

no max-hops

hop-number - Maximum hop number for multiple spanning tree. (Range: 1-40)

Default Setting

20

Command Mode

MST Configuration

Command Usage

An MSTI region is treated as a single node by the STP and RSTP protocols. Therefore, the message age for BPDUs inside an MSTI region is never changed. However, each spanning tree instance within a region, and the internal spanning

tree (IST) that connects these instances use a hop count to specify the maximum number of bridges that will propagate a BPDU. Each bridge decrements the hop count by one before passing on the BPDU. When the hop count reaches zero, the message is dropped.

Example

```
Console(config-mstp)#max-hops 30
Console(config-mstp)#
```

mst priority

This command configures the priority of a spanning tree instance. Use the **no** form to restore the default.

Syntax

mst *instance-id* **priority** *priority*

no mst *instance-id* **priority**

instance-id - Instance identifier of the spanning tree. (Range: 0-4094)

priority - Priority of the a spanning tree instance.
(Range: 0-61440 in steps of 4096; Options: 0, 4096, 8192, 12288, 16384, 20480, 24576, 28672, 32768, 36864, 40960, 45056, 49152, 53248, 57344, 61440)

Default Setting

32768

Command Mode

MST Configuration

Command Usage

- MST priority is used in selecting the root bridge and alternate bridge of the specified instance. The device with the highest priority (i.e., lowest numerical value) becomes the MSTI root device. However, if all devices have the same priority, the device with the lowest MAC address will then become the root device.

- You can set this switch to act as the MSTI root device by specifying a priority of 0, or as the MSTI alternate device by specifying a priority of 16384.

Example

```
Console(config-mstp)#mst 1 priority 4096
Console(config-mstp)#
```

mst vlan

This command adds VLANs to a spanning tree instance. Use the **no** form to remove the specified VLANs. Using the **no** form without any VLAN parameters to remove all VLANs.

Syntax

[**no**] **mst** *instance-id* **vlan** *vlan-range*

instance-id - Instance identifier of the spanning tree. (Range: 0-4094)

vlan-range - Range of VLANs. (Range: 1-4094)

Default Setting

none

Command Mode

MST Configuration

Command Usage

- Use this command to group VLANs into spanning tree instances. MSTP generates a unique spanning tree for each instance. This provides multiple pathways across the network, thereby balancing the traffic load, preventing wide-scale disruption when a bridge node in a single instance fails, and allowing for faster convergence of a new topology for the failed instance.

- By default all VLANs are assigned to the Internal Spanning Tree (MSTI 0) that connects all bridges and LANs within the MST region. This switch supports up to 64 instances. You should try to group VLANs which cover the same general area of your network. However, remember that you must configure all bridges within the same MSTI Region (page 486) with the same set of instances, and the same instance (on each bridge) with the same set of VLANs. Also, note that RSTP treats each MSTI region as a single node, connecting all regions to the Common Spanning Tree.

Example

```
Console(config-mstp)#mst 1 vlan 2-5
Console(config-mstp)#
```

name

This command configures the name for the multiple spanning tree region in which this switch is located. Use the no form of the command to set the name to the default name.

Syntax

name *name*

no name

name - Name of multiple spanning tree region. (Range: 1-32 alphanumeric characters)

Default Setting
Switch's MAC address

Command Mode
MST Configuration

Command Usage
The MST region name and revision number (page 487) are used to designate a unique MST region. A bridge (i.e., spanning-tree compliant device such as this switch) can only belong to one MST region. And all bridges in the same region must be configured with the same MST instances.

Example

```
Console(config-mstp)#name R&D
Console(config-mstp)#
```

revision

This command configures the revision number for this multiple spanning tree configuration of this switch. Use the no form of the command to set the revision number to the default value.

Syntax

revision *number*

no revision

number - Revision number of the spanning tree. (Range: 0-65535)

Default Setting
0

Command Mode
MST Configuration

Command Usage
The MST region name (page 486) and revision number are used to designate a unique MST region. A bridge (i.e., spanning-tree compliant device such as this switch) can only belong to one MST region. And all bridges in the same region must be configured with the same MST instances.

Example

```
Console(config-mstp)#revision 1
Console(config-mstp)#
```

spanning-tree bpdu-filter

This command allows you to avoid transmitting BPDUs on configured edge ports that are connected to end nodes. Use the **no** form to disable this feature.

Syntax

[no] spanning-tree bpdu-filter

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- This command stops all Bridge Protocol Data Units (BPDUs) from being transmitted on configured edge ports to save CPU processing time. This function is designed to work in conjunction with edge ports which should only connect end stations to the switch, and therefore do not need to process BPDUs. However, note that if a trunking port connected to another switch or bridging device is mistakenly configured as an edge port, and BPDU filtering is enabled on this port, this might cause a loop in the spanning tree.

- BPDU filter can only be configured on an interface if the edge port attribute is not disabled (that is, if edge port is set to enabled or auto with the spanning-tree edge-port command).

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree edge-port
Console(config-if)#spanning-tree bpdu-filter
Console(config-if)#
```

spanning-tree bpdu-guard

This command shuts down an edge port (i.e., an interface set for fast forwarding) if it receives a BPDU. Use the **no** form without any keywords to disable this feature, or with a keyword to restore the default settings.

Syntax

spanning-tree bpdu-guard [auto-recovery [interval *interval*]]

no spanning-tree bpdu-guard [auto-recovery [interval]]

auto-recovery - Automatically re-enables an interface after the specified interval.

interval - The time to wait before re-enabling an interface. (Range: 30-86400 seconds)

Default Setting
BPDU Guard: Disabled
Auto-Recovery: Disabled
Auto-Recovery Interval: 300 seconds

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
- An edge port should only be connected to end nodes which do not generate BPDUs. If a BPDU is received on an edge port, this indicates an invalid network configuration, or that the switch may be under attack by a hacker. If an interface is shut down by BPDU Guard, it must be manually re-enabled using the no shutdown command if the auto-recovery interval is not specified.

- BPDU guard can only be configured on an interface if the edge port attribute is not disabled (that is, if edge port is set to enabled or auto with the spanning-tree edge-port command).

Example
```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree edge-port
Console(config-if)#spanning-tree bpdu-guard
Console(config-if)#
```

spanning-tree cost
This command configures the spanning tree path cost for the specified interface. Use the **no** form to restore the default auto-configuration mode.

Syntax
spanning-tree cost *cost*

no spanning-tree cost

cost - The path cost for the port. (Range: 0 for auto-configuration, 1-65535 for short path cost method, 1-200,000,000 for long path cost method)[8]

Table 78: Recommended STA Path Cost Range

Port Type	Short Path Cost (IEEE 802.1D-1998)	Long Path Cost (IEEE 802.1D-2004)
Ethernet	50-600	200,000-20,000,000
Fast Ethernet	10-60	20,000-2,000,000

8. Use the spanning-tree pathcost method command to set the path cost method. The range displayed in the CLI prompt message shows the maximum value for path cost. However, note that the switch still enforces the rules for path cost based on the specified path cost method (long or short).

Table 78: Recommended STA Path Cost Range (Continued)

Port Type	Short Path Cost (IEEE 802.1D-1998)	Long Path Cost (IEEE 802.1D-2004)
Gigabit Ethernet	3-10	2,000-200,000
10G Ethernet	1-5	200-20,000

Default Setting

By default, the system automatically detects the speed and duplex mode used on each port, and configures the path cost according to the values shown below. Path cost "0" is used to indicate auto-configuration mode. When the short path cost method is selected and the default path cost recommended by the IEEE 8021w standard exceeds 65,535, the default is set to 65,535.

Table 79: Default STA Path Costs

Port Type	Short Path Cost (IEEE 802.1D-1998)	Long Path Cost (IEEE 802.1t)
Ethernet	65,535	1,999,999
Fast Ethernet	65,535	199,999
Gigabit Ethernet	10,000	20,000
2.5G Gigabit Ethernet	4,000	8,000
10G Ethernet	1,000	2,000
25G Ethernet	400	800
40G Ethernet	500	1,000
100G Ethernet	100	200

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- This command is used by the Spanning Tree Algorithm to determine the best path between devices. Therefore, lower values should be assigned to ports attached to faster media, and higher values assigned to ports with slower media.
- Path cost takes precedence over port priority.
- When the path cost method (page 481) is set to short, the maximum value for path cost is 65,535.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree cost 50
Console(config-if)#
```

spanning-tree edge-port

This command specifies an interface as an edge port. Use the **no** form to restore the default.

Syntax

spanning-tree edge-port [**auto**]

no spanning-tree edge-port

auto - Automatically determines if an interface is an edge port.

Default Setting

Auto

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- You can enable this option if an interface is attached to a LAN segment that is at the end of a bridged LAN or to an end node. Since end nodes cannot cause forwarding loops, they can pass directly through to the spanning tree forwarding state. Specifying Edge Ports provides quicker convergence for devices such as workstations or servers, retains the current forwarding database to reduce the amount of frame flooding required to rebuild address tables during reconfiguration events, does not cause the spanning tree to initiate reconfiguration when the interface changes state, and also overcomes other STA-related time out problems. However, remember that Edge Port should only be enabled for ports connected to an end-node device.

- When edge port is set as auto, the operational state is determined automatically by the Bridge Detection State Machine described in 802.1D-2004, where the edge port state may change dynamically based on environment changes (e.g., receiving a BPDU or not within the required interval).

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree edge-port
Console(config-if)#
```

spanning-tree link-type

This command configures the link type for Rapid Spanning Tree and Multiple Spanning Tree. Use the **no** form to restore the default.

Syntax

spanning-tree link-type {**auto** | **point-to-point** | **shared**}

no spanning-tree link-type

auto - Automatically derived from the duplex mode setting.

point-to-point - Point-to-point link.

shared - Shared medium.

Default Setting
auto

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
- Specify a point-to-point link if the interface can only be connected to exactly one other bridge, or a shared link if it can be connected to two or more bridges.
- When automatic detection is selected, the switch derives the link type from the duplex mode. A full-duplex interface is considered a point-to-point link, while a half-duplex interface is assumed to be on a shared link.
- RSTP only works on point-to-point links between two bridges. If you designate a port as a shared link, RSTP is forbidden. Since MSTP is an extension of RSTP, this same restriction applies.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree link-type point-to-point
```

spanning-tree loopback-detection

This command enables the detection and response to Spanning Tree loopback BPDU packets on the port. Use the **no** form to disable this feature.

Syntax

[no] **spanning-tree loopback-detection**

Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
- If Port Loopback Detection is not enabled and a port receives it's own BPDU, then the port will drop the loopback BPDU according to IEEE Standard 802.1W-2001 9.3.4 (Note 1).
- Port Loopback Detection will not be active if Spanning Tree is disabled on the switch.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree loopback-detection
```

spanning-tree loopback-detection action

This command configures the response for loopback detection to shut down the interface. Use the **no** form to restore the default.

Syntax

spanning-tree loopback-detection action {**shutdown** *duration*}

no spanning-tree loopback-detection action

shutdown - Shuts down the interface.

duration - The duration to shut down the interface. (Range: 60-86400 seconds)

Default Setting

shutdown, 60 seconds

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- If an interface is shut down by this command, and the release mode is set to "auto" with the spanning-tree loopback-detection release-mode command, the selected interface will be automatically enabled when the shutdown interval has expired.

- If an interface is shut down by this command, and the release mode is set to "manual," the interface can be re-enabled using the spanning-tree loopback-detection release command.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree loopback-detection action shutdown 600
Console(config-if)#
```

spanning-tree loopback-detection release-mode

This command configures the release mode for a port that was placed in the discarding state because a loopback BPDU was received. Use the **no** form to restore the default.

Syntax

spanning-tree loopback-detection release-mode {**auto** | **manual**}

no spanning-tree loopback-detection release-mode

auto - Allows a port to automatically be released from the discarding state when the loopback state ends.

manual - The port can only be released from the discarding state manually.

Default Setting

auto

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- If the port is configured for automatic loopback release, then the port will only be returned to the forwarding state if one of the following conditions is satisfied:
  - The port receives any other BPDU except for it's own, or;
  - The port's link status changes to link down and then link up again, or;
  - The port ceases to receive it's own BPDUs in a forward delay interval.
- If Port Loopback Detection is not enabled and a port receives it's own BPDU, then the port will drop the loopback BPDU according to IEEE Standard 802.1W-2001 9.3.4 (Note 1).
- Port Loopback Detection will not be active if Spanning Tree is disabled on the switch.
- When configured for manual release mode, then a link down / up event will not release the port from the discarding state. It can only be released using the spanning-tree loopback-detection release command.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree loopback-detection release-mode manual
Console(config-if)#
```

spanning-tree loopback-detection trap

This command enables SNMP trap notification for Spanning Tree loopback BPDU detections. Use the **no** form to restore the default.

Syntax

[no] spanning-tree loopback-detection trap

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree loopback-detection trap
```

spanning-tree restricted-tcn

This command prevents a TCNs from being propagated from a switch port to other ports. Use the **no** form to restore the default setting.

Syntax

[no] spanning-tree restricted-tcn

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Commnad Usage

This command prevents a switch from propagating Topology Change Notifications (TCNs) to other ports on the switch.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree restricted-tcn
```

spanning-tree mst cost

This command configures the path cost on a spanning instance in the Multiple Spanning Tree. Use the **no** form to restore the default auto-configuration mode.

Syntax

spanning-tree mst *instance-id* **cost** *cost*

no spanning-tree mst *instance-id* **cost**

instance-id - Instance identifier of the spanning tree. (Range: 0-4094)

cost - Path cost for an interface. (Range: 0 for auto-configuration, 1-65535 for short path cost method[9], 1-200,000,000 for long path cost method)

The recommended path cost range is listed in Table 78 on page 489.

Default Setting

By default, the system automatically detects the speed and duplex mode used on each port, and configures the path cost according to the values shown in Table 79. Path cost "0" is used to indicate auto-configuration mode. When the short path cost method is selected and the default path cost recommended by the IEEE 8021w standard exceeds 65,535, the default is set to 65,535. The default path costs are listed in Table 79 on page 490.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Each spanning-tree instance is associated with a unique set of VLAN IDs.
- This command is used by the multiple spanning-tree algorithm to determine the best path between devices. Therefore, lower values should be assigned to interfaces attached to faster media, and higher values assigned to interfaces with slower media.
- Use the **no spanning-tree mst cost** command to specify auto-configuration mode.
- Path cost takes precedence over interface priority.

Example

```
Console(config)#interface Ethernet 1/5
Console(config-if)#spanning-tree mst 1 cost 50
Console(config-if)#
```

9. Use the spanning-tree pathcost method command to set the path cost method.

spanning-tree mst port-priority

This command configures the interface priority on a spanning instance in the Multiple Spanning Tree. Use the **no** form to restore the default.

Syntax

spanning-tree mst *instance-id* **port-priority** *priority*

no spanning-tree mst *instance-id* **port-priority**

instance-id - Instance identifier of the spanning tree. (Range: 0-4094)

priority - Priority for an interface. (Range: 0-240 in steps of 16)

Default Setting

128

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- This command defines the priority for the use of an interface in the multiple spanning-tree. If the path cost for all interfaces on a switch are the same, the interface with the highest priority (that is, lowest value) will be configured as an active link in the spanning tree.
- Where more than one interface is assigned the highest priority, the interface with lowest numeric identifier will be enabled.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree mst 1 port-priority 0
Console(config-if)#
```

spanning-tree port-bpdu-flooding

This command floods BPDUs to other ports when spanning tree is disabled globally or disabled on a specific port. Use the **no** form to restore the default setting.

Syntax

[no] **spanning-tree port-bpdu-flooding**

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- When enabled, BPDUs are flooded to all other spanning-tree disabled ports on the switch or within the receiving port's native VLAN as specified by the spanning-tree system-bpdu-flooding command.

- The spanning-tree system-bpdu-flooding command has no effect if BPDU flooding is disabled on a port by the **spanning-tree port-bpdu-flooding** command.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree port-bpdu-flooding
Console(config-if)#
```

spanning-tree port-priority

This command configures the priority for the specified interface. Use the **no** form to restore the default.

Syntax

spanning-tree port-priority *priority*

no spanning-tree port-priority

priority - The priority for a port. (Range: 0-240, in steps of 16)

Default Setting

128

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- This command defines the priority for the use of a port in the Spanning Tree Algorithm. If the path cost for all ports on a switch are the same, the port with the highest priority (that is, lowest value) will be configured as an active link in the spanning tree.
- Where more than one port is assigned the highest priority, the port with lowest numeric identifier will be enabled.
- The criteria used for determining the port role is based on root bridge ID, root path cost, designated bridge, designated port, port priority, and port number, in that order and as applicable to the role under question.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree port-priority 0
```

spanning-tree root-guard

This command prevents a designated port[10] from taking superior BPDUs into account and allowing a new STP root port to be elected. Use the **no** form to disable this feature.

Syntax

[no] spanning-tree root-guard

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- A bridge with a lower bridge identifier (or same identifier and lower MAC address) can take over as the root bridge at any time.
- When Root Guard is enabled, and the switch receives a superior BPDU on this port, it is set to the Discarding state until it stops receiving superior BPDUs for a fixed recovery period. While in the discarding state, no traffic is forwarded across the port.
- Root Guard can be used to ensure that the root bridge is not formed at a suboptimal location. Root Guard should be enabled on any designated port connected to low-speed bridges which could potentially overload a slower link by taking over as the root port and forming a new spanning tree topology. It could also be used to form a border around part of the network where the root bridge is allowed.
- When spanning tree is initialized globally on the switch or on an interface, the switch will wait for 20 seconds to ensure that the spanning tree has converged before enabling Root Guard.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree root-guard
Console(config-if)#
```

spanning-tree spanning-disabled

This command disables the spanning tree algorithm for the specified interface. Use the **no** form to re-enable the spanning tree algorithm for the specified interface.

Syntax

[no] spanning-tree spanning-disabled

10. See Port Role in the *Web Management Guide*.

Default Setting
Enabled

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
When spanning tree is enabled globally (spanning-tree command) or enabled on an interface by this command, loopback detection is disabled.

Example
This example disables the spanning tree algorithm for port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#spanning-tree spanning-disabled
Console(config-if)#
```

spanning-tree tc-prop-stop

This command stops the propagation of topology change notifications (TCN for STP) and topology change messages (TC for RSTP/MSTP). Use the **no** form to allow propagation of TCN/TC messages.

Syntax

[no] spanning-tree tc-prop-stop

Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
When this command is enabled on an interface, topology change information originating from the interface will still be propagated.

This command should not be used on an interface which is purposely configured in a ring topology.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#spanning-tree tc-prop-stop
Console(config-if)#
```

spanning-tree loopback-detection release

This command manually releases a port placed in discarding state by loopback-detection.

Syntax

spanning-tree loopback-detection release *interface*

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode

Privileged Exec

Command Usage

Use this command to release an interface from discarding state if loopback detection release mode is set to "manual" by the spanning-tree loopback-detection release-mode command and BPDU loopback occurs.

Example

```
Console#spanning-tree loopback-detection release ethernet 1/1
Console#
```

spanning-tree protocol-migration

This command re-checks the appropriate BPDU format to send on the selected interface.

Syntax

spanning-tree protocol-migration *interface*

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode

Privileged Exec

Command Usage

If at any time the switch detects STP BPDUs, including Configuration or Topology Change Notification BPDUs, it will automatically set the selected interface to forced STP-compatible mode. However, you can also use the **spanning-tree protocol-**

migration command at any time to manually re-check the appropriate BPDU format to send on the selected interfaces (i.e., RSTP or STP-compatible).

Example

```
Console#spanning-tree protocol-migration ethernet 1/5
Console#
```

show spanning-tree

This command shows the configuration for the common spanning tree (CST), for all instances within the multiple spanning tree (MST), or for a specific instance within the multiple spanning tree (MST).

Syntax

show spanning-tree [*interface* | **mst** *instance-id* [**brief** | *interface*] | **brief** | **stp-enabled-only**]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

instance-id - Instance identifier of the multiple spanning tree. (Range: 0-4094)

brief - Shows a summary of global and interface settings.

stp-enabled-only - Displays global settings, and settings for interfaces for which STP is enabled.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- Use the **show spanning-tree** command with no parameters to display the spanning tree configuration for the switch for the Common Spanning Tree (CST) and for every interface in the tree.
- Use the **show spanning-tree** *interface* command to display the spanning tree configuration for an interface within the Common Spanning Tree (CST).
- Use the **show spanning-tree mst** command to display the spanning tree configuration for all instances within the Multiple Spanning Tree (MST), including global settings and settings for active interfaces.

- Use the **show spanning-tree mst** *instance-id* command to display the spanning tree configuration for an instance within the Multiple Spanning Tree (MST), including global settings and settings for all interfaces.

Example

```
Console#show spanning-tree
Spanning Tree Information
---------------------------------------------------------------
 Spanning Tree Mode               : MSTP
 Spanning Tree Enabled/Disabled   : Enabled
 Instance                         : 0
 VLANs Configured                 : 1-4094
 Priority                         : 32768
 Bridge Hello Time (sec.)         : 2
 Bridge Max. Age (sec.)           : 20
 Bridge Forward Delay (sec.)      : 15
 Root Hello Time (sec.)           : 2
 Root Max. Age (sec.)             : 20
 Root Forward Delay (sec.)        : 15
 Max. Hops                        : 20
 Remaining Hops                   : 20
 Designated Root                  : 32768.0.0001ECF8D8C6
 Current Root Port                : 21
 Current Root Cost                : 100000
 Number of Topology Changes       : 5
 Last Topology Change Time (sec.): 11409
 Transmission Limit               : 3
 Path Cost Method                 : Long
 Flooding Behavior                : To VLAN
 Cisco Prestandard                : Disabled
---------------------------------------------------------------
Eth  1/ 1 Information
---------------------------------------------------------------
 Admin Status                      : Enabled
 Role                              : Disabled
 State                             : Discarding
 External Admin Path Cost          : 0
 Internal Admin Path Cost          : 0
 External Oper Path Cost           : 100000
 Internal Oper Path Cost           : 100000
 Priority                          : 128
 Designated Cost                   : 100000
 Designated Port                   : 128.1
 Designated Root                   : 32768.0.0001ECF8D8C6
 Designated Bridge                 : 32768.0.123412341234
 Forward Transitions               : 4
 Admin Edge Port                   : Disabled
 Oper Edge Port                    : Disabled
 Admin Link Type                   : Auto
 Oper Link Type                    : Point-to-point
 Flooding Behavior                 : Enabled
 Spanning-Tree Status              : Enabled
 Loopback Detection Status         : Enabled
 Loopback Detection Release Mode   : Auto
 Loopback Detection Trap           : Disabled
 Loopback Detection Action         : Block
 Root Guard Status                 : Disabled
 BPDU Guard Status                 : Disabled
 BPDU Guard Auto Recovery          : Disabled
 BPDU Guard Auto Recovery Interval : 300
 BPDU Filter Status                : Disabled
 TC Propagate Stop                 : Disabled
 Restricted TCN                    : Disabled
```

```
:
:
```

This example shows a brief summary of global and interface setting for the spanning tree.

```
Console#show spanning-tree brief
Spanning Tree Mode             : RSTP
Spanning Tree Enabled/Disabled : Enabled
Designated Root                : 32768.0000E8944000
Current Root Port (Eth)        : 1/24
Current Root Cost              : 10000

Interface Pri Designated           Designated Oper     STP    Role State Oper
             Bridge ID             Port ID    Cost     Status            Edge
--------- --- -------------------- ---------- -------- ------ ---- ----- ---
Eth 1/ 1  128 32768.0000E89382A0    128.1        100000 EN     DESG FWD   No
Eth 1/ 2  128 32768.0000E89382A0    128.2         10000 EN     DISB BLK   No
Eth 1/ 3  128 32768.0000E89382A0    128.3         10000 EN     DISB BLK   No
Eth 1/ 4  128 32768.0000E89382A0    128.4         10000 EN     DISB BLK   No
Eth 1/ 5  128 32768.0000E89382A0    128.5         10000 EN     DISB BLK   No
:
:
:
```

show spanning-tree mst configuration

This command shows the configuration of the multiple spanning tree.

Command Mode

Privileged Exec

Example

```
Console#show spanning-tree mst configuration
Mstp Configuration Information
-------------------------------------------------------------
 Configuration Name : R&D
 Revision Level     :0

 Instance VLANs
-------------------------------------------------------------
     0    1-4094
Console#
```

show spanning-tree tc-prop

This command shows the configuration of topology change propagation domains.

Syntax

show spanning-tree tc-prop [group *group-id*]

group-id - Group identifier. (Range: 1-255)

Command Mode

Privileged Exec

Example

```
Console#show spanning-tree tc-prop group 1
 Group 1
  Eth 1/ 1, Eth 1/ 2, Eth 1/ 3, Eth 1/ 4, Eth 1/ 5
Console#
```

22 VLAN Commands

A VLAN is a group of ports that can be located anywhere in the network, but communicate as though they belong to the same physical segment. This section describes commands used to create VLAN groups, add port members, specify how VLAN tagging is used, and enable automatic VLAN registration for the selected interface.

Table 80: VLAN Commands

Command Group	Function
GVRP and Bridge Extension Commands	Configures GVRP settings that permit automatic VLAN learning; shows the configuration for bridge extension MIB
Editing VLAN Groups	Sets up VLAN groups, including name, VID and state
Configuring VLAN Interfaces	Configures VLAN interface parameters, including ingress and egress tagging mode, ingress filtering, and PVID
Displaying VLAN Information	Displays VLAN groups, status, port members, and MAC addresses
Configuring IEEE 802.1Q Tunneling	Configures 802.1Q Tunneling (QinQ Tunneling)
Configuring L2PT Tunneling[1]	Configures Layer 2 Protocol Tunneling (L2PT), either by discarding, processing, or transparently passing control packets across a QinQ tunnel
Configuring VLAN Translation[2]	Maps VLAN ID between customer and service provider for networks that do not support IEEE 802.1Q tunneling
Configuring Protocol-Based VLANs[2]	Configures protocol-based VLANs based on frame type and protocol
Configuring IP Subnet VLANs[2]	Configures IP Subnet-based VLANs
Configuring MAC Based VLANs[2]	Configures MAC-based VLANs
Configuring Voice VLANs	Configures VoIP traffic detection and enables a Voice VLAN
Configuring Excluded VLANs	Configures excluded VLAN sessions

1 These functions are not compatible.

2 If a packet matches the rules defined by more than one of these functions, only one of them is applied, with the precedence being MAC-based, IP subnet-based, protocol-based, and then native port-based (see the switchport priority default command).

GVRP and Bridge Extension Commands

GARP VLAN Registration Protocol defines a way for switches to exchange VLAN information in order to automatically register VLAN members on interfaces across the network. This section describes how to enable GVRP for individual interfaces and globally for the switch, as well as how to display default configuration settings for the Bridge Extension MIB.

Table 81: GVRP and Bridge Extension Commands

Command	Function	Mode
bridge-ext gvrp	Enables GVRP globally for the switch	GC
garp timer	Sets the GARP timer for the selected function	IC
switchport forbidden vlan	Configures forbidden VLANs for an interface	IC
switchport gvrp	Enables GVRP for an interface	IC
show bridge-ext	Shows the global bridge extension configuration	PE
show garp timer	Shows the GARP timer for the selected function	NE, PE
show gvrp configuration	Displays GVRP configuration for the selected interface	NE, PE

bridge-ext gvrp

This command enables GVRP globally for the switch. Use the **no** form to disable it.

Syntax

[no] bridge-ext gvrp

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

GVRP defines a way for switches to exchange VLAN information in order to register VLAN members on ports across the network. This function should be enabled to permit automatic VLAN registration, and to support VLANs which extend beyond the local switch.

Example

```
Console(config)#bridge-ext gvrp
Console(config)#
```

garp timer

This command sets the values for the join, leave and leaveall timers. Use the **no** form to restore the timers' default values.

Syntax

garp timer {**join** | **leave** | **leaveall**} *timer-value*

no garp timer {**join** | **leave** | **leaveall**}

{**join** | **leave** | **leaveall**} - Timer to set.

timer-value - Value of timer.
Ranges:
join: 20-1000 centiseconds
leave: 60-3000 centiseconds
leaveall: 500-18000 centiseconds

Default Setting

join: 20 centiseconds
leave: 60 centiseconds
leaveall: 1000 centiseconds

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Group Address Registration Protocol is used by GVRP and GMRP to register or deregister client attributes for client services within a bridged LAN. The default values for the GARP timers are independent of the media access method or data rate. These values should not be changed unless you are experiencing difficulties with GMRP or GVRP registration/deregistration.
- Timer values are applied to GVRP for all the ports on all VLANs.
- Timer values must meet the following restrictions:
  - leave > (2 x join)
  - leaveall > leave

Note: Set GVRP timers on all Layer 2 devices connected in the same network to the same values. Otherwise, GVRP may not operate successfully.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#garp timer join 100
Console(config-if)#
```

switchport forbidden vlan

This command configures forbidden VLANs. Use the **no** form to remove the list of forbidden VLANs.

Syntax

switchport forbidden vlan {**add** *vlan-list* | **remove** *vlan-list*}

no switchport forbidden vlan

add *vlan-list* - List of VLAN identifiers to add.

remove *vlan-list* - List of VLAN identifiers to remove.

vlan-list - Separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. (Range: 1-4094).

Default Setting

No VLANs are included in the forbidden list.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- This command prevents a VLAN from being automatically added to the specified interface via GVRP using the switchport gvrp command.
- If a VLAN has been added to the set of allowed VLANs for an interface, then you cannot add it to the set of forbidden VLANs for that same interface.
- GVRP cannot be enabled for ports set to Access mode (see the switchport mode command).
- This command will not be accepted if the specified VLAN does not exist on the switch.

Example

The following example shows how to prevent port 1 from being added to VLAN 3:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport forbidden vlan add 3
Console(config-if)#
```

switchport gvrp

This command enables GVRP for a port. Use the **no** form to disable it.

Syntax

[**no**] **switchport gvrp**

Default Setting

Disabled

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
GVRP cannot be enabled for ports set to Access mode using the switchport mode command.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport gvrp
Console(config-if)#
```

show bridge-ext
This command shows the configuration for bridge extension commands.

Default Setting
None

Command Mode
Privileged Exec

Example

```
Console#show bridge-ext
 Maximum Supported VLAN Numbers        : 4094
 Maximum Supported VLAN ID             : 4094
 Extended Multicast Filtering Services : No
 Static Entry Individual Port          : Yes
 VLAN Version Number                   : 2
 VLAN Learning                         : IVL
 Configurable PVID Tagging             : Yes
 Local VLAN Capable                    : No
 Traffic Classes                       : Enabled
 Global GVRP Status                    : Disabled
Console#
```

show garp timer
This command shows the GARP timers for the selected interface.

Syntax
show garp timer [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
Shows all GARP timers.

Command Mode
Normal Exec, Privileged Exec

Example

```
Console#show garp timer ethernet 1/1
Eth 1/ 1 GARP Timer Status:
 Join Timer      : 20 centiseconds
 Leave Timer     : 60 centiseconds
 Leave All Timer : 1000 centiseconds

Console#
```

show gvrp configuration

This command shows if GVRP is enabled.

Syntax

show gvrp configuration [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
Shows both global and interface-specific configuration.

Command Mode
Normal Exec, Privileged Exec

Example

```
Console#show gvrp configuration ethernet 1/7
Eth 1/ 7:
 GVRP Configuration : Disabled
Console#
```

Editing VLAN Groups

Table 82: Commands for Editing VLAN Groups

Command	Function	Mode
vlan database	Enters VLAN database mode to add, change, and delete VLANs	GC
vlan	Configures a VLAN, including VID, name and state	VC

vlan database

This command enters VLAN database mode. All commands in this mode will take effect immediately.

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Use the VLAN database command mode to add, change, and delete VLANs. After finishing configuration changes, you can display the VLAN settings by entering the show vlan command.
- Use the interface vlan command mode to define the port membership mode and add or remove ports from a VLAN. The results of these commands are written to the running-configuration file, and you can display this file by entering the show running-config command.

Example

```
Console(config)#vlan database
Console(config-vlan)#
```

vlan

This command configures a VLAN. Use the **no** form to restore the default settings or delete a VLAN.

Syntax

vlan *vlan-id* [**name** *vlan-name*] **media ethernet** [**state** {**active** | **suspend**}] [**rspan**]

no vlan *vlan-id* [**name** | **state**]

vlan-id - VLAN ID, specified as a single number, a range of consecutive numbers separated by a hyphen, or multiple numbers separated by commas. (Range: 1-4094)

name - Keyword to be followed by the VLAN name.

vlan-name - ASCII string from 1 to 32 characters.

media ethernet - Ethernet media type.

state - Keyword to be followed by the VLAN state.

active - VLAN is operational.

suspend - VLAN is suspended. Suspended VLANs do not pass packets.

rspan - Keyword to create a VLAN used for mirroring traffic from remote switches. The VLAN used for RSPAN cannot include VLAN 1 (the switch's default VLAN). Nor should it include VLAN 4093 (which is used for switch clustering). Configuring VLAN 4093 for other purposes may cause problems in the Clustering operation. For more information on configuring RSPAN through the CLI, see "RSPAN Mirroring Commands" on page 424.

Note: Ports can only be added to an RSPAN VLAN using the commands described under "RSPAN Mirroring Commands".

Default Setting

By default only VLAN 1 exists and is active.

Command Mode

VLAN Database Configuration

Command Usage

- **no vlan** *vlan-id* deletes the VLAN.
- **no vlan** *vlan-id* **name** removes the VLAN name.
- **no vlan** *vlan-id* **state** returns the VLAN to the default state (i.e., active).
- You can configure up to 4094 VLANs on the switch.

Example

The following example adds a VLAN, using VLAN ID 105 and name RD5. The VLAN is activated by default.

```
Console(config)#vlan database
Console(config-vlan)#vlan 105 name RD5 media ethernet
Console(config-vlan)#
```

Configuring VLAN Interfaces

Table 83: Commands for Configuring VLAN Interfaces

Command	Function	Mode
interface vlan	Enters interface configuration mode for a specified VLAN	IC
switchport acceptable-frame-types	Configures frame types to be accepted by an interface	IC
switchport allowed vlan	Configures the VLANs associated with an interface	IC
switchport forbidden vlan	Configures forbidden VLANs for an interface	IC
switchport gvrp	Enables GVRP for an interface	IC
switchport ingress-filtering	Enables ingress filtering on an interface	IC
switchport mode	Configures VLAN membership mode for an interface	IC
switchport native vlan	Configures the PVID (native VLAN) of an interface	IC
vlan-trunking	Allows unknown VLAN groups to pass through a specified interface	IC
switchport priority default	Sets a port priority for incoming untagged frames	IC

interface vlan

This command enters interface configuration mode for VLANs, which is used to configure VLAN parameters for a physical interface. Use the **no** form to change a Layer 3 normal VLAN back to a Layer 2 interface.

Syntax

[no] **interface vlan** *vlan-id*

vlan-id - ID of the configured VLAN. (Range: 1-4094)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Creating a "normal" VLAN with the vlan command initializes it as a Layer 2 interface. To change it to a Layer 3 interface, use the interface command to enter interface configuration for the desired VLAN, enter any Layer 3 configuration commands, and save the configuration settings.
- To change a Layer 3 normal VLAN back to a Layer 2 VLAN, use the no interface command.

Example

The following example shows how to set the interface configuration mode to VLAN 1, and then assign an IP address to the VLAN:

```
Console(config)#interface vlan 1
Console(config-if)#ip address 192.168.1.254 255.255.255.0
Console(config-if)#
```

switchport acceptable-frame-types

This command configures the acceptable frame types for a port. Use the **no** form to restore the default.

Syntax

switchport acceptable-frame-types {**all** | **tagged**}

no switchport acceptable-frame-types

all - The port accepts all frames, tagged or untagged.

tagged - The port only receives tagged frames.

Default Setting

All frame types

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

When set to receive all frame types, any received frames that are untagged are assigned to the port default VLAN if not matched to a configured MAC VLAN, IP-subnet VLAN, or protocol VLAN.

Example

The following example shows how to restrict the traffic received on port 1 to tagged frames:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport acceptable-frame-types tagged
Console(config-if)#
```

switchport allowed vlan

This command configures VLAN groups on the selected interface. Use the **no** form to restore the default.

Syntax

switchport allowed vlan {*vlan-list* | **add** *vlan-list* [**tagged** | **untagged** | **double-tagged**] | **remove** *vlan-list*}

no switchport allowed vlan

vlan-list - If a VLAN list is entered without using the **add** option, the interface is assigned to the specified VLANs, and membership in all previous VLANs is removed. The interface is added as an untagged member if switchport mode is set to hybrid or access, or as an tagged member if switchport mode is set to trunk.

Separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. (Range: 1-4094).

add *vlan-list* - List of VLAN identifiers to add. When the **add** option is used, the interface is assigned to the specified VLANs, and membership in all previous VLANs is retained.

tagged - Adds a port as a tagged member of a VLAN.

untagged - Adds a port as an untagged member of a VLAN.

double-tagged - Adds a port as a double-tagged member of a VLAN.

remove *vlan-list* - List of VLAN identifiers to remove.

Default Setting

All ports are assigned to VLAN 1 by default.
The default frame type is untagged.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- If a port or trunk has switchport mode set to **access**, then only one VLAN can be added with this command. If a VLAN list is specified, only the last VLAN in the list will be added to the interface.
- If a port or trunk has switchport mode set to **trunk** (i.e., 1Q Trunk), then you can only assign the interface to VLAN groups as a tagged member.
- Frames are always tagged within the switch. The tagged/untagged parameter used when adding a VLAN to an interface tells the switch whether to keep or remove the tag from a frame on egress.
- If none of the intermediate network devices nor the host at the other end of the connection supports VLANs, the interface should be added to these VLANs as an untagged member. Otherwise, it is only necessary to add at most one VLAN as untagged, and this should correspond to the native VLAN for the interface.
- Adding a port as a double-tagged VLAN member is only supported for Ethernet interfaces and not port-channel interfaces.
- If a VLAN on the forbidden list for an interface is manually added to that interface, the VLAN is automatically removed from the forbidden list for that interface.

- Ports can only be added to an RSPAN VLAN using the commands described under "RSPAN Mirroring Commands".

Example

The following example shows how to add VLANs 1, 2, 5 and 6 to the allowed list as tagged VLANs for port 1:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport allowed vlan add 1,2,5,6 tagged
Console(config-if)#
```

switchport ingress-filtering

This command enables ingress filtering for an interface. Use the **no** form to restore the default.

Syntax

[no] switchport ingress-filtering

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- If ingress filtering is disabled and a port receives frames classified to VLANs for which it is not a member, these frames will be flooded to all other ports that are members of the VLANs.
- If ingress filtering is enabled and a port receives frames classified to VLANs for which it is not a member, these frames will be discarded.
- Ingress filtering does not affect VLAN independent BPDU frames, such as GVRP or STA. However, they do affect VLAN dependent BPDU frames, such as GMRP.
- Ingress filtering cannot be enabled for a port if the port does not join the PVID VLAN.
- Ingress filtering cannot be disabled for a port if loopback detection on the port is active. (Both global and per port are enabled.)

Example

The following example shows how to set the interface to port 1 and then enable ingress filtering:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport ingress-filtering
Console(config-if)#
```

switchport mode

This command configures the VLAN membership mode for a port. Use the **no** form to restore the default.

Syntax

switchport mode {**access** | **hybrid** | **trunk**}

no switchport mode

access - Specifies an access VLAN interface. The port transmits and receives untagged frames on a single VLAN only.

hybrid - Specifies a hybrid VLAN interface. The port may transmit tagged or untagged frames.

trunk - Specifies a port as an end-point for a VLAN trunk. A trunk is a direct link between two switches, so the port transmits tagged frames that identify the source VLAN. Note that frames belonging to the port's default VLAN (i.e., associated with the PVID) are also transmitted as tagged frames.

Default Setting

All ports are in hybrid mode with the PVID set to VLAN 1.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

The following shows how to set the configuration mode to port 1, and then set the switchport mode to hybrid:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport mode hybrid
Console(config-if)#
```

switchport native vlan

This command configures the PVID (i.e., port VLAN ID) for a port. Use the **no** form to restore the default.

Syntax

switchport native vlan *vlan-id*

no switchport native vlan

vlan-id - Default VLAN ID for a port. (Range: 1-4094)

Default Setting

VLAN 1

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- When changing the PVID for a port using access mode, the port will automatically join the new PVID VLAN and leave the VLAN which it had joined before.
- When using Access mode, and an interface is assigned to a new VLAN, its PVID is automatically set to the identifier for that VLAN.
- The PVID can be set to any VLAN that the port does not join when using hybrid or trunk mode, and ingress filtering is disabled.
- The PVID can only be set to a VLAN that the port joins when using hybrid or trunk mode, and ingress filtering is enabled.

Example

The following example shows how to set the PVID for port 1 to VLAN 3:

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport native vlan 3
Console(config-if)#
```

vlan-trunking

This command allows unknown VLAN groups to pass through the specified interface. Use the **no** form to disable this feature.

Syntax

[**no**] **vlan-trunking**

Default Setting

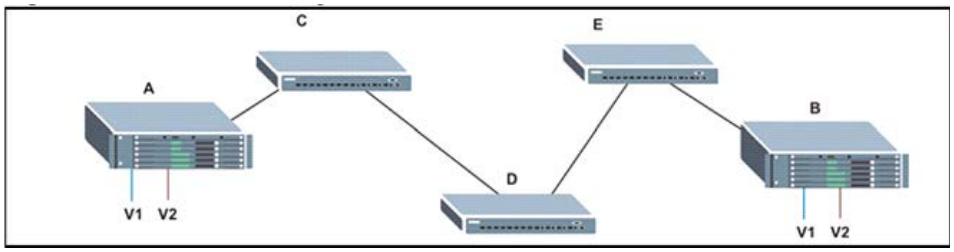
Disabled

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
- Use this command to configure a tunnel across one or more intermediate switches which pass traffic for VLAN groups to which they do not belong.

  The following figure shows VLANs 1 and 2 configured on switches A and B, with VLAN trunking being used to pass traffic for these VLAN groups across switches C, D and E.

  Figure 5: Configuring VLAN Trunking

  Without VLAN trunking, you would have to configure VLANs 1 and 2 on all intermediate switches – C, D and E; otherwise these switches would drop any frames with unknown VLAN group tags. However, by enabling VLAN trunking on the intermediate switch ports along the path connecting VLANs 1 and 2, you only need to create these VLAN groups in switches A and B. Switches C, D and E automatically allow frames with VLAN group tags 1 and 2 (groups that are unknown to those switches) to pass through their VLAN trunking ports.

- VLAN trunking is mutually exclusive with the "access" switchport mode (see the switchport mode command). If VLAN trunking is enabled on an interface, then that interface cannot be set to access mode, and vice versa.

- To prevent loops from forming in the spanning tree, all unknown VLANs will be bound to a single instance (either STP/RSTP or an MSTP instance, depending on the selected STA mode).

- If both VLAN trunking and ingress filtering are disabled on an interface, packets with unknown VLAN tags will still be allowed to enter this interface and will be flooded to all other ports where VLAN trunking is enabled. (In other words, VLAN trunking will still be effectively enabled for the unknown VLAN).

Example
The following example enables VLAN trunking on ports 27 and 28 to establish a path across the switch for unknown VLAN groups:

```
Console(config)#interface ethernet 1/27
Console(config-if)#vlan-trunking
Console(config-if)#interface ethernet 1/28
```

```
Console(config-if)#vlan-trunking
Console(config-if)#
```

Displaying VLAN Information

This section describes commands used to display VLAN information.

Table 84: Commands for Displaying VLAN Information

Command	Function	Mode
show interfaces status vlan	Displays status for the specified VLAN interface	NE, PE
show interfaces switchport	Displays the administrative and operational status of an interface	NE, PE
show vlan	Shows VLAN information	NE, PE

show vlan

This command shows VLAN information.

Syntax

show vlan [**id** *vlan-id* | **name** *vlan-name*]

id - Keyword to be followed by the VLAN ID.

vlan-id - ID of the configured VLAN. (Range: 1-4094)

name - Keyword to be followed by the VLAN name.

vlan-name - ASCII string from 1 to 32 characters.

Default Setting

Shows all VLANs.

Command Mode

Normal Exec, Privileged Exec

Example

The following example shows how to display information for VLAN 1:

```
Console#show vlan id 1

VLAN ID             : 1
Type                : Static
Name                : DefaultVlan
Status              : Active
Ports/Port Channels : Eth1/ 1(S) Eth1/ 2(S) Eth1/ 3(S) Eth1/ 4(S) Eth1/ 5(S)
                      Eth1/ 6(S) Eth1/ 7(S) Eth1/ 8(S) Eth1/ 9(S) Eth1/10(S)
                      Eth1/11(S) Eth1/12(S) Eth1/13(S) Eth1/14(S) Eth1/15(S)
                      Eth1/16(S) Eth1/17(S) Eth1/18(S)

Remote SPAN VLANs
------------------------------------------------
```

```
Console#
```

Configuring IEEE 802.1Q Tunneling

IEEE 802.1Q tunneling (QinQ tunneling) uses a single Service Provider VLAN (SPVLAN) for customers who have multiple VLANs. Customer VLAN IDs are preserved and traffic from different customers is segregated within the service provider's network even when they use the same customer-specific VLAN IDs. QinQ tunneling expands VLAN space by using a VLAN-in-VLAN hierarchy, preserving the customer's original tagged packets, and adding SPVLAN tags to each frame (also called double tagging).

This section describes the commands used to configure QinQ tunneling.

Table 85: 802.1Q Tunneling Commands

Command	Function	Mode
dot1q-tunnel system-tunnel-control	Configures the switch to operate in normal mode or QinQ mode	GC
dot1q-tunnel tpid	Configures the other tag ethertype for QinQ tunneling	GC
switchport dot1q-tunnel mode	Configures the QinQ tunnel port mode of an interface	IC
switchport dot1q-tunnel priority map	Copies inner tag priority to outer tag priority	IC
switchport dot1q-tunnel service match cvid	Creates a CVLAN to SPVLAN mapping entry and optionally replaces the CVLAN	IC
switchport dot1q-tunnel vlan-double-tag cvid	Adds a CVID to untagged frames	IC
show dot1q-tunnel service	Displays tunnel service subscriptions, default discard service, and discarded untagged traffic configuration	PE
show dot1q-tunnel	Displays the configuration of QinQ tunnel ports	PE
show dot1q-tunnel vlan-double-tag	Displays port double-tag CVID configuration	PE
show interfaces switchport	Displays port QinQ operational status	PE

General Configuration Guidelines for QinQ

1. Configure the switch to QinQ mode (dot1q-tunnel system-tunnel-control).
2. Create a SPVLAN (vlan).
3. Configure the QinQ tunnel access port to dot1Q-tunnel access mode (switchport dot1q-tunnel mode).

4. Set the Tag Protocol Identifier (TPID) value of the tunnel access port. This step is required if the attached client is using a nonstandard 2-byte ethertype to identify 802.1Q tagged frames. The standard ethertype value is 0x8100. (See dot1q-tunnel tpid.)

5. Configure the QinQ tunnel access port to join the SPVLAN as an untagged member (switchport allowed vlan).

6. Configure the SPVLAN ID as the native VID on the QinQ tunnel access port (switchport native vlan).

7. Configure the QinQ tunnel uplink port to dot1Q-tunnel uplink mode (switchport dot1q-tunnel mode).

8. Configure the QinQ tunnel uplink port to join the SPVLAN as a tagged member (switchport allowed vlan).

Limitations for QinQ

- The native VLAN for the tunnel uplink ports and tunnel access ports cannot be the same. However, the same service VLANs can be set on both tunnel port types.
- IGMP Snooping should not be enabled on a tunnel access port.
- If the spanning tree protocol is enabled, be aware that a tunnel access or tunnel uplink port may be disabled if the spanning tree structure is automatically reconfigured to overcome a break in the tree. It is therefore advisable to disable spanning tree on these ports.

dot1q-tunnel system-tunnel-control

This command sets the switch to operate in QinQ mode. Use the **no** form to disable QinQ operating mode.

Syntax

[no] dot1q-tunnel system-tunnel-control

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

QinQ tunnel mode must be enabled on the switch for QinQ interface settings to be functional.

Example

```
Console(config)#dot1q-tunnel system-tunnel-control
Console(config)#
```

dot1q-tunnel tpid

Use this command to set the global setting for the QinQ outer tag ethertype field. Use the no form of the command to set the ethertype field to the default value.

Syntax

[no] **dot1q-tunnel tpid** *ethertype*

ethertype – A specific Ethernet protocol number. (Range: 800-ffff hex)

Default Setting

The ethertype is set to 0x8100

Command Mode

Global Configuration

Command Usage

Use the dot1q-tunnel tpid command to set the global custom 802.1Q ethertype. This feature allows the switch to interoperate with third-party switches that do not use the standard 0x8100 ethertype to identify 802.1Q-tagged frames. For example, if 0x1234 is set as the global 802.1Q ethertype, incoming frames on trunk ports containing that ethertype are assigned to the VLAN contained in the tag following the ethertype field. Frames arriving on trunk ports containing any other ethertype are looked upon as untagged frames, and assigned to the native VLAN of the port.

The specified ethertype only applies to ports configured in Uplink mode using the switchport dot1q-tunnel mode command. If the port is in normal mode (i.e, unspecified), the TPID is always 0x8100. If the port is in Access mode, received packets are processes as untagged packets.

Example

```
Console(config)#dot1q-tunnel tpid 0x88A8
Console(config)#
```

switchport dot1q-tunnel mode

This command configures an interface as a QinQ tunnel port. Use the **no** form to disable QinQ on the interface.

Syntax

switchport dot1q-tunnel mode {**access** | **uplink**}

no switchport dot1q-tunnel mode

access – Sets the port as an 802.1Q tunnel access port.

uplink – Sets the port as an 802.1Q tunnel uplink port.

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- QinQ tunneling must be enabled on the switch using the dot1q-tunnel system-tunnel-control command before the **switchport dot1q-tunnel mode** interface command can take effect.
- When a tunnel uplink port receives a packet from a customer, the customer tag (regardless of whether there are one or more tag layers) is retained in the inner tag, and the service provider's tag added to the outer tag.
- When a tunnel uplink port receives a packet from the service provider, the outer service provider's tag is stripped off, and the packet passed on to the VLAN indicated by the inner tag. If no inner tag is found, the packet is passed onto the native VLAN defined for the uplink port.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel mode access
Console(config-if)#
```

switchport dot1q-tunnel priority map

This command copies the inner tag priority to the outer tag priority. Use the **no** form to disable this feature.

Syntax

[no] **switchport dot1q-tunnel priority map**

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

When priority bits are found in the inner tag, these are also copied to the outer tag. This allows the service provider to differentiate service based on the indicated priority and appropriate methods of queue management at intermediate nodes across the tunnel.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel priority map
Console(config-if)#
```

switchport dot1q-tunnel service match cvid

This command creates a CVLAN to SPVLAN mapping entry and optionally replaces the CVLAN. Use the **no** form to delete all VLAN mapping entries or a specified entry.

Syntax

switchport dot1q-tunnel service *svid* **match cvid** *cvid* [**replace cvid** *cvid* | **remove-ctag**]

no switchport dot1q-tunnel service [*svid* [**match cvid** *cvid*]]

svid - VLAN ID for the outer VLAN tag (Service Provider VID). (Range: 1-4094)

cvid - VLAN ID for the inner VLAN tag (Customer VID). (Range: 1-4094)

replace cvid - Specifies a VLAN ID to replace the customer VLAN ID.

remove-ctag - Specifies to remove the customer VLAN ID.

Default Setting

Default mapping uses the PVID of the ingress port on the edge router for the SPVID.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- The inner VLAN tag of a customer packet entering the edge router of a service provider's network is mapped to an outer tag indicating the service provider VLAN that will carry this traffic across the 802.1Q tunnel. This process is performed in a transparent manner.

- When priority bits are found in the inner tag, these are also copied to the outer tag. This allows the service provider to differentiate service based on the indicated priority and appropriate methods of queue management at intermediate nodes across the tunnel.

- Rather than relying on standard service paths and priority queuing, QinQ VLAN mapping can be used to further enhance service by defining a set of

differentiated service pathways to follow across the service provider's network for traffic arriving from specified inbound customer VLANs.

- Note that all customer interfaces should be configured as access interfaces (that is, a user-to-network interface) and service provider interfaces as uplink interfaces (that is, a network-to-network interface). Use the dot1q-tunnel tpid uplink command to set an interface to access or uplink mode.
- When using the **replace cvid** option to replace a customer VLAN ID, the port must be configured as a double-tagged member of the VLAN using the switchport allowed vlan command.
- The **replace cvid** option is supported only for Ethernet interfaces and not port-channel interfaces.
- When the **remove-ctag** option is specified, the inner-tag containing the customer's VID is removed, and the outer-tag containing the service provider's VID remains in place.

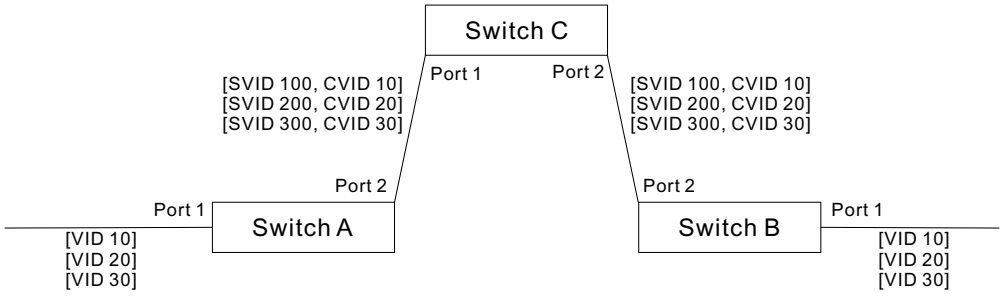
Example

This example sets the SVID to 99 in the outer tag for egress packets exiting port 1 when the packet's CVID is 2.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel service 99 match cvid 2
Console(config-if)#
```

The following example maps C-VLAN 10 to S-VLAN 100, C-VLAN 20 to S-VLAN 200 and C-VLAN 30 to S-VLAN 300 for ingress traffic on port 1 of Switches A and B.

Figure 6: Mapping QinQ Service VLAN to Customer VLAN



Step 1. Configure Switch A and B.

1. Create VLANs 100, 200 and 300.

```
Console(config)#vlan database
Console(config-vlan)#vlan 100,200,300 media ethernet state active
```

2. Enable QinQ.

```
Console(config)#dot1q-tunnel system-tunnel-control
```

3. Configure port 2 as a tagged member of VLANs 100, 200 and 300 using uplink mode.

```
Console(config)#interface ethernet 1/2
Console(config-if)#switchport allowed vlan add 100,200,300 tagged
Console(config-if)#switchport dot1q-tunnel mode uplink
```

4. Configures port 1 as an untagged member of VLANs 100, 200 and 300 using access mode.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport allowed vlan add 100,200,300 untagged
Console(config-if)#switchport dot1q-tunnel mode access
```

5. Configure the following selective QinQ mapping entries.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel service 100 match cvid 10
Console(config-if)#switchport dot1q-tunnel service 200 match cvid 20
Console(config-if)#switchport dot1q-tunnel service 300 match cvid 30
```

6. Configures port 1 as member of VLANs 10, 20 and 30 to avoid filtering out incoming frames tagged with VID 10, 20 or 30 on port 1

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport allowed vlan add 10,20,30
```

7. Verify configuration settings.

```
Console#show dot1q-tunnel service
802.1Q Tunnel Service Subscriptions

 Port     Match C-VID S-VID

 -------- ----------- -----

 Eth 1/ 3          10   100

 Eth 1/ 3          20   200

 Eth 1/ 3          30   300
```

Step 2. Configure Switch C.

1. Create VLAN 100, 200 and 300.

```
Console(config)#vlan database
Console(config-vlan)#vlan 100,200,300 media ethernet state active
```

2. Configure port 1 and port 2 as tagged members of VLAN 100, 200 and 300.

```
Console(config)#interface ethernet 1/1,2
Console(config-if)#switchport allowed vlan add 100,200,300 tagged
```

switchport dot1q-tunnel vlan-double-tag cvid

This command adds a customer VLAN ID to untagged frames. Use the **no** form to remove the configuration.

Syntax

switchport dot1q-tunnel vlan-double-tag cvid *cvid*

no switchport dot1q-tunnel vlan-double-tag

cvid - VLAN ID for the inner VLAN tag (Customer VID). (Range: 1-4094)

Default Setting

None.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- When a port receives an untagged frame (the frame does not contain any VLAN tag), the switch will label the frame with the port's native VLAN tag (SVID) and insert the specified customer VLAN (CVID).
- The SVID (Native VLAN) and specified VLAN (CVID) will be inserted in the customer frames as they enter the service provider network, and the tags will be stripped when frames leave the service provider network.
- This double-tag function feature can select whether to label the inner VLAN tag, but cannot select the outer VLAN tag, and can only use TPID 0x8100.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel vlan-double-tag cvid 101
Console(config-if)#
```

show dot1q-tunnel service

This command shows tunnel service subscriptions, default discard service, and discarded untagged traffic configuration.

Syntax

show dot1q-tunnel service [*svid*]

svid - VLAN ID for the outer VLAN tag (SPVID). (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#show dot1q service
802.1Q Tunnel Service Subscriptions
```

```
 Port     Match C-VID Range S-VID Replace
 -------- ----------------- ----- --------
 Eth 1/ 3                10   100
 Eth 1/ 3                20   200
 Eth 1/ 3                30   300


Console(config)#show dot1q-tunnel service 100
802.1Q Tunnel Service Subscriptions

 Port     Match C-VID Range S-VID Replace
 -------- ----------------- ----- --------
 Eth 1/ 3                10   100

Console#
```

show dot1q-tunnel

This command displays information about QinQ tunnel ports.

Syntax

show dot1q-tunnel [**interface** *interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode

Privileged Exec

Example

```
Console(config)#dot1q-tunnel system-tunnel-control
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel mode access
Console(config-if)#interface ethernet 1/2
Console(config-if)#switchport dot1q-tunnel mode uplink
Console(config-if)#end
Console#show dot1q-tunnel
802.1Q Tunnel Status : Enabled
802.1Q Tunnel TPID   : 8100 (Hex)

Port     Mode   Priority Mapping
-------- ------ ----------------
Eth 1/ 1 Access Disabled
Eth 1/ 2 Uplink Disabled
Eth 1/ 3 Normal Disabled
:
Console#show dot1q-tunnel interface ethernet 1/5
802.1Q Tunnel Service Subscriptions

 Port     Match C-VID Range S-VID Replace
 -------- ----------------- ----- --------
 Eth 1/ 5                 1   100
```

```
Console#show dot1q-tunnel service 100
802.1Q Tunnel Service Subscriptions

 Port     Match C-VID Range S-VID Replace
 -------- ----------------- ----- --------
 Eth 1/ 5                1   100
 Eth 1/ 6                1   100

Console#
```

show dot1q-tunnel vlan-double-tag

This command shows port double-tag CVID configuration.

Syntax

show dot1q-tunnel vlan-double-tag

Command Mode

Privileged Exec

Example

```
Console#show dot1q-tunnel vlan-double-tag
802.1Q Tunnel Vlan Stacking Subscriptions

Port     Status   CVlan
---------- --------- --------
 Eth 1/ 1 Enabled  101
 Eth 1/ 2 Disabled  0
 Eth 1/ 3 Disabled  0
 Eth 1/ 4 Disabled  0
 Eth 1/ 5 Disabled  0
 Eth 1/ 6 Disabled  0
 Eth 1/ 7 Disabled  0
   .
   .
   .
   .

Console#
```

Configuring L2PT Tunneling

This section describes the commands used to configure Layer 2 Protocol Tunneling (L2PT).

Table 86: L2 Protocol Tunnel Commands

Command	Function	Mode
l2protocol-tunnel tunnel-dmac	Configures the destination address for Layer 2 Protocol Tunneling	GC
switchport l2protocol-tunnel	Enables Layer 2 Protocol Tunneling for the specified protocol	IC
show l2protocol-tunnel	Shows settings for Layer 2 Protocol Tunneling	PE

l2protocol-tunnel tunnel-dmac

This command configures the destination address for Layer 2 Protocol Tunneling (L2PT). Use the **no** form to restore the default setting.

Syntax

l2protocol-tunnel tunnel-dmac *mac-address*

no l2protocol-tunnel tunnel-dmac

mac-address – The switch rewrites the destination MAC address in all upstream L2PT protocol packets (i.e, STP BPDUs) to this value, and forwards them on to uplink ports. The MAC address must be specified in the format xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.

The tunnel address can be any multicast address, except for the following:

- IPv4 multicast addresses (with prefix 01-00-5E)
- IPv6 multicast addresses (with prefix 33-33-33)
- Addresses used by the spanning tree protocol.

Default Setting

01-12-CF-.00-00-02, proprietary tunnel address

Command Mode

Global Configuration

Command Usage

- When L2PT is not used, protocol packets (such as STP) are flooded to 802.1Q access ports on the same edge switch, but filtered from 802.1Q tunnel ports. This creates disconnected protocol domains in the customer's network.

- L2PT can be used to pass various types of protocol packets belonging to the same customer transparently across a service provider's network. In this way,

normally segregated network segments can be configured to function inside a common protocol domain.

- L2PT encapsulates protocol packets entering ingress ports on the service provider's edge switch, replacing the destination MAC address with a proprietary MAC address (for example, the spanning tree protocol uses 10-12-CF-00-00-02), a reserved address for other specified protocol types (as defined in IEEE 802.1ad – Provider Bridges), or a user-defined address. All intermediate switches carrying this traffic across the service provider's network treat these encapsulated packets in the same way as normal data, forwarding them across to the tunnel's egress port. The egress port decapsulates these packets, restores the proper protocol and MAC address information, and then floods them onto the same VLANs at the customer's remote site (via all of the appropriate tunnel ports and access ports[11] connected to the same metro VLAN).

- The way in which L2PT processes packets is based on the following criteria – (1) packet is received on a QinQ uplink port, (2) packet is received on a QinQ access port, or (3) received packet is Cisco-compatible L2PT (i.e., as indicated by a proprietary MAC address).

Processing protocol packets defined in IEEE 802.1ad – Provider Bridges

- When an IEEE 802.1ad protocol packet is received on an uplink port (i.e., an 802.1Q tunnel ingress port connecting the edge switch to the service provider network)
  - with the destination address 01-80-C2-00-00-00,0B~0F (C-VLAN tag), it is forwarded to all QinQ uplink ports and QinQ access ports in the same S-VLAN for which L2PT is enabled for that protocol.
  - with the destination address 01-80-C2-00-00-01~0A (S-VLAN tag), it is filtered, decapsulated, and processed locally by the switch if the protocol is supported.
- When a protocol packet is received on an access port (i.e., an 802.1Q trunk port connecting the edge switch to the local customer network)
  - with the destination address 01-80-C2-00-00-00,0B~0F (C-VLAN), and
    - L2PT is enabled on the port, the frame is forwarded to all QinQ uplink ports and QinQ access ports on which L2PT is enabled for that protocol in the same S-VLAN.
    - L2PT is disabled on the port, the frame is decapsulated and processed locally by the switch if the protocol is supported.

11. Access ports in this context are 802.1Q trunk ports.

- with destination address 01-80-C2-00-00-01~0A (S-VLAN), the frame is filtered, decapsulated, and processed locally by the switch if the protocol is supported.

Processing Cisco-compatible protocol packets

- When a Cisco-compatible L2PT packet is received on an uplink port, and
  - recognized as a CDP/VTP/STP/PVST+ protocol packet (where STP means STP/RSTP/MSTP), it is forwarded to the following ports in the same S-VLAN: (a) all access ports for which L2PT has been disabled, and (b) all uplink ports.
  - recognized as a Generic Bridge PDU Tunneling (GBPT) protocol packet (i.e., having the destination address 01-00-0C-CD-CD-D0), it is forwarded to the following ports in the same S-VLAN:
    - other access ports for which L2PT is enabled after decapsulating the packet and restoring the proper protocol and MAC address information.
    - all uplink ports.
- When a Cisco-compatible L2PT packet is received on an access port, and
  - recognized as a CDP/VTP/STP/PVST+ protocol packet, and
    - L2PT is enabled on this port, it is forwarded to the following ports in the same S-VLAN: (a) other access ports for which L2PT is enabled, and (b) uplink ports after rewriting the destination address to make it a GBPT protocol packet (i.e., setting the destination address to 01-00-0C-CD-CD-D0).
    - L2PT is disabled on this port, it is forwarded to the following ports in the same S-VLAN: (a) other access ports for which L2PT is disabled, and (b) all uplink ports.
  - recognized as a GBPT protocol packet (i.e., having the destination address 01-00-0C-CD-CD-D0), and
    - L2PT is enabled on this port, it is forwarded to other access ports in the same S-VLAN for which L2PT is enabled
    - L2PT is disabled on this port, it is forwarded to the following ports in the same S-VLAN: (a) other access ports for which L2PT is disabled, and (b) all uplink ports.
- For L2PT to function properly, QinQ must be enabled on the switch using the dot1q-tunnel system-tunnel-control command, and the interface configured to 802.1Q tunnel mode using the dot1q-tunnel tpid command.

Example

```
Console(config)#dot1q-tunnel system-tunnel-control
Console(config)#l2protocol-tunnel tunnel-dmac 01-80-C2-00-00-01
Console(config-)#
```

switchport l2protocol-tunnel

This command enables Layer 2 Protocol Tunneling (L2PT) for the specified protocol. Use the **no** form to disable L2PT for the specified protocol.

Syntax

[no] switchport l2protocol-tunnel {**cdp** | **lacp** | **lldp** | **pvst+** | **spanning-tree** | **vtp**}

cdp - Cisco Discovery Protocol

lacp - Link Aggregation Control Protocol

lldp - Link Layer Discovery Protocol

pvst+ - Cisco Per VLAN Spanning Tree Plus

spanning-tree - Spanning Tree (STP, RSTP, MSTP)

vtp - Cisco VLAN Trunking Protocol

Default Setting

Disabled for all protocols

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Refer to the Command Usage section for the l2protocol-tunnel tunnel-dmac command.
- For L2PT to function properly, QinQ must be enabled on the switch using the dot1q-tunnel system-tunnel-control command, and the interface configured to 802.1Q tunnel mode using the dot1q-tunnel tpid command.

Example

```
Console(config)#dot1q-tunnel system-tunnel-control
Console(config)#interface ethernet 1/1
Console(config-if)#switchport dot1q-tunnel mode access
Console(config-if)#switchport l2protocol-tunnel spanning-tree
Console(config-if)#
```

show l2protocol-tunnel

This command shows settings for Layer 2 Protocol Tunneling (L2PT).

Command Mode

Privileged Exec

Example

```
Console#show l2protocol-tunnel
Layer 2 Protocol Tunnel

Tunnel MAC Address : 01-12-CF-00-00-00

Interface  Protocol
------------------------------------------------------------
Eth 1/ 1   Spanning Tree

Console#
```

Configuring VLAN Translation

QinQ tunneling uses double tagging to preserve the customer's VLAN tags on traffic crossing the service provider's network. However, if any switch in the path crossing the service provider's network does not support this feature, then the switches directly connected to that device can be configured to swap the customer's VLAN ID with the service provider's VLAN ID for upstream traffic, or the service provider's VLAN ID with the customer's VLAN ID for downstream traffic.

This section describes commands used to configure VLAN translation.

Table 87: VLAN Translation Commands

Command	Function	Mode
switchport vlan-translation	Maps VLAN IDs between the customer and service provider	IC
show vlan-translation	Displays the configuration settings for VLAN translation	PE

switchport vlan-translation

This command maps VLAN IDs between the customer and service provider.

Syntax

switchport vlan-translation [ingress | egress] *original-vlan new-vlan*

no switchport vlan-translation [ingress | egress] *original-vlan*

ingress - specifies ingress only

egress - specifies egress only

original-vlan - The original VLAN ID. (Range: 1-4094)

new-vlan - The new VLAN ID. (Range: 1-4094)

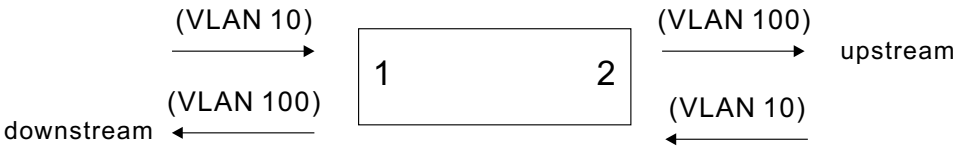
Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet)

Command Usage
- If the next switch upstream does not support QinQ tunneling, then use this command to map the customer's VLAN ID to the service provider's VLAN ID for the upstream port. Similarly, if the next switch downstream does not support QinQ tunneling, then use this command to map the service provider's VLAN ID to the customer's VLAN ID for the downstream port. Note that one command maps both the *original-vlan* to *new-vlan* for ingress traffic and the *new-vlan* to *original-vlan* for egress traffic on the specified port.

  For example, assume that the upstream switch does not support QinQ tunneling. If the command **switchport vlan-translation 10 100** is used to map VLAN 10 to VLAN 100 for upstream traffic entering port 1, and VLAN 100 to VLAN 10 for downstream traffic leaving port 1, then the VLAN IDs will be swapped as shown below.

  Figure 7: Configuring VLAN Translation



- The maximum number of VLAN translation entries is 8 per port, and up to 96 for the system. However, note that configuring a large number of entries may degrade the performance of other processes that also use the TCAM, such as IP Source Guard filter rules, Quality of Service (QoS) processes, QinQ, MAC-based VLANs, VLAN translation, or traps.

- If VLAN translation is set on an interface with this command, and the same interface is also configured as a QinQ access port with the dot1q-tunnel tpid command, VLAN tag assignments will be determined by the QinQ process, not by VLAN translation.

Example
This example configures VLAN translation for Port 1 as described in the Command Usage section above.

```
Console(config)#vlan database
Console(config-vlan)#vlan 10 media ethernet state active
Console(config-vlan)#vlan 100 media ethernet state active
Console(config-vlan)#exit
Console(config)#interface ethernet 1/1,2
Console(config-if)#switchport allowed vlan add 10 tagged
Console(config-if)#switchport allowed vlan add 100 tagged
Console(config-if)#interface ethernet 1/1
Console(config-if)#switchport vlan-translation 10 100
Console(config-if)#end
Console#show vlan-translation
```

```
Ingress VLAN Translation
Interface Old VID New VID
--------- ------- -------
Eth 1/ 1       10     100

Egress VLAN Translation
Interface Old VID New VID
--------- ------- -------
Eth 1/ 1      100      10

Console#
```

show vlan-translation

This command displays the configuration settings for VLAN translation.

Syntax

show vlan-translation [**egress** [**interface** *interface*] | **ingress** [**interface** *interface*]| **interface** *interface*]

egress - Show configuration settings for egress ports.

ingress - Show configuration settings for ingress ports.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode

Privileged Exec

Example

```
Console#show vlan-translation

Ingress VLAN Translation
Interface Old VID New VID
--------- ------- -------
Eth 1/ 1       10     100
Eth 1/ 2      100     200

Egress VLAN Translation
Interface Old VID New VID
--------- ------- -------
Eth 1/ 1      100      10
Eth 1/ 2      100     200
Eth 1/ 2      200     10
Console#
```

Configuring Protocol-Based VLANs

The network devices required to support multiple protocols cannot be easily grouped into a common VLAN. This may require non-standard devices to pass traffic between different VLANs in order to encompass all the devices participating in a specific protocol. This kind of configuration deprives users of the basic benefits of VLANs, including security and easy accessibility.

To avoid these problems, you can configure this switch with protocol-based VLANs that divide the physical network into logical VLAN groups for each required protocol. When a frame is received at a port, its VLAN membership can then be determined based on the protocol type in use by the inbound packets.

Table 88: Protocol-Based VLAN Commands

Command	Function	Mode
protocol-vlan protocol-group	Create a protocol group, specifying the supported protocols	GC
protocol-vlan protocol-group	Maps a protocol group to a VLAN	IC
show protocol-vlan protocol-group	Shows the configuration of protocol groups	PE
show interfaces protocol-vlan protocol-group	Shows the interfaces mapped to a protocol group and the corresponding VLAN	PE

To configure protocol-based VLANs, follow these steps:

1. First configure VLAN groups for the protocols you want to use (page 512). Although not mandatory, we suggest configuring a separate VLAN for each major protocol running on your network. Do not add port members at this time.

2. Create a protocol group for each of the protocols you want to assign to a VLAN using the protocol-vlan protocol-group command (Global Configuration mode).

3. Then map the protocol for each interface to the appropriate VLAN using the protocol-vlan protocol-group command (Interface Configuration mode).

Note: Traffic which matches IP Protocol Ethernet Frames is mapped to the VLAN that has been configured with the switch's administrative IP interface (default VLAN 1). IP Protocol Ethernet traffic must not be mapped to another VLAN or you will lose administrative network connectivity to the switch. If lost in this manner, network access can be regained by removing the offending Protocol VLAN rule via the console. Alternately, the switch can be power-cycled, however all unsaved configuration changes will be lost.

protocol-vlan protocol-group (Configuring Groups)

This command creates a protocol group, or adds specific protocols to a group. Use the **no** form to remove a protocol group.

Syntax

protocol-vlan protocol-group *group-id* [{**add** | **remove**} **frame-type** *frame* **protocol-type** *protocol*]

no protocol-vlan protocol-group *group-id*

group-id - Group identifier of this protocol group. (Range: 1-2147483647)

frame[12] - Frame type used by this protocol. (Options: ethernet, rfc_1042, llc_other)

protocol - Protocol type. The only option for the llc_other frame type is ipx_raw. The options for all other frames types include: arp, ip, ipv6, pppoe-dis, pppoe-ses, rarp.

Default Setting

No protocol groups are configured.

Command Mode

Global Configuration

Example

The following creates protocol group 1, and specifies Ethernet frames with IP and ARP protocol types:

```
Console(config)#protocol-vlan protocol-group 1 add frame-type ethernet
  protocol-type ip
Console(config)#protocol-vlan protocol-group 1 add frame-type ethernet
  protocol-type arp
Console(config)#
```

protocol-vlan protocol-group (Configuring Interfaces)

This command maps a protocol group to a VLAN for the current interface. Use the **no** form to remove the protocol mapping for this interface.

Syntax

protocol-vlan protocol-group *group-id* **vlan** *vlan-id* [**priority** *priority*]

no protocol-vlan protocol-group *group-id*

group-id - Group identifier of this protocol group. (Range: 1-2147483647)

vlan-id - VLAN to which matching protocol traffic is forwarded. (Range: 1-4094)

12. SNAP frame types are not supported by this switch due to hardware limitations.

priority - The priority assigned to untagged ingress traffic. (Range: 0-7, where 7 is the highest priority)

Default Setting

No protocol groups are mapped for any interface.
Priority: 0

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- When creating a protocol-based VLAN, only assign interfaces via this command. If you assign interfaces using any of the other VLAN commands (such as the vlan command), these interfaces will admit traffic of any protocol type into the associated VLAN.
- When MAC-based, IP subnet-based, and protocol-based VLANs are supported concurrently, priority is applied in this sequence, and then port-based VLANs last.
- When a frame enters a port that has been assigned to a protocol VLAN, it is processed in the following manner:
  - If the frame is tagged, it will be processed according to the standard rules applied to tagged frames.
  - If the frame is untagged and the protocol type matches, the frame is forwarded to the appropriate VLAN.
  - If the frame is untagged but the protocol type does not match, the frame is forwarded to the default VLAN for this interface.

Example

The following example maps the traffic entering Port 1 which matches the protocol type specified in protocol group 1 to VLAN 2.

```
Console(config)#interface ethernet 1/1
Console(config-if)#protocol-vlan protocol-group 1 vlan 2 priority 0
Console(config-if)#
```

show protocol-vlan protocol-group

This command shows the frame and protocol type associated with protocol groups.

Syntax

show protocol-vlan protocol-group [*group-id*] [**sort-by-type**]

group-id - Group identifier for a protocol group. (Range: 1-2147483647)

sort-by-type - Sort display information by frame type and protocol type.

Default Setting
All protocol groups are displayed.

Command Mode
Privileged Exec

Example
This shows protocol group 1 configured for IP over Ethernet:

```
Console#show protocol-vlan protocol-group

 Protocol Group ID   Frame Type    Protocol Type
------------------ ------------ ---------------
                 1      ethernet     08 00
Console#
```

show interfaces protocol-vlan protocol-group

This command shows the mapping from protocol groups to VLANs for the selected interfaces.

Syntax

show interfaces protocol-vlan protocol-group [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
The mapping for all interfaces is displayed.

Command Mode
Privileged Exec

Example
This shows that traffic entering Port 1 that matches the specifications for protocol group 1 will be mapped to VLAN 2:

```
Console#show interfaces protocol-vlan protocol-group
Port     Protocol Group ID VLAN ID Priority
-------- ----------------- ------- --------
 Eth 1/1 1                 2       1
Console#
```

Configuring IP Subnet VLANs

When using IEEE 802.1Q port-based VLAN classification, all untagged frames received by a port are classified as belonging to the VLAN whose VID (PVID) is associated with that port.

When IP subnet-based VLAN classification is enabled, the source address of untagged ingress frames are checked against the IP subnet-to-VLAN mapping table. If an entry is found for that subnet, these frames are assigned to the VLAN indicated in the entry. If no IP subnet is matched, the untagged frames are classified as belonging to the receiving port's VLAN ID (PVID).

Table 89: IP Subnet VLAN Commands

Command	Function	Mode
subnet-vlan	Defines the IP Subnet VLANs	GC
show subnet-vlan	Displays IP Subnet VLAN settings	PE

subnet-vlan

This command configures IP Subnet VLAN assignments. Use the **no** form to remove an IP subnet-to-VLAN assignment.

Syntax

subnet-vlan subnet *ip-address mask* **vlan** *vlan-id* [**priority** *priority*]

no subnet-vlan subnet {*ip-address mask* | **all**}

ip-address – The IP address that defines the subnet. Valid IP addresses consist of four decimal numbers, 0 to 255, separated by periods.

mask – This mask identifies the host address bits of the IP subnet.

vlan-id – VLAN to which matching IP subnet traffic is forwarded. (Range: 1-4094)

priority – The priority assigned to untagged ingress traffic. (Range: 0-7, where 7 is the highest priority)

Default Setting

Priority: 0

Command Mode

Global Configuration

Command Usage

- Each IP subnet can be mapped to only one VLAN ID. An IP subnet consists of an IP address and a subnet mask. The specified VLAN need not be an existing VLAN.

- When an untagged frame is received by a port, the source IP address is checked against the IP subnet-to-VLAN mapping table, and if an entry is found, the corresponding VLAN ID is assigned to the frame. If no mapping is found, the PVID of the receiving port is assigned to the frame.
- The IP subnet cannot be a broadcast or multicast IP address.
- When MAC-based, IP subnet-based, or protocol-based VLANs are supported concurrently, priority is applied in this sequence, and then port-based VLANs last.

Example

The following example assigns traffic for the subnet 192.168.12.192, mask 255.255.255.224, to VLAN 4.

```
Console(config)#subnet-vlan subnet 192.168.12.192 255.255.255.224 vlan 4
Console(config)#
```

show subnet-vlan

This command displays IP Subnet VLAN assignments.

Command Mode

Privileged Exec

Command Usage

- Use this command to display subnet-to-VLAN mappings.
- The last matched entry is used if more than one entry can be matched.

Example

The following example displays all configured IP subnet-based VLANs.

```
Console#show subnet-vlan
IP Address       Mask             VLAN ID  Priority
---------------  ---------------  -------  --------
192.168.12.0     255.255.255.128        1         0
192.168.12.128   255.255.255.192        3         0
192.168.12.192   255.255.255.224        4         0
192.168.12.224   255.255.255.240        5         0
192.168.12.240   255.255.255.248        6         0
192.168.12.248   255.255.255.252        7         0
192.168.12.252   255.255.255.254        8         0
192.168.12.254   255.255.255.255        9         0
192.168.12.255   255.255.255.255       10         0
Console#
```

Configuring MAC Based VLANs

When using IEEE 802.1Q port-based VLAN classification, all untagged frames received by a port are classified as belonging to the VLAN whose VID (PVID) is associated with that port.

When MAC-based VLAN classification is enabled, the source address of untagged ingress frames are checked against the MAC address-to-VLAN mapping table. If an entry is found for that address, these frames are assigned to the VLAN indicated in the entry. If no MAC address is matched, the untagged frames are classified as belonging to the receiving port's VLAN ID (PVID).

Table 90: MAC Based VLAN Commands

Command	Function	Mode
mac-vlan	Defines the IP Subnet VLANs	GC
show mac-vlan	Displays IP Subnet VLAN settings	PE

mac-vlan

This command configures MAC address-to-VLAN mapping. Use the **no** form to remove an assignment.

Syntax

mac-vlan mac-address *mac-address* [**mask** *mask-address*] **vlan** *vlan-id* [**priority** *priority*]

no mac-vlan mac-address {*mac-address* [**mask** *mask-address*] | **all**}

mac-address – The source MAC address to be matched. Configured MAC addresses can only be unicast addresses. The MAC address must be specified in the format xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.

mask-address - Identifies a range of MAC addresses. The mask can be specified in the format xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx, where an equivalent binary value "1" means relevant and "0" means ignore.

vlan-id – VLAN to which the matching source MAC address traffic is forwarded. (Range: 1-4094)

priority – The priority assigned to untagged ingress traffic. (Range: 0-7, where 7 is the highest priority)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- The MAC-to-VLAN mapping applies to all ports on the switch.

- Source MAC addresses can be mapped to only one VLAN ID.
- Configured MAC addresses cannot be broadcast or multicast addresses.
- When MAC-based, IP subnet-based, and protocol-based VLANs are supported concurrently, priority is applied in this sequence, and then port-based VLANs last.
- The binary equivalent mask matching the characters in the front of the first non-zero character must all be 1s (e.g., 111, i.e., it cannot be 101 or 001...). A mask for the MAC address: 00-50-6e-00-5f-b1 translated into binary:

  MAC: 00000000-01010000-01101110-00000000-01011111-10110001

  could be: 11111111-11xxxxxx-xxxxxxxx-xxxxxxxx-xxxxxxxx-xxxxxxxx

  So the mask in hexadecimal for this example could be:

  ff-fx-xx-xx-xx-xx/ff-c0-00-00-00-00/ff-e0-00-00-00-00

Example

The following example assigns traffic from source MAC address 00-00-00-11-22-33 to VLAN 10.

```
Console(config)#mac-vlan mac-address 00-00-00-11-22-33 mask FF-FF-FF-FF-00-00
  vlan 10
Console(config)#
```

show mac-vlan

This command displays MAC address-to-VLAN assignments.

Command Mode

Privileged Exec

Command Usage

Use this command to display MAC address-to-VLAN mappings.

Example

The following example displays all configured MAC address-based VLANs.

```
Console#show mac-vlan
MAC Address        Mask               VLAN ID  Priority
-----------------  -----------------  --------  --------
00-E0-4C-68-14-79  FF-FF-FF-FF-FF-FF       100         0
Console#
```

Configuring Voice VLANs

The switch allows you to specify a Voice VLAN for the network and set a CoS priority for the VoIP traffic. VoIP traffic can be detected on switch ports by using the source MAC address of packets, or by using LLDP (IEEE 802.1AB) to discover connected VoIP devices. When VoIP traffic is detected on a configured port, the switch automatically assigns the port to the Voice VLAN. Alternatively, switch ports can be manually configured.

Table 91: Voice VLAN Commands

Command	Function	Mode
voice vlan	Defines the Voice VLAN ID	GC
voice vlan aging	Configures the aging time for Voice VLAN ports	GC
voice vlan mac-address	Configures VoIP device MAC addresses	GC
switchport voice vlan	Sets the Voice VLAN port mode	IC
switchport voice vlan priority	Sets the VoIP traffic priority for ports	IC
switchport voice vlan rule	Sets the automatic VoIP traffic detection method for ports	IC
switchport voice vlan security	Enables Voice VLAN security on ports	IC
show voice vlan	Displays Voice VLAN settings	PE

voice vlan

This command enables VoIP traffic detection and defines the Voice VLAN ID. Use the **no** form to disable the Voice VLAN.

Syntax

voice vlan *voice-vlan-id*

no voice vlan

voice-vlan-id - Specifies the voice VLAN ID. (Range: 1-4094)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- When IP telephony is deployed in an enterprise network, it is recommended to isolate the Voice over IP (VoIP) network traffic from other data traffic. Traffic isolation helps prevent excessive packet delays, packet loss, and jitter, which results in higher voice quality. This is best achieved by assigning all VoIP traffic to a single VLAN.

- VoIP traffic can be detected on switch ports by using the source MAC address of packets, or by using LLDP (IEEE 802.1AB) to discover connected VoIP devices. When VoIP traffic is detected on a configured port, the switch automatically assigns the port as a tagged member of the Voice VLAN.
- Only one Voice VLAN is supported and it must already be created on the switch before it can be specified as the Voice VLAN.
- The Voice VLAN ID cannot be modified when the global auto-detection status is enabled (see the switchport voice vlan command).

Example

The following example enables VoIP traffic detection and specifies the Voice VLAN ID as 1234.

```
Console(config)#voice vlan 1234
Console(config)#
```

voice vlan aging

This command sets the Voice VLAN ID time out. Use the no form to restore the default.

Syntax

voice vlan aging *minutes*

no voice vlan

minutes - Specifies the port Voice VLAN membership time out. (Range: 5-43200 minutes)

Default Setting

1440 minutes

Command Mode

Global Configuration

Command Usage

The Voice VLAN aging time is the time after which a port is removed from the Voice VLAN when VoIP traffic is no longer received on the port.

The VoIP aging time starts to count down when the OUI's MAC address expires from the MAC address table. Therefore, the MAC address aging time should be added to the overall aging time. For example, if you configure the MAC address table aging time to 30 seconds, and voice VLAN aging time to 5 minutes, then after 5.5 minutes, a port will be removed from the voice VLAN when VoIP traffic is no longer received on the port. Alternatively, if you clear the MAC address table manually, then the switch will also start counting down the voice VLAN aging time.

Note that when the switchport voice vlan command is set to auto mode, the remaining aging time displayed by the show voice vlan command will be displayed. Otherwise, if the switchport voice vlan command is disabled or set to manual mode, the remaining aging time will display "NA."

Example

The following example configures the Voice VLAN aging time as 3000 minutes.

```
Console(config)#voice vlan aging 3000
Console(config)#
```

voice vlan mac-address

This command specifies MAC address ranges to add to the OUI Telephony list. Use the **no** form to remove an entry from the list.

Syntax

voice vlan mac-address *mac-address* **mask** *mask-address* [**description** *description*]

no voice vlan mac-address *mac-address* **mask** *mask-address*

mac-address - Defines a MAC address OUI that identifies VoIP devices in the network. (Format: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx; for example, 01-23-45-00-00-00)

mask-address - Identifies a range of MAC addresses. (Range: 80-00-00-00-00-00 to FF-FF-FF-FF-FF-FF)

description - User-defined text that identifies the VoIP devices. (Range: 1-30 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- VoIP devices attached to the switch can be identified by the manufacturer's Organizational Unique Identifier (OUI) in the source MAC address of received packets. OUI numbers are assigned to manufacturers and form the first three octets of device MAC addresses. The MAC OUI numbers for VoIP equipment can be configured on the switch so that traffic from these devices is recognized as VoIP.

- Setting a mask of FF-FF-FF-00-00-00 identifies all devices with the same OUI (the first three octets). Other masks restrict the MAC address range. Setting a mask of FF-FF-FF-FF-FF-FF specifies a single MAC address.

Example

The following example adds a MAC OUI to the OUI Telephony list.

```
Console(config)#voice vlan mac-address 00-12-34-56-78-90 mask ff-ff-ff-00-00-
  00 description "A new phone"
Console(config)#
```

switchport voice vlan

This command specifies the Voice VLAN mode for ports. Use the **no** form to disable the Voice VLAN feature on the port.

Syntax

switchport voice vlan {**manual** | **auto**}

no switchport voice vlan

manual - The Voice VLAN feature is enabled on the port, but the port must be manually added to the Voice VLAN.

auto - The port will be added as a tagged member to the Voice VLAN when VoIP traffic is detected on the port.

Default Setting

Disabled

Command Mode

Interface Configuration

Command Usage

- When auto is selected, you must select the method to use for detecting VoIP traffic, either OUI or 802.1AB (LLDP) using the switchport voice vlan rule command. When OUI is selected, be sure to configure the MAC address ranges in the Telephony OUI list using the voice vlan mac-address command.

- All ports are set to VLAN hybrid mode by default. Prior to enabling VoIP for a port (by setting the VoIP mode to Auto or Manual as described below), ensure that VLAN membership is not set to access mode using the switchport mode command.

Example

The following example sets port 1 to Voice VLAN auto mode.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan auto
Console(config-if)#
```

switchport voice vlan priority

This command specifies a CoS priority for VoIP traffic on a port. Use the **no** form to restore the default priority on a port.

Syntax

switchport voice vlan priority *priority-value*

no switchport voice vlan priority

priority-value - The CoS priority value. (Range: 0-6)

Default Setting

6

Command Mode

Interface Configuration

Command Usage

Specifies a CoS priority to apply to the port VoIP traffic on the Voice VLAN. The priority of any received VoIP packet is overwritten with the new priority when the Voice VLAN feature is active for the port.

Example

The following example sets the CoS priority to 5 on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan priority 5
Console(config-if)#
```

switchport voice vlan rule

This command selects a method for detecting VoIP traffic on a port. Use the **no** form to disable the detection method on the port.

Syntax

[no] **switchport voice vlan rule** {**oui** | **lldp**}

oui - Traffic from VoIP devices is detected by the Organizationally Unique Identifier (OUI) of the source MAC address.

lldp - Uses LLDP to discover VoIP devices attached to the port.

Default Setting

OUI: Enabled
LLDP: Disabled

Command Mode

Interface Configuration

Command Usage

- When OUI is selected, be sure to configure the MAC address ranges in the Telephony OUI list (see the voice vlan mac-address command). MAC address OUI numbers must be configured in the Telephony OUI list so that the switch recognizes the traffic as being from a VoIP device.

- LLDP checks that the "telephone bit" in the system capability TLV is turned on. See "LLDP Commands" on page 726 for more information on LLDP.

Example

The following example enables the OUI method on port 1 for detecting VoIP traffic.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan rule oui
Console(config-if)#
```

switchport voice vlan security

This command enables security filtering for VoIP traffic on a port. Use the **no** form to disable filtering on a port.

Syntax

[no] switchport voice vlan security

Default Setting

Disabled

Command Mode

Interface Configuration

Command Usage

- Security filtering discards any non-VoIP packets received on the port that are tagged with the voice VLAN ID. VoIP traffic is identified by source MAC addresses configured in the Telephony OUI list, or through LLDP that discovers VoIP devices attached to the switch. Packets received from non-VoIP sources are dropped.

- When enabled, be sure the MAC address ranges for VoIP devices are configured in the Telephony OUI list (voice vlan mac-address).

Example

The following example enables security filtering on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#switchport voice vlan security
Console(config-if)#
```

show voice vlan

This command displays the Voice VLAN settings on the switch and the OUI Telephony list.

Syntax

show voice vlan {oui | status}

oui - Displays the OUI Telephony list.

status - Displays the global and port Voice VLAN settings.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

When the switchport voice vlan command is set to auto mode, the remaining aging time displayed by the show voice vlan command will be displayed (or "Not Start" will be displayed). Otherwise, if the switchport voice vlan command is disabled or set to manual mode, the remaining aging time will display "NA."

Example

```
Console#show voice vlan status
Global Voice VLAN Status
Voice VLAN Status     : Enabled
Voice VLAN ID         : 1234
Voice VLAN aging time : 1440 minutes

Voice VLAN Port Summary
Port     Mode     Security Rule      Priority Remaining Age
                                              (minutes)
-------- -------- -------- --------- -------- -------------
Eth 1/ 1 Auto     Enabled  OUI              6 100
Eth 1/ 2 Disabled Disabled OUI              6 NA
Eth 1/ 3 Manual   Enabled  OUI              5 100
Eth 1/ 4 Auto     Disabled OUI              6 Not Start
Eth 1/ 5 Disabled Disabled OUI              6 NA
Eth 1/ 6 Disabled Disabled OUI              6 NA
Eth 1/ 7 Disabled Disabled OUI              6 NA
Eth 1/ 8 Disabled Disabled OUI              6 NA
Eth 1/ 9 Disabled Disabled OUI              6 NA
Eth 1/10 Disabled Disabled OUI              6 NA

Console#show voice vlan oui
OUI Address       Mask              Description
----------------- ----------------- ------------------------------
00-12-34-56-78-9A FF-FF-FF-00-00-00 old phones
00-11-22-33-44-55 FF-FF-FF-00-00-00 new phones
00-98-76-54-32-10 FF-FF-FF-FF-FF-FF Chris' phone

Console#
```

Configuring Excluded VLANs

Excluded VLANs provide port-based security and isolation between ports within an assigned session. An Excluded VLAN session contains Uplink ports that can communicate with all other ports in the session, and Downlink ports that can only communicate with Uplink ports in the session. The Uplink ports are intended to provide open access to an external network, such as the Internet, while the Downlink ports provide restricted access to local users.

Table 92: Excluded VLAN Commands

Command	Function	Mode
excluded-vlan	Configures an excluded VLAN session, including VLANs, uplink and downlink ports	GC
show excluded-vlan	Displays the configured excluded VLANs	PE

excluded-vlan

This command configures an excluded VLAN session, including the VLAN ID, uplink ports, and downlink ports. Use the **no** form of the command to remove an excluded VLAN session.

Syntax

[**no**] **excluded-vlan** [**session** *session-id*] [*vlan-id* [*vlan-mask*]] {**uplink** *interface-list* [**downlink** *interface-list*] | **downlink** *interface-list*}

session-id - Specifies the session ID. (Range: 1-4)

vlan-id - Specifies a VLAN ID. (Range: 1-4094)

vlan-mask - Specifies a binary bitmask that is applied to the VLAN ID to define a range of VLANs. When a bit of the VLAN Mask is 1, the value of the corresponding bit of the VLAN ID remains the same. When a bit of configured VLAN Mask is 0, the value of the corresponding bit of the VLAN ID is ignored. For example, a VLAN ID of 1 (000000000001) with a VLAN Mask of 4092 (111111111100) defines a range of VLAN IDs of 1-3. A VLAN Mask of 4095 (111111111111) defines a single VLAN ID. (Range: 0-4095)

interface-list -

ethernet *unit/port-list*

unit - Unit identifier.

port-list - Physical port number or list of port numbers. Separate nonconsecutive port numbers with a comma and no spaces; or use a hyphen to designate a range of port numbers.

port-channel *channel-id*

Default Setting
No sessions configured.

Command Mode
Global Configuration

Command Usage
- An Excluded VLAN session consists of defined Downlink ports, Uplink ports, and VLANs. Up to 4 Excluded VLAN sessions can be configured on the switch, and up to 8 VLANs can be included in each session.
- Packets from a Downlink port can only be forwarded to Uplink ports in the same session.
- Packets from Uplink ports can be forwarded to any ports in the same session.
- Uplink and Dowlink interfaces can include configured port trunks.
- A specified Uplink or Dowlink interface can only be assigned to one Excluded VLAN session, it cannot be configured for multiple sessions at the same time.

Example
```
Console(config)#excluded-vlan session 1 5 4095 uplink ethernet 1/6 downlink
  ethernet 1/5

Console(config)#
```

show excluded-vlan
This command displays the configured excluded VLANs on the switch.

Syntax
show excluded-vlan

Command Mode
Privileged Exec

Example
```
Console#show excluded-vlan

 Session   Uplink Ports            Downlink Ports             VLANs
--------- ---------------------- ---------------------- -------------
    1      Ethernet  1/6          Ethernet  1/5              5/4095

Console#
```

23 ERPS Commands

The G.8032 recommendation, also referred to as Ethernet Ring Protection Switching (ERPS), can be used to increase the availability and robustness of Ethernet rings.

This chapter describes commands used to configure ERPS.

Table 93: ERPS Commands

Command	Function	Mode
erps	Enables ERPS globally on the switch	GC
erps node-id	Sets the MAC address for a ring node	GC
erps vlan-group	Creates ERPS VLAN groups to assign to rings or instances	GC
erps ring	Creates a physical ERPS ring and enters ERPS Ring Configuration mode	GC
erps instance	Creates an ERPS instance and enters ERPS Instance Configuration mode	GC
ring-port	Configures a node's connection to the ring through the east or west interface	ERPS Ring
exclusion-vlan	Specifies the VLANS to be excluded from the ERPS protection ring.	ERPS Ring
enable (ring)	Activates the current ERPS ring	ERPS Ring
enable (instance)	Activates the current ERPS instance	ERPS Inst
meg-level	Sets the Maintenance Entity Group level for a ring	ERPS Inst
control-vlan	Adds a Control VLAN to an ERPS ring	ERPS Inst
rpl owner	Configures a ring node to be the RPL owner	ERPS Inst
rpl neighbor	Configures a ring node to be the RPL neighbor	ERPS Inst
wtr-timer	Sets timer to verify that the ring has stabilized before blocking the RPL after recovery from a signal failure	ERPS Inst
guard-timer	Sets the timer to prevent ring nodes from receiving outdated R-APS messages	ERPS Inst
holdoff-timer	Sets the timer to filter out intermittent link faults	ERPS Inst
major-ring	Specifies the ERPS ring used for sending control packets	ERPS Inst
propagate-tc	Enables propagation of topology change messages from a secondary ring to the primary ring	ERPS Inst
bpdu-tcn-notify	Enables the transmission of TCN BPDUs on an EPRS instance	ERPS Inst
non-revertive	Enables non-revertive mode, which requires the protection state on the RPL to manually cleared	ERPS Inst

Table 93: ERPS Commands (Continued)

Command	Function	Mode
raps-def-mac	Sets the switch's MAC address to be used as the node identifier in R-APS messages	ERPS Inst
raps-without-vc	Terminates the R-APS channel at the primary ring to sub-ring interconnection nodes	ERPS Inst
version	Specifies compatibility with ERPS version 1 or 2	ERPS Inst
inclusion-vlan	Specifies the VLAN groups to be included in the ERPS protection ring.	ERPS Inst
physical-ring	Associates an ERPS instance with an existing physical ring	ERPS Inst
erps forced-switch	Blocks the specified ring port	PE
erps manual-switch	Blocks the specified ring port, in the absence of a failure or an erps forced-switch command	PE
erps clear	Manually clears protection state which has been invoked by a Forced Switch or Manual Switch command, and the node is operating under non-revertive mode; or before the WTR or WTB timer expires when the node is operating in revertive mode	PE
clear erps statistics	Clears statistics for all ERPS instances or a specific instance	PE
show erps statistics	Displays statistics for all configured instances, or for a specified instance	PE
show erps	Displays status information for all configured VLAN groups, rings, or instances.	PE

Configuration Guidelines for ERPS

1. Create an ERPS ring: Create a ring using the erps ring command. The ring name is used as an index in the G.8032 database.

2. Configure the east and west interfaces: Each node on the ring connects to it through two ring ports. Use the ring-port command to configure one port connected to the next node in the ring to the east (or clockwise direction); and then use the ring-port command again to configure another port facing west in the ring.

3. Configure VLAN groups to assign to specific ERPS instances using the erps vlan-group command.

4. Configure ERPS instances using the erps instance command and then associate the instances to a configured ring using the physical-ring command.

5. Configure the RPL owner: Configure one node in the ring as the Ring Protection Link (RPL) owner using the rpl owner command. When this switch is configured as the RPL owner, the west ring port is set as being connected to the RPL. Under normal operations (Idle state), the RPL is blocked to ensure that a loop cannot form in the ring. If a signal failure brings down any other link in the ring, the RPL will be unblocked (Protection state) to ensure proper connectivity among all ring nodes until the failure is recovered.

6. Configure ERPS timers: Use the guard-timer command to set the timer is used to prevent ring nodes from receiving outdated R-APS messages, the holdoff-timer command to filter out intermittent link faults, and the wtr-timer command to verify that the ring has stabilized before blocking the RPL after recovery from a signal failure.

7. Configure the ERPS Control VLAN (CVLAN): Use the control-vlan command to create the VLAN used to pass R-APS ring maintenance commands. The CVLAN must NOT be configured with an IP address. In addition, only ring ports may be added to the CVLAN (prior to configuring the VLAN as a CVLAN). No other ports can be members of this VLAN (once set as a CVLAN). Also, the ring ports of the CVLAN must be tagged. Failure to observe these restrictions can result in a loop in the network.

8. Enable ERPS: Before enabling a ring as described in the next step, first use the erps command to globally enable ERPS on the switch. If ERPS has not yet been enabled or has been disabled with the no erps command, no ERPS rings will work.

9. Enable ERPS rings and instances: Before an ERPS ring can work, it must be enabled using the enable (ring) command and specific instances enabled using the enable (instance) command. When configuration is completed and the ring enabled, R-APS messages will start flowing in the control VLAN, and normal traffic will begin to flow in the data VLANs. To stop a ring, it can be disabled on any node using the no enable (ring) command.

10. Display ERPS status information: Use the show erps statistics command to display general ERPS status information or detailed ERPS status information for a specific ring.

erps

This command enables ERPS on the switch. Use the **no** form to disable this feature.

Syntax

[no] erps

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

ERPS must be enabled globally on the switch before it can enabled on an ERPS ring using the enable (ring) command.

Example

```
Console(config)#erps
Console(config)#
```

erps node-id

This command sets the MAC address for a ring node. Use the **no** form to restore the default setting.

Syntax

erps node-id *mac-address*

no erps node-id

mac-address – A MAC address unique to the ring node. The MAC address must be specified in the format xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.

Default Setting

CPU MAC address

Command Mode

Global Configuration

Command Usage

- The ring node identifier is used to identify a node in R-APS messages for both automatic and manual switching recovery operations.

  For example, a node that has one ring port in SF condition and detects that the condition has been cleared, will continuously transmit R-APS (NR) messages with its own Node ID as priority information over both ring ports, informing its neighbors that no request is present at this node. When another recovered node holding the link blocked receives this message, it compares the Node ID information with its own. If the received R-APS (NR) message has a higher priority, this unblocks its ring ports. Otherwise, the block remains unchanged.

- The node identifier may also be used for debugging, such as to distinguish messages when a node is connected to more than one ring.

Example

```
Console(config)#node-id 00-12-CF-61-24-2D
Console(config)#
```

erps vlan-group

This command creates or modifies an ERPS VLAN group. Use the **no** form of this command to remove VLANs from a VLAN group or to delete a VLAN group.

Syntax

erps vlan-group *vlan-group-name* {**add**|**remove**} *vlan-list*

no erps vlan-group *vlan-group-name*

vlan-group-name – Name of the VLAN group. (Range: 1-12 characters).

add – Adds VLANs to a group.

remove – Deletes VLANs from a group.

vlan-list – A single VLAN ID, a list of VLAN IDs separated by commas, or a range of VLANs defined by two VLAN IDs separated by a hyphen.

Default Setting

None

Command Mode

Global Configuration

Command Usage

- A set of VLANs in an Ethernet ring can be grouped into several subsets and applied to an ERPS instance.
- A VLAN group configuration is allowed to be deleted only if all associations are removed

Example

```
Console(config)#erps vlan-group alpha add 2
Console(config)#
```

erps ring

This command creates a physical ERPS ring and enters ERPS configuration mode for the specified ring. Use the **no** form to delete a physical ring.

Syntax

[**no**] **erps ring** *ring-name*

ring-name - Name of a specific ERPS ring. (Range: 1-12 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- The switch can support ERPS rings up to half the number of physical ports on the switch.

Example

```
Console(config)#erps ring campus1
Console(config-erps-ring)#
```

erps instance

This command creates an ERPS instance and enters ERPS instance configuration mode. Use the **no** form to delete an ERPS instance.

Syntax

erps instance *instance-name* [**id** *ring-id*]

no erps instance *instance-name*

instance-name - Name of a specific ERPS instance. (Range: 1-12 characters)

ring-id - ERPS ring identifier used in R-APS messages. (Range: 1-255)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Service Instances within each ring are based on a unique maintenance association for the specific users, distinguished by the ring name, maintenance level, maintenance association's name, and assigned VLAN. The maximum number of ERPS instances that can be configured on the switch is equal to the total number of physical ports.

- R-APS information is carried in an R-APS PDUs. The last octet of the MAC address is designated as the Ring ID (01-19-A7-00-00-[Ring ID]). If use of the default MAC address is disabled with the no raps-def-mac command, then the Ring ID configured by the **erps instance** command will be used in R-APS PDUs.

- You must disable a running instance before modifying a Ring ID.

Example

```
Console(config)#erps instance r&d id 1
Console(config-erps-inst)#
```

ring-port

This command configures a node's connection to the ring through the east or west interface. Use the **no** form to disassociate a node from the ring.

Syntax

ring-port {**east** | **west**} **interface** *interface*

no ring-port {**east** | **west**}

east - Connects to next ring node to the east.

west - Connects to next ring node to the west.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting

Not associated

Command Mode

ERPS Ring Configuration

Command Usage

- Each node must be connected to two neighbors on the ring. For convenience, the ports connected are referred to as east and west ports. Alternatively, the closest neighbor to the east should be the next node in the ring in a clockwise direction, and the closest neighbor to the west should be the next node in the ring in a counter-clockwise direction.
- Note that a ring port cannot be configured as a member of a spanning tree, a dynamic trunk, or a static trunk.
- If a port channel (static trunk) is specified as a ring port, it can not be destroyed before it is removed from the domain configuration.
- A static trunk will be treated as a signal fault, if it contains no member ports or all of its member ports are in signal fault.
- If a static trunk is configured as a ring port prior to assigning any member ports, spanning tree will be disabled for the first member port assigned to the static trunk.

Example

```
Console(config-erps-ring)#ring-port east interface ethernet 1/12
Console(config-erps-ring)#
```

exclusion-vlan

Use this command to specify VLAN groups that are to be on the exclusion list of a physical ERPS ring. Use the **no** form of the command to remove VLAN groups from the list.

Syntax

[no] **inclusion-vlan** *vlan-group-name*

vlan-group-name - Name of the VLAN group. (Range: 1-12 characters)

Default Setting

None

Command Mode

ERPS Ring Configuration

Command Usage

- VLANs that are on the exclusion list are **not** protected by the ERPS ring.
- Any VLAN not listed on either the inclusion or exclusion list will be blocked on ring ports.
- Use the show erps statistics command to view the exclusion-vlan list of VLAN IDs.
- Traffic from control VLANs, inclusion VLANs, and exclusion VLANs of an ERPS ring will be forwarded by non-ERPS ring ports.

Example

```
Console(config-erps)#exclusion-vlan vlgroup3
Console(config-erps)#
```

enable (ring)

This command activates the current ERPS ring. Use the **no** form to disable the current ring.

Syntax

[no] **enable**

Default Setting

Disabled

Command Mode

ERPS Ring Configuration

Command Usage

- Before enabling a ring, the global ERPS function should be enabled with the erps command, the east and west ring ports configured on each node with the ring-port command, the RPL owner specified with the rpl owner command, and the control VLAN configured with the control-vlan command.

- Once enabled, the RPL owner node and non-owner node state machines will start, and the ring will enter idle state if no signal failures are detected.

Example

```
Console(config-erps-ring)#enable
Console(config-erps-ring)#
```

enable (instance)

This command activates the current ERPS instance. Use the **no** form to disable the current instance.

Syntax

[no] **enable**

Default Setting

Disabled

Command Mode

ERPS Instance Configuration

Command Usage

- Before enabling an instance, the global ERPS function should be enabled with the erps command, the ring enabled with the enable (ring) command, the east and west ring ports configured on each node with the ring-port command, the RPL owner specified with the rpl owner command, and the control VLAN configured with the control-vlan command.

- Once enabled, the RPL owner node and non-owner node state machines will start, and the instance will enter idle state if no signal failures are detected.

Example

```
Console(config-erps-inst)#enable
Console(config-erps-inst)#
```

meg-level

This command sets the Maintenance Entity Group level for an instance. Use the **no** form to restore the default setting.

Syntax

meg-level *level*

no meg-level

level - The maintenance entity group (MEG) level which provides a communication channel for ring automatic protection switching (R-APS) information. (Range: 0-7)

Default Setting
1

Command Mode
ERPS Instance Configuration

Command Usage
- This parameter is used to ensure that received R-APS PDUs are directed for this instance. A unique level should be configured for each local instance if there are many R-APS PDUs passing through this switch.

Example

```
Console(config-erps)#meg-level 0
Console(config-erps)#
```

control-vlan

This command specifies a dedicated VLAN used for sending and receiving ERPS protocol messages. Use the **no** form to remove the Control VLAN.

Syntax

control-vlan *vlan-id*

no control-vlan

vlan-id - VLAN ID (Range: 1-4094)

Default Setting
None

Command Mode
ERPS Instance Configuration

Command Usage
- The Control VID must be included in one of inclusion VLAN groups.
- Configure one control VLAN for each ERPS instance. First create the VLAN to be used as the control VLAN (vlan, page 512), add the VLAN to an ERPS VLAN group (erps vlan-group), add the ring ports for the east and west interface as tagged members to this VLAN (switchport allowed vlan, page 515), and then use the control-vlan command to add it to the ERPS instance.
- The following restrictions are recommended to avoid creating a loop in the network or other problems which may occur under some situations:
  - The Control VLAN must not be configured as a Layer 3 interface (with an IP address), nor as a dynamic VLAN (with GVRP enabled).
  - In addition, only ring ports may be added to the Control VLAN. No other ports can be members of this VLAN.

- Also, the ring ports of the Control VLAN must be tagged.

- Once the instance has been activated with the enable (instance) command, the configuration of the control VLAN cannot be modified. Use the no enable (ring) command to stop the ERPS instance before making any configuration changes to the control VLAN.

Example

```
Console(config)#vlan database
Console(config-vlan)#vlan 2 name rdc media ethernet state active
Console(config-vlan)#exit
Console(config)#interface ethernet 1/12
Console(config-if)#switchport allowed vlan add 2 tagged
Console(config-if)#interface ethernet 1/11
Console(config-if)#switchport allowed vlan add 2 tagged
Console(config-if)#exit
Console(config)#erps vlan-group alpha add 2
Console(config)#erps instance rd1
Console(config-erps-inst)#control-vlan 2
Console(config-erps-inst)#
```

rpl owner

This command configures a ring node to be the Ring Protection Link (RPL) owner. Use the **no** form to restore the default setting.

Syntax

rpl owner

no rpl

Default Setting

None (that is, neither owner nor neighbor)

Command Mode

ERPS Instance Configuration

Command Usage

- Only one RPL owner can be configured on an instance. The owner blocks traffic on the RPL during Idle state, and unblocks it during Protection state (that is, when a signal fault is detected on the instance or the protection state is enabled with the erps forced-switch or erps manual-switch command).

- The east and west connections to the instance must be specified for all ring nodes using the ring-port command. When this switch is configured as the RPL owner, the west ring port is automatically set as being connected to the RPL.

Example

```
Console(config-erps-inst)#rpl owner
Console(config-erps-inst)#
```

rpl neighbor

This command configures a ring node to be the Ring Protection Link (RPL) neighbor. Use the **no** form to restore the default setting.

Syntax

rpl neighbor

no rpl

Default Setting

None (that is, neither owner nor neighbor)

Command Mode

ERPS Instance Configuration

Command Usage

- The RPL neighbor node, when configured, is a ring node adjacent to the RPL that is responsible for blocking its end of the RPL under normal conditions (i.e., the instance is established and no requests are present in the instance) in addition to the block at the other end by the RPL Owner Node. The RPL neighbor node may participate in blocking or unblocking its end of the RPL, but is not responsible for activating the reversion behavior.
- Only one RPL owner can be configured on an instance. If the switch is set as the RPL owner for an ERPS ring, the west ring port is set as one end of the RPL. If the switch is set as the RPL neighbor for an ERPS ring, the east ring port is set as the other end of the RPL.
- The east and west connections to the ring must be specified for all ring nodes using the ring-port command. When this switch is configured as the RPL neighbor, the east ring port is set as being connected to the RPL.
- Note that is not mandatory to declare an RPL neighbor.

Example

```
Console(config-erps-inst)#rpl neighbor
Console(config-erps-inst)#
```

wtr-timer

This command sets the wait-to-restore timer which is used to verify that the ring has stabilized before blocking the RPL after recovery from a signal failure. Use the **no** form to restore the default setting.

Syntax

wtr-timer *minutes*

no wtr-timer

minutes - The wait-to-restore timer is used to verify that the ring has stabilized before blocking the RPL after recovery from a signal failure. (Range: 1-12 minutes)

Default Setting
5 minutes

Command Mode
ERPS Instance Configuration

Command Usage
If the switch goes into ring protection state due to a signal failure, after the failure condition is cleared, the RPL owner will start the wait-to-restore timer and wait until it expires to verify that the ring has stabilized before blocking the RPL and returning to the Idle (normal operating) state.

Example

```
Console(config-erps-inst)#wtr-timer 10
Console(config-erps-inst)#
```

guard-timer

This command sets the guard timer to prevent ring nodes from receiving outdated R-APS messages. Use the no form to restore the default setting.

Syntax

guard-timer *milliseconds*

no guard-timer

milliseconds - The guard timer is used to prevent ring nodes from receiving outdated R-APS messages. During the duration of the guard timer, all received R-APS messages are ignored by the ring protection control process, giving time for old messages still circulating on the ring to expire. (Range: 10-2000 milliseconds, in steps of 10 milliseconds)

Default Setting
500 milliseconds

Command Mode
ERPS Instance Configuration

Command Usage
The guard timer duration should be greater than the maximum expected forwarding delay for an R-APS message to pass around the ring. A side-effect of the guard timer is that during its duration, a node will be unaware of new or existing ring requests transmitted from other nodes.

Example

```
Console(config-erps-inst)#guard-timer 300
Console(config-erps-inst)#
```

holdoff-timer

This command sets the timer to filter out intermittent link faults. Use the **no** form to restore the default setting.

Syntax

holdoff-timer *milliseconds*

no holdoff-timer

milliseconds - The hold-off timer is used to filter out intermittent link faults. Faults will only be reported to the ring protection mechanism if this timer expires. (Range: 0-10000 milliseconds, in steps of 100 milliseconds)

Default Setting

0 milliseconds

Command Mode

ERPS Instance Configuration

Command Usage

In order to coordinate timing of protection switches at multiple layers, a hold-off timer may be required. Its purpose is to allow, for example, a server layer protection switch to have a chance to fix the problem before switching at a client layer.

When a new defect or more severe defect occurs (new Signal Failure), this event will not be reported immediately to the protection switching mechanism if the provisioned hold-off timer value is non-zero. Instead, the hold-off timer will be started. When the timer expires, whether a defect still exists or not, the timer will be checked. If one does exist, that defect will be reported to the protection switching mechanism. The reported defect need not be the same one that started the timer.

Example

```
Console(config-erps-inst)#holdoff-timer 300
Console(config-erps-inst)#
```

major-ring

This command specifies the ERPS ring used for sending control packets. Use the **no** form to remove the current setting.

Syntax

major-ring *instance-name*

no major-ring

instance-name - Name of the ERPS instance used for sending control packets. (Range: 1-12 characters)

Default Setting
None

Command Mode
ERPS Instance Configuration

Command Usage
- ERPS control packets can only be sent on one instance. This command is used to indicate that the current instance is a secondary ring, and to specify the major instance which will be used to send ERPS control packets.

- The Ring Protection Link (RPL) is the west port and can not be configured. So the physical port on a secondary instance must be the west port. In other words, if a domain has two physical ring ports, this instance can only be a major ring, not a secondary ring (or sub-domain) which can have only one physical ring port. This command will therefore fail if the east port is already configured (see the ring-port command).

Example
```
Console(config-erps-inst)#major-domain rd0
Console(config-erps-inst)#
```

propagate-tc
This command enables propagation of topology change messages for a secondary ring to the primary ring. Use the **no** form to disable this feature.

Syntax
[no] propagate-tc

Default Setting
Disabled

Command Mode
ERPS Instance Configuration

Command Usage
- When a secondary ring detects a topology change, it can pass a message about this event to the major ring. When the major ring receives this kind of message from a secondary ring, it can clear the MAC addresses on its ring ports to help the secondary ring restore its connections more quickly through protection switching.

- When the MAC addresses are cleared, data traffic may flood onto the major ring. The data traffic will become stable after the MAC addresses are learned

again. The major ring will not be broken, but the bandwidth of data traffic on the major ring may suffer for a short period of time due to this flooding behavior.

Example

```
Console(config-erps-inst)#propagate-tc
Console(config-erps-inst)#
```

bpdu-tcn-notify

This command configures an ERPS instance to send BPDU TCN notifications. Use the no form of this command to disable BPDU TCN notifications.

Syntax

[no] bpdu-tcn-notify

Default Setting

Disabled

Command Mode

ERPS Instance Configuration

Command Usage

When enabled, Spanning Tree topology change notification (TCN) BPDUs are transmitted when an ERPS forwarding database (FDB) flush occurs on a ring instance.

Example

```
Console(config-erps-inst)#bpdu-tcn-notify
Console(config-erps-inst)#
```

non-revertive

This command enables non-revertive mode, which requires the protection state on the RPL to manually cleared. Use the no form to restore the default revertive mode.

Syntax

[no] non-revertive

Default Setting

Disabled

Command Mode

ERPS Instance Configuration

Command Usage

- Revertive behavior allows the switch to automatically return the RPL from Protection state to Idle state through the exchange of protocol messages.

  Non-revertive behavior for Protection, Forced Switch, and Manual Switch states are basically the same. Non-revertive behavior requires the erps clear command to used to return the RPL from Protection state to Idle state.

- Recovery for Protection Switching – A ring node that has one or more ring ports in an SF (Signal Fail) condition, upon detecting the SF condition cleared, keeps at least one of its ring ports blocked for the traffic channel and for the R-APS channel, until the RPL is blocked as a result of ring protection reversion, or until there is another higher priority request (e.g., an SF condition) in the ring.

  A ring node that has one ring port in an SF condition and detects the SF condition cleared, continuously transmits the R-APS (NR – no request) message with its own Node ID as the priority information over both ring ports, informing that no request is present at this ring node and initiates a guard timer. When another recovered ring node (or nodes) holding the link block receives this message, it compares the Node ID information with its own Node ID. If the received R-APS (NR) message has the higher priority, this ring node unblocks its ring ports. Otherwise, the block remains unchanged. As a result, there is only one link with one end blocked.

  The ring nodes stop transmitting R-APS (NR) messages when they accept an R-APS (NR, RB – RPL Blocked), or when another higher priority request is received.

  - Recovery with Revertive Mode – When all ring links and ring nodes have recovered and no external requests are active, reversion is handled in the following way:

    a. The reception of an R-APS (NR) message causes the RPL Owner Node to start the WTR (Wait-to-Restore) timer.

    b. The WTR timer is cancelled if during the WTR period a higher priority request than NR is accepted by the RPL Owner Node or is declared locally at the RPL Owner Node.

    c. When the WTR timer expires, without the presence of any other higher priority request, the RPL Owner Node initiates reversion by blocking its traffic channel over the RPL, transmitting an R-APS (NR, RB) message over both ring ports, informing the ring that the RPL is blocked, and performing a flush FDB action.

    d. The acceptance of the R-APS (NR, RB) message causes all ring nodes to unblock any blocked non-RPL link that does not have an SF condition. If it is an R-APS (NR, RB) message without a DNF (do not flush) indication, all ring nodes flush the FDB.

  - Recovery with Non-revertive Mode – In non-revertive operation, the ring does not automatically revert when all ring links and ring nodes have recovered and no external requests are active. Non-revertive operation is handled in the following way:

a. The RPL Owner Node does not generate a response on reception of an R-APS (NR) messages.

b. When other healthy ring nodes receive the NR (Node ID) message, no action is taken in response to the message.

c. When the operator issues the erps clear command for non-revertive mode at the RPL Owner Node, the non-revertive operation is cleared, the RPL Owner Node blocks its RPL port, and transmits an R-APS (NR, RB) message in both directions, repeatedly.

d. Upon receiving an R-APS (NR, RB) message, any blocking node should unblock its non-failed ring port. If it is an R-APS (NR, RB) message without a DNF indication, all ring nodes flush the FDB.

- Recovery for Forced Switching – An erps forced-switch command is removed by issuing the erps clear command to the same ring node where Forced Switch mode is in effect. The clear command removes any existing local operator commands, and triggers reversion if the ring is in revertive behavior mode.

  The ring node where the Forced Switch was cleared keeps the ring port blocked for the traffic channel and for the R-APS channel, due to the previous Forced Switch command. This ring port is kept blocked until the RPL is blocked as a result of ring protection reversion, or until there is another higher priority request (e.g., an SF condition) in the ring.

  The ring node where the Forced Switch was cleared continuously transmits the R-APS (NR) message on both ring ports, informing other nodes that no request is present at this ring node. The ring nodes stop transmitting R-APS (NR) messages when they accept an RAPS (NR, RB) message, or when another higher priority request is received.

  If the ring node where the Forced Switch was cleared receives an R-APS (NR) message with a Node ID higher than its own Node ID, it unblocks any ring port which does not have an SF condition and stops transmitting R-APS (NR) message over both ring ports.

  - Recovery with revertive mode is handled in the following way:

    a. The reception of an R-APS (NR) message causes the RPL Owner Node to start the WTB timer.

    b. The WTB timer is canceled if during the WTB period a higher priority request than NR is accepted by the RPL Owner Node or is declared locally at the RPL Owner Node.

    c. When the WTB timer expires, in the absence of any other higher priority request, the RPL Owner Node initiates reversion by blocking the traffic channel over the RPL, transmitting an R-APS (NR, RB) message over both ring ports, informing the ring that the RPL is blocked, and flushes the FDB.

    d. The acceptance of the R-APS (NR, RB) message causes all ring nodes to unblock any blocked non-RPL that does not have an SF condition. If it is an R-APS (NR, RB) message without a DNF indication, all ring nodes

flush their FDB. This action unblocks the ring port which was blocked as a result of an operator command.

- Recovery with non-revertive mode is handled in the following way:

  a. The RPL Owner Node, upon reception of an R-APS(NR) message and in the absence of any other higher priority request does not perform any action.

  b. Then, after the operator issues the erps clear command at the RPL Owner Node, this ring node blocks the ring port attached to the RPL, transmits an R-APS (NR, RB) message on both ring ports, informing the ring that the RPL is blocked, and flushes its FDB.

  c. The acceptance of the R-APS (NR, RB) message triggers all ring nodes to unblock any blocked non-RPL which does not have an SF condition. If it is an R-APS (NR, RB) message without a DNF indication, all ring nodes flush their FDB. This action unblocks the ring port which was blocked as result of an operator command.

- Recovery for Manual Switching – An erps manual-switch command is removed by issuing the erps clear command at the same ring node where the Manual Switch is in effect. The clear command removes any existing local operator commands, and triggers reversion if the ring is in revertive behavior mode.

  The ring node where the Manual Switch was cleared keeps the ring port blocked for the traffic channel and for the R-APS channel, due to the previous Manual Switch command. This ring port is kept blocked until the RPL is blocked as a result of ring protection reversion, or until there is another higher priority request (e.g., an SF condition) in the ring.

  The Ethernet Ring Node where the Manual Switch was cleared continuously transmits the R-APS (NR) message on both ring ports, informing that no request is present at this ring node. The ring nodes stop transmitting R-APS (NR) messages when they accept an RAPS (NR, RB) message, or when another higher priority request is received.

  If the ring node where the Manual Switch was cleared receives an R-APS (NR) message with a Node ID higher than its own Node ID, it unblocks any ring port which does not have an SF condition and stops transmitting R-APS (NR) message on both ring ports.

  - Recovery with revertive mode is handled in the following way:

    a. The RPL Owner Node, upon reception of an R-APS (NR) message and in the absence of any other higher priority request, starts the WTB timer and waits for it to expire. While the WTB timer is running, any latent R-APS (MS) message is ignored due to the higher priority of the WTB running signal.

    b. When the WTB timer expires, it generates the WTB expire signal. The RPL Owner Node, upon reception of this signal, initiates reversion by blocking the traffic channel on the RPL, transmitting an R-APS (NR, RB) message over both ring ports, informing the ring that the RPL is blocked, and flushes its FDB.

c. The acceptance of the R-APS (NR, RB) message causes all ring nodes to unblock any blocked non-RPL that does not have an SF condition. If it is an R-APS (NR, RB) message without a DNF indication, all Ethernet Ring Nodes flush their FDB. This action unblocks the ring port which was blocked as a result of an operator command.

- Recovery with non-revertive mode is handled in the following way:

a. The RPL Owner Node, upon reception of an R-APS (NR) message and in the absence of any other higher priority request does not perform any action.

b. Then, after the operator issues the erps clear command at the RPL Owner Node, this ring node blocks the ring port attached to the RPL, transmits an R-APS (NR, RB) message over both ring ports, informing the ring that the RPL is blocked, and flushes its FDB.

c. The acceptance of the R-APS (NR, RB) message triggers all ring nodes to unblock any blocked non-RPL which does not have an SF condition. If it is an R-APS (NR, RB) message without a DNF indication, all ring nodes flush their FDB. This action unblocks the ring port which was blocked as result of an operator command.

Example

```
Console(config-erps-inst)#non-revertive
Console(config-erps-inst)#
```

raps-def-mac

This command sets the switch's MAC address to be used as the node identifier in R-APS messages. Use the **no** form to use the node identifier specified in the G8032 standards.

Syntax

[no] raps-def-mac

Default Setting

Enabled

Command Mode

ERPS Instance Configuration

Command Usage

- When ring nodes running ERPSv1 and ERPSv2 co-exist on the same ring, the Ring ID of each ring node must be configured as "1".
- If this command is disabled, the following strings are used as the node identifier:
  - ERPSv1: 01-19-A7-00-00-01
  - ERPSv2: 01-19-A7-00-00-[Ring ID]

Example

```
Console(config-erps-inst)#raps-def-mac
Console(config-erps-inst)#
```

raps-without-vc

This command terminates the R-APS channel at the primary ring to sub-ring interconnection nodes. Use the **no** form to restore the default setting.

Syntax

[no] raps-without-vc

Default Setting

R-APS with Virtual Channel

Command Mode

ERPS Instance Configuration

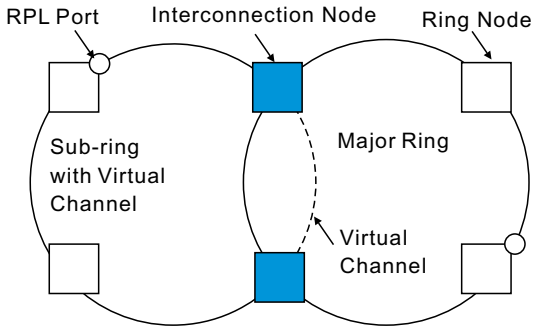
Command Usage

- A sub-ring may be attached to a primary ring with or without a virtual channel. A virtual channel is used to connect two interconnection points on the sub-ring, tunneling R-APS control messages across an arbitrary Ethernet network topology. If a virtual channel is not used to cross the intermediate Ethernet network, data in the traffic channel will still flow across the network, but the all R-APS messages will be terminated at the interconnection points.

- Sub-ring with R-APS Virtual Channel – When using a virtual channel to tunnel R-APS messages between interconnection points on a sub-ring, the R-APS virtual channel may or may not follow the same path as the traffic channel over the network. R-APS messages that are forwarded over the sub-ring's virtual channel are broadcast or multicast over the interconnected network. For this reason the broadcast/multicast domain of the virtual channel should be limited to the necessary links and nodes. For example, the virtual channel could span only the interconnecting rings or sub-rings that are necessary for forwarding R-APS messages of this sub-ring. Care must also be taken to ensure that the local RAPS messages of the sub-ring being transported over the virtual channel into the interconnected network can be uniquely distinguished from those of other interconnected ring R-APS messages. This can be achieved by, for example, by using separate VIDs for the virtual channels of different sub-rings.

  Note that the R-APS virtual channel requires a certain amount of bandwidth to forward R-APS messages on the interconnected Ethernet network where a sub-ring is attached. Also note that the protection switching time of the sub-ring may be affected if R-APS messages traverse a long distance over an R-APS virtual channel.

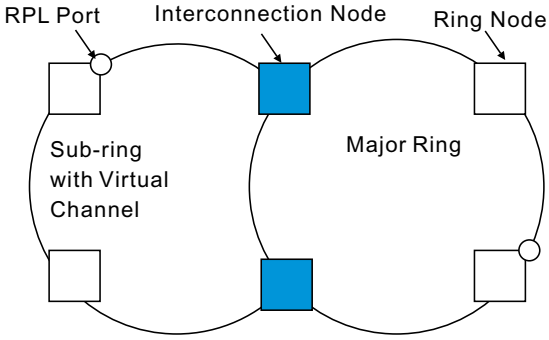
Figure 8: Sub-ring with Virtual Channel



- Sub-ring without R-APS Virtual Channel – Under certain circumstances it may not be desirable to use a virtual channel to interconnect the sub-ring over an arbitrary Ethernet network. In this situation, the R-APS messages are terminated on the interconnection points. Since the sub-ring does not provide an R-APS channel nor R-APS virtual channel beyond the interconnection points, R-APS channel blocking is not employed on the normal ring links to avoid channel segmentation. As a result, a failure at any ring link in the sub-ring will cause the R-APS channel of the sub-ring to be segmented, thus preventing R-APS message exchange between some of the sub-ring's ring nodes.

  No R-APS messages are inserted or extracted by other rings or sub- rings at the interconnection nodes where a sub-ring is attached. Hence there is no need for either additional bandwidth or for different VIDs/Ring IDs for the ring interconnection. Furthermore, protection switching time for a sub-ring is independent from the configuration or topology of the interconnected rings. In addition, this option always ensures that an interconnected network forms a tree topology regardless of its interconnection configuration. This means that it is not necessary to take precautions against forming a loop which is potentially composed of a whole interconnected network.

Figure 9: Sub-ring without Virtual Channel



Example

```
Console(config-erps-inst)#raps-without-vc
Console(config-erps-inst)#
```

version

This command specifies compatibility with ERPS version 1 or 2.

Syntax

version {1 | 2}

no version

1 - ERPS version 1 based on ITU-T G.8032/Y.1344.

2 - ERPS version 2 based on ITU-T G.8032/Y.1344 Version 2.

Default Setting

2

Command Mode

ERPS Instance Configuration

Command Usage

- In addition to the basic features provided by version 1, version 2 also supports:
  - Multi-ring/ladder network support
  - Revertive/Non-revertive recovery
  - Forced Switch (FS) and Manual Switch (MS) commands for manually blocking a particular ring port
  - Flush FDB (forwarding database) logic which reduces amount of flush FDB operations in the ring
  - Support of multiple ERP instances on a single ring
- Version 2 is backward compatible with Version 1. If version 2 is specified, the inputs and commands are forwarded transparently. If set to version 1, MS and FS operator commands are filtered, and the switch set to revertive mode.
- The version number is automatically set to "1" when a ring node, supporting only the functionalities of G.8032v1, exists on the same ring with other nodes that support G.8032v2.
- When ring nodes running G.8032v1 and G.8032v2 co-exist on a ring, the ring ID of each node is configured as "1".
- In version 1, the MAC address 01-19-A7-00-00-01 is used for the node identifier. The raps-def-mac command has no effect.

Example

```
Console(config-erps-inst)#version 1
Console(config-erps-inst)#
```

inclusion-vlan

Use this command to specify VLAN groups that are to be on the inclusion list of an ERPS instance. Use the **no** form of the command to removed the VLAN from the list.

Syntax

[no] **inclusion-vlan** *vlan-group-name*

vlan-group-name - Name of the VLAN group. (Range: 1-12 characters).

Default Setting

None

Command Mode

ERPS Instance Configuration

Command Usage

- VLANs that are on the inclusion list are protected by the ERPS instance.
- Any VLAN not listed on either the inclusion or exclusion list will be blocked on ring ports.
- Use the show erps statistics command to view the inclusion-vlan list of VLAN IDs.
- Traffic from control VLANs, inclusion VLANs, and exclusion VLANs of an ERPS instance will be forwarded by non-ERPS ring ports.

Example

```
Console(config-erps-inst)#inclusion-vlan vlgroup3
Console(config-erps-inst)#
```

physical-ring

Use this command to associate an ERPS instance with an existing physical ring. Use the **no** form of the command to removed the association.

Syntax

physical-ring *ring-name*

no physical-ring

ring-name - Name of a specific ERPS ring. (Range: 1-12 characters)

Default Setting

None

Command Mode

ERPS Instance Configuration

Command Usage

The physical ring name must first be defined using the erps ring command.

Example

```
Console(config-erps-inst)#phyical-ring campus1
Console(config-erps-inst)#
```

erps forced-switch

This command blocks the specified ring port.

Syntax

erps forced-switch instance *instance-name* {**east** | **west**}

instance-name - Name of a specific ERPS instance. (Range: 1-12 characters)

east - East ring port.

west - West ring port.

Command Mode

Privileged Exec

Command Usage

- A ring with no pending request has a logical topology with the traffic channel blocked at the RPL and unblocked on all other ring links. In this situation, the **erps forced-switch** command triggers protection switching as follows:

  a. The ring node where a forced switch command was issued blocks the traffic channel and R-APS channel on the ring port to which the command was issued, and unblocks the other ring port.

  b. The ring node where the forced switch command was issued transmits R-APS messages indicating FS over both ring ports. R-APS (FS) messages are continuously transmitted by this ring node while the local FS command is the ring node's highest priority command (see Table 94 on page 581). The R-APS (FS) message informs other ring nodes of the FS command and that the traffic channel is blocked on one ring port.

  c. A ring node accepting an R-APS (FS) message, without any local higher priority requests unblocks any blocked ring port. This action subsequently unblocks the traffic channel over the RPL.

  d. The ring node accepting an R-APS (FS) message, without any local higher priority requests stops transmission of R-APS messages.

  e. The ring node receiving an R-APS (FS) message flushes its FDB.

- Protection switching on a forced switch request is completed when the above actions are performed by each ring node. At this point, traffic flows around the ring are resumed. From this point on the following rules apply regarding processing of further forced switch commands:

While an existing forced switch request is present in a ring, any new forced switch request is accepted, except on a ring node having a prior local forced switch request. The ring nodes where further forced switch commands are issued block the traffic channel and R-APS channel on the ring port at which the forced switch was issued. The ring node where the forced switch command was issued transmits an R-APS message over both ring ports indicating FS. R-APS (FS) messages are continuously transmitted by this ring node while the local FS command is the ring node's highest priority command. As such, two or more forced switches are allowed in the ring, which may inadvertently cause the segmentation of an ring. It is the responsibility of the operator to prevent this effect if it is undesirable.

Ring protection requests, commands and R-APS signals have the priorities as specified in the following table.

Table 94: ERPS Request/State Priority

Request / State and Status	Type	Priority
Clear	local	highest
FS	local	|
R-APS (FS)	remote	|
local SF*	local	|
local clear SF	local	|
R-APS (SF)	remote	|
R-APS (MS)	remote	|
MS	local	|
WTR Expires	local	|
WTR Running	local	|
WTB Expires	local	|
WTB Running	local	|
R-APS (NR, RB)	remote	|
R-APS (NR)	remote	lowest

* If an Ethernet Ring Node is in the Forced Switch state, local SF is ignored.

- Recovery for forced switching under revertive and non-revertive mode is described under the Command Usage section for the non-revertive command.

- When a ring is under an FS condition, and the node at which an FS command was issued is removed or fails, the ring remains in FS state because the FS command can only be cleared at node where the FS command was issued. This results in an unrecoverable FS condition.

  When performing a maintenance procedure (e.g., replacing, upgrading) on a ring node (or a ring link), it is recommended that FS commands be issued at the two adjacent ring nodes instead of directly issuing a FS command at the

ring node under maintenance in order to avoid falling into the above mentioned unrecoverable situation.

Example

```
Console#erps forced-switch instance r&d west
Console#
```

erps manual-switch

This command blocks the specified ring port, in the absence of a failure or an erps forced-switch command.

Syntax

erps manual-switch instance *instance-name* {**east** | **west**}

instance-name - Name of a specific ERPS instance. (Range: 1-12 characters)

east - East ring port.

west - West ring port.

Command Mode

Privileged Exec

Command Usage

- A ring with no request has a logical topology with the traffic channel blocked at the RPL and unblocked on all other ring links. In this situation, the **erps manual-switch** command triggers protection switching as follows:

  a. If no other higher priority commands exist, the ring node, where a manual switch command was issued, blocks the traffic channel and R-APS channel on the ring port to which the command was issued, and unblocks the other ring port.

  b. If no other higher priority commands exist, the ring node where the manual switch command was issued transmits R-APS messages over both ring ports indicating MS. R-APS (MS) message are continuously transmitted by this ring node while the local MS command is the ring node's highest priority command (see Table 94 on page 581). The R-APS (MS) message informs other ring nodes of the MS command and that the traffic channel is blocked on one ring port.

  c. If no other higher priority commands exist and assuming the ring node was in Idle state before the manual switch command was issued, the ring node flushes its local FDB.

  d. A ring node accepting an R-APS (MS) message, without any local higher priority requests unblocks any blocked ring port which does not have an SF condition. This action subsequently unblocks the traffic channel over the RPL.

e. A ring node accepting an R-APS (MS) message, without any local higher priority requests stops transmitting R-APS messages.

f. A ring node receiving an R-APS (MS) message flushes its FDB.

- Protection switching on a manual switch request is completed when the above actions are performed by each ring node. At this point, traffic flows around the ring are resumed. From this point on, the following rules apply regarding processing of further manual switch commands:

  a. While an existing manual switch request is present in the ring, any new manual switch request is rejected. The request is rejected at the ring node where the new request is issued and a notification is generated to inform the operator that the new MS request was not accepted.

  b. A ring node with a local manual switch command which receives an R-APS (MS) message with a different Node ID clears its manual switch request and starts transmitting R-APS (NR) messages. The ring node keeps the ring port blocked due to the previous manual switch command.

  c. An ring node with a local manual switch command that receives an R-APS message or a local request of higher priority than R-APS (MS) clear its manual switch request. The ring node then processes the new higher priority request.

- Recovery for manual switching under revertive and non-revertive mode is described under the Command Usage section for the non-revertive command.

Example

```
Console#erps manual-switch instance r&d west
Console#
```

erps clear

This command manually clears the protection state which has been invoked by a forced switch or manual switch command, and the node is operating under non-revertive mode; or before the WTR or WTB timer expires when the node is operating in revertive mode.

Syntax

erps clear instance *instance-name*

instance-name - Name of a specific ERPS instance. (Range: 1-12 characters)

Command Mode

Privileged Exec

Command Usage

- Two steps are required to make a ring operating in non-revertive mode return to Idle state from forced switch or manual switch state:

1. Issue an **erps clear** command to remove the forced switch command on the node where a local forced switch command is active.

2. Issue an **erps clear** command on the RPL owner node to trigger the reversion.

- The **erps clear** command will also stop the WTR and WTB delay timers and reset their values.
- More detailed information about using this command for non-revertive mode is included under the Command Usage section for the non-revertive command.

Example

```
Console#erps clear instance r&d
Console#
```

clear erps statistics

This command clears all statistics for a specific ERPS instance, or all instances.

Syntax

clear erps statistics [**instance** *instance-name*]

instance-name - Name of a specific ERPS instance. (Range: 1-12 characters)

Command Mode

Privileged Exec

Example

```
Console#clear erps statistics instance r&d
Console#
```

show erps statistics

This command displays statistics information for all configured instances, or for a specified instance.

Syntax

show erps statistics [**instance** *instance-name*]]

instance-name - Name of a specific ERPS instance. (Range: 1-12 characters)

Command Mode

Privileged Exec

Example

This example displays statistics for all configured ERPS instances.

```
Console#show erps statistics
ERPS statistics for instance r&d :
Interface    Local SF   Local Clear SF
------------ ---------- --------------
(W) Eth 1/ 1 0          0
             SF         NR         NR-RB      FS         MS
             ---------- ---------- ---------- ---------- ----------
    Sent              0         62        948          0          0
    Received          0          0          0          0          0
    Ignored           0          0          0          0          0
             EVENT      HEALTH
             ---------- ----------
    Sent              0          0
    Received          0          0
    Ignored           0          0

Interface    Local SF   Local Clear SF
------------ ---------- --------------
(E) Eth 1/ 3 0          0
             SF         NR         NR-RB      FS         MS
             ---------- ---------- ---------- ---------- ----------
    Sent              0         62        948          0          0
    Received          0          0          0          0          0
    Ignored           0          0          0          0          0
             EVENT      HEALTH
             ---------- ----------
    Sent              0          0
    Received          0          0
    Ignored           0          0

Console#
```

show erps

This command displays status information for all configured VLAN groups, rings, and instances, or for a specified VLAN group, ring, or instance.

Syntax

show erps {[**vlan-group** *vlan-group-name*] | [**ring** *ring-name*] | [**instance** *instance-name*]}

vlan-group - Keyword to display ERPS VLAN group settings.

vlan-group-name – Name of the VLAN group. (Range: 1-12 characters).

ring - Keyword to display ERPS ring configuration settings.

ring-name - Name of a specific ERPS ring. (Range: 1-12 characters)

instance - Keyword to display ERPS instance configuration settings.

instance-name - Name of a specific ERPS instance. (Range: 1-12 characters)

Command Mode

Privileged Exec

Example

This example displays a summary of all the ERPS VLAN groups configured on the switch.

```
Console#show erps vlan-group
ERPS Status            : Disabled
ERPS node-id           : B8-6A-97-41-F3-83
Number of ERPS Vgroup  : 1

VLAN-group   ID  VLANs
------------ --- ----------------------------------------
vlgroup3       1 3,6,9

Console#
```

This example displays a summary of all the ERPS rings configured on the switch.

```
Console#show erps ring
ERPS Status            : Enabled
ERPS node-id           : B8-6A-97-41-F3-83
Number of ERPS Ring    : 2

Ring         ID  Enabled West I/F  EAST I/F
------------ --- ------- --------- ---------
test1          1 No
campus1        2 Yes     Eth 1/1   Eth 1/3

Console#
```

This example displays a summary of all the ERPS instances configured on the switch.

```
Console#show erps instance
ERPS Status            : Disabled
ERPS node-id           : B8-6A-97-41-F3-83
Number of ERPS Inst    : 1

Instance     ID  Enabled Physical Ring Ctrl VLAN Node State Node Type
------------ --- ------- ------------- --------- ---------- ------------
test1          1 No                              Init       None

             W/E  Interface Port State Local SF Local FS Local MS RPL
             ---- --------- ---------- -------- -------- -------- ----
             West           Unknown    No       No       No       No
             East           Unknown    No       No       No       No

             Inclusion VLAN groups
             ---------------------------------------------------------------
             None

Console#
```

24 Class of Service Commands

The commands described in this section allow you to specify which data packets have greater precedence when traffic is buffered in the switch due to congestion. This switch supports CoS with eight priority queues for each port. Data packets in a port's high-priority queue will be transmitted before those in the lower-priority queues. The default priority can be set for each interface, also the queue service mode and the mapping of frame priority tags to the switch's priority queues can be configured.

Table 95: Priority Commands

Command Group	Function
Priority Commands (Layer 2)	Configures the queue mode, queue weights, and default priority for untagged frames
Priority Commands (Layer 3 and 4)	Sets the default priority processing method (CoS or DSCP), maps priority tags for internal processing, maps values from internal priority table to CoS values used in tagged egress packets for Layer 2 interfaces, maps internal per hop behavior to hardware queues

Priority Commands (Layer 2)

This section describes commands used to configure Layer 2 traffic priority on the switch.

Table 96: Priority Commands (Layer 2)

Command	Function	Mode
queue mode	Sets the queue mode to Weighted Round-Robin (WRR), strict priority, or a combination of strict and weighted queuing	GC
queue weight	Assigns round-robin weights to the priority queues	GC
switchport priority default	Sets a port priority for incoming untagged frames	IC
show interfaces switchport	Displays the administrative and operational status of an interface	PE
show queue mode	Shows the current queue mode	PE
show queue weight	Shows weights assigned to the weighted queues	PE

queue mode

This command sets the scheduling mode used for processing each of the class of service (CoS) priority queues. The options include strict priority, Weighted Round-Robin (WRR), or a combination of strict and weighted queuing. Use the **no** form to restore the default value.

Syntax

queue mode {**strict** | **wrr** | **strict-wrr** [*queue-type-list*]}

no queue mode

strict - Services the egress queues in sequential order, transmitting all traffic in the higher priority queues before servicing lower priority queues. This ensures that the highest priority packets are always serviced first, ahead of all other traffic.

wrr - Weighted Round-Robin shares bandwidth at the egress ports by using scheduling weights (based on the queue weight command), and servicing each queue in a round-robin fashion.

strict-wrr - Uses strict or weighted service as specified for each queue.

queue-type-list - Indicates if the queue is a normal or strict type. (Options: 0 indicates a normal queue, 1 indicates a strict queue)

Default Setting

WRR

Command Mode

Global Configuration

Command Usage

- The switch can be set to service the port queues based on strict priority, WRR, or a combination of strict and weighted queuing.
- Strict priority requires all traffic in a higher priority queue to be processed before lower priority queues are serviced.
- Weighted Round Robin (WRR) uses a predefined relative weight for each queue that determines the percentage of service time the switch services each queue before moving on to the next queue. This prevents the head-of-line blocking that can occur with strict priority queuing. Use the queue weight command to assign weights for WRR queuing to the eight priority queues.
- If Strict and WRR mode is selected, a combination of strict and weighted service is used as specified for each queue. The queues assigned to use strict or WRR priority should be specified using the *queue-type-list* parameter.
- A weight can be assigned to each of the weighted queues (and thereby to the corresponding traffic priorities). This weight sets the frequency at which each queue is polled for service, and subsequently affects the response time for software applications assigned a specific priority value.

- Service time is shared at the egress ports by defining scheduling weights for WRR, or for the queuing mode that uses a combination of strict and weighted queuing. Service time is allocated to each queue by calculating a precise number of bytes per second that will be serviced on each round.
- The specified queue mode applies to all interfaces.

Example

The following example sets the queue mode to strict priority service mode:

```
Console(config)#queue mode strict
Console(config)#
```

queue weight

This command assigns weights to the eight class of service (CoS) priority queues when using weighted queuing, or one of the queuing modes that use a combination of strict and weighted queuing. Use the **no** form to restore the default weights.

Syntax

queue weight *weight0...weight7*

no queue weight

weight0...weight7 - The ratio of weights for queues 0 - 7 determines the weights used by the WRR scheduler. (Range: 1-127)

Default Setting

Weights 1, 2, 4, 6, 8, 10, 12, 14 are assigned to queues 0 - 7 respectively.

Command Mode

Global Configuration

Command Usage

- This command shares bandwidth at the egress port by defining scheduling weights for Weighted Round-Robin, or for the queuing mode that uses a combination of strict and weighted queuing (page 588).
- Bandwidth is allocated to each queue by calculating a precise number of bytes per second that will be serviced on each round.

Example

The following example shows how to assign round-robin weights of 1 - 8 to the CoS priority queues 0 - 7.

```
Console(config)#queue weight 1 2 3 4 5 6 7 8
Console(config)#
```

switchport priority default

This command sets a priority for incoming untagged frames. Use the **no** form to restore the default value.

Syntax

switchport priority default *default-priority-id*

no switchport priority default

default-priority-id - The priority number for untagged ingress traffic. The priority is a number from 0 to 7. Seven is the highest priority.

Default Setting

The priority is not set, and the default value for untagged frames received on the interface is zero.

Command Mode

Interface Configuration (Ethernet)

Command Usage

- The precedence for priority mapping is IP DSCP, and then default switchport priority.
- The default priority applies for an untagged frame received on a port set to accept all frame types (i.e, receives both untagged and tagged frames). This priority does not apply to IEEE 802.1Q VLAN tagged frames. If the incoming frame is an IEEE 802.1Q VLAN tagged frame, the IEEE 802.1p User Priority bits will be used.
- The switch provides eight priority queues for each port. It can be configured to use strict priority queuing, Weighted Round Robin (WRR), or a combination of strict and weighted queuing using the queue mode command. Inbound frames that do not have VLAN tags are tagged with the input port's default ingress user priority, and then placed in the appropriate priority queue at the output port. The default priority for all ingress ports is zero. Therefore, any inbound frames that do not have priority tags will be placed in queue 2 of the output port. (Note that if the output port is an untagged member of the associated VLAN, these frames are stripped of all VLAN tags prior to transmission.)

Example

The following example shows how to set a default priority on port 3 to 5:

```
Console(config)#interface ethernet 1/3
Console(config-if)#switchport priority default 5
Console(config-if)#
```

show queue mode

This command shows the current queue mode.

Syntax

show queue mode

Command Mode

Privileged Exec

Example

```
Console#show queue mode
Unit   Port   queue mode
----   ----   ---------------
   1      1   Weighted Round Robin
...
```

show queue weight

This command displays the weights used for the weighted queues.

Syntax

show queue weight

Command Mode

Privileged Exec

Example

```
Console#show queue weight
Information of Eth 1/1
 Queue ID  Weight
 --------  ------
        0       1
        1       2
        2       4
        3       6
        4       8
        5      10
        6      12
        7      14
...
```

Priority Commands (Layer 3 and 4)

This section describes commands used to configure Layer 3 and 4 traffic priority mapping on the switch.

Table 97: Priority Commands (Layer 3 and 4)

Command	Function	Mode
qos map phb-queue	Maps internal per-hop behavior values to hardware queues	IC
qos map cos-dscp	Maps CoS/CFI values in incoming packets to per-hop behavior and drop precedence values for internal priority processing	IC
qos map dscp-mutation	Maps DSCP values in incoming packets to per-hop behavior and drop precedence values for internal priority processing	IC
qos map ip-prec-dscp	Maps IP Precedence values in incoming packets to per-hop behavior and drop precedence values for internal priority processing	IC
qos map trust-mode	Sets QoS mapping to DSCP or CoS	IC
show qos map cos-dscp	Shows ingress CoS to internal DSCP map	PE
show qos map dscp-mutation	Shows ingress DSCP to internal DSCP map	PE
show qos map ip-prec-dscp	Shows ingress IP Precedence to internal DSCP map	PE
show qos map phb-queue	Shows internal per-hop behavior to hardware queue map	PE
show qos map trust-mode	Shows the QoS mapping mode	PE

* The default settings used for mapping priority values to internal DSCP values and back to the hardware queues are designed to optimize priority services for the majority of network applications. It should not be necessary to modify any of the default settings unless a queuing problem occurs with a particular application.

qos map phb-queue

This command determines the hardware output queues to use based on the internal per-hop behavior value. Use the **no** form to restore the default settings.

Syntax

qos map phb-queue *queue-id* **from** *phb0 ... phb7*

no map phb-queue *phb0 ... phb7*

phb - Per-hop behavior, or the priority used for this router hop. (Range: 0-7)

queue-id - The ID of the priority queue. (Range: 0-7, where 7 is the highest priority queue)

Default Setting

Table 98: Mapping Internal Per-hop Behavior to Hardware Queues

Per-hop Behavior	0	1	2	3	4	5	6	7
Hardware Queues	2	0	1	3	4	5	6	7

Command Mode

Interface Configuration (Port, Static Aggregation)

Command Usage

- Enter a queue identifier, followed by the keyword "from" and then up to eight internal per-hop behavior values separated by spaces.
- Egress packets are placed into the hardware queues according to the mapping defined by this command.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#qos map phb-queue 0 from 1 2 3
Console(config-if)#
```

qos map cos-dscp

This command maps CoS/CFI values in incoming packets to per-hop behavior and drop precedence values for priority processing. Use the **no** form to restore the default settings.

Syntax

qos map cos-dscp *phb drop-precedence* **from** *cos0 cfi0...cos7 cfi7*

no qos map cos-dscp *cos0 cfi0...cos7 cfi7*

phb - Per-hop behavior, or the priority used for this router hop. (Range: 0-7)

drop-precedence - Drop precedence used for controlling traffic congestion. (Range: 0 - Green, 3 - Yellow, 1 - Red)

cos - CoS value in ingress packets. (Range: 0-7)

cfi - Canonical Format Indicator. Set to this parameter to "0" to indicate that the MAC address information carried in the frame is in canonical format. (Range: 0-1)

Default Setting

Table 99: Default Mapping of CoS/CFI to Internal PHB/Drop Precedence

CoS	CFI 0	1
0	(0,0)	(0,0)
1	(1,0)	(1,0)
2	(2,0)	(2,0)

Table 99: Default Mapping of CoS/CFI to Internal PHB/Drop Precedence

CoS	CFI 0	1
3	(3,0)	(3,0)
4	(4,0)	(4,0)
5	(5,0)	(5,0)
6	(6,0)	(6,0)
7	(7,0)	(7,0)

Command Mode

Interface Configuration (Port, Static Aggregation)

Command Usage

- The default mapping of CoS to PHB values shown in Table 99 is based on the recommended settings in IEEE 802.1p for mapping CoS values to output queues.
- Enter a value pair for the internal per-hop behavior and drop precedence, followed by the keyword "from" and then up to eight CoS/CFI paired values separated by spaces.
- If a packet arrives with a 802.1Q header but it is not an IP packet, then the CoS/CFI-to-PHB/Drop Precedence mapping table is used to generate priority and drop precedence values for internal processing. Note that priority tags in the original packet are not modified by this command.
- The internal DSCP consists of three bits for per-hop behavior (PHB) which determines the queue to which a packet is sent; and two bits for drop precedence (namely color) which is used to control traffic congestion.
- The specified mapping applies to all interfaces.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#qos map cos-dscp 0 0 from 0 1
Console(config-if)#
```

qos map dscp-mutation

This command maps DSCP values in incoming packets to per-hop behavior and drop precedence values for priority processing. Use the **no** form to restore the default settings.

Syntax

qos map dscp-mutation *phb drop-precedence* **from** *dscp0 ... dscp7*

no qos map dscp-mutation *dscp0 ... dscp7*

phb - Per-hop behavior, or the priority used for this router hop. (Range: 0-7)

drop-precedence - Drop precedence used for in controlling traffic congestion. (Range: 0 - Green, 3 - Yellow, 1 - Red)

dscp - DSCP value in ingress packets. (Range: 0-63)

Default Setting

Table 100: Default Mapping of DSCP Values to Internal PHB/Drop Values

ingress-dscp10 \ ingress-dscp1	0	1	2	3	4	5	6	7	8	9
0	0,0	0,1	0,0	0,3	0,0	0,1	0,0	0,3	1,0	1,1
1	1,0	1,3	1,0	1,1	1,0	1,3	2,0	2,1	2,0	2,3
2	2,0	2,1	2,0	2,3	3,0	3,1	3,0	3,3	3.0	3,1
3	3,0	3,3	4,0	4,1	4,0	4,3	4,0	4,1	4.0	4,3
4	5,0	5,1	5,0	5,3	5,0	5,1	6,0	5,3	6,0	6,1
5	6,0	6,3	6,0	6,1	6,0	6,3	7,0	7,1	7.0	7,3
6	7,0	7,1	7,0	7,3						

The ingress DSCP is composed of ingress-dscp10 (most significant digit in the left column) and ingress-dscp1 (least significant digit in the top row (in other words, ingress-dscp = ingress-dscp10 * 10 + ingress-dscp1); and the corresponding internal-dscp is shown at the intersecting cell in the table.

The ingress DSCP is bitwise ANDed with the binary value 11 to determine the drop precedence. If the resulting value is 10 binary, then the drop precedence is set to 0.

Command Mode

Interface Configuration (Port, Static Aggregation)

Command Usage

- Enter a value pair for the internal per-hop behavior and drop precedence, followed by the keyword "from" and then up to eight DSCP values separated by spaces.
- This map is only used when the QoS mapping mode is set to "DSCP" by the qos map trust-mode command, and the ingress packet type is IPv4.
- Two QoS domains can have different DSCP definitions, so the DSCP-to-PHB/ Drop Precedence mutation map can be used to modify one set of DSCP values

to match the definition of another domain. The mutation map should be applied at the receiving port (ingress mutation) at the boundary of a QoS administrative domain.

- The specified mapping applies to all interfaces.

Example

This example changes the priority for all packets entering port 1 which contain a DSCP value of 1 to a per-hop behavior of 3 and a drop precedence of 1. Referring to Table 100, note that the DSCP value for these packets is now set to 25 ($3x2^3+1$) and passed on to the egress interface.

```
Console(config)#interface ethernet 1/5
Console(config-if)#qos map dscp-mutation 3 1 from 1
Console(config-if)#
```

qos map ip-prec-dscp

This command maps IP precedence values in incoming packets to per-hop behavior and drop precedence values for priority processing. Use the **no** form to restore the default settings.

Syntax

qos map ip-prec-dscp *phb0 drop-precedence0 ... phb7 drop-precedence7*

no map ip-prec-dscp

phb - Per-hop behavior, or the priority used for this router hop. (Range: 0-7)

drop-precedence - Drop precedence used for controlling traffic congestion. (Range: 0 - Green, 3 - Yellow, 1 - Red)

Default Setting

Table 101: Default Mapping of IP Precedence to Internal PHB/Drop Values

IP Precedence Value	0	1	2	3	4	5	6	7
Per-hop Behavior	0	1	2	3	4	5	6	7
Drop Precedence	0	0	0	0	0	0	0	0

Command Mode

Interface Configuration (Port, Static Aggregation)

Command Usage

- Enter up to eight paired values for per-hop behavior and drop precedence separated by spaces. These values are used for internal priority processing, and correspond to IP Precedence values 0 - 7.

- If the QoS mapping mode is set the IP Precedence and the ingress packet type is IPv4, then the IP Precedence-to-DSCP mapping table is used to generate priority and drop precedence values for internal processing.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#qos map ip-prec-dscp 7 0 6 0 5 0 4 0 3 0 2 1 1 1 0 1
Console(config-if)#
```

qos map trust-mode

This command sets QoS mapping to DSCP or CoS. Use the **no** form to restore the default setting.

Syntax

qos map trust-mode {**cos** | **dscp**}

no qos map trust-mode

cos - Sets the QoS mapping mode to CoS.

dscp - Sets the QoS mapping mode to DSCP.

Default Setting

CoS

Command Mode

Interface Configuration (Port)

Command Usage

- If the QoS mapping mode is set to DSCP with this command, and the ingress packet type is IPv4, then priority processing will be based on the DSCP value in the ingress packet.
- If the QoS mapping mode is set to DSCP, and a non-IP packet is received, the packet's CoS and CFI (Canonical Format Indicator) values are used for priority processing if the packet is tagged. For an untagged packet, the default port priority (see page 590) is used for priority processing.
- If the QoS mapping mode is set to CoS with this command, and the ingress packet type is IPv4, then priority processing will be based on the CoS and CFI values in the ingress packet.

  For an untagged packet, the default port priority (see page 590) is used for priority processing.

Example

This example sets the QoS priority mapping mode to use DSCP based on the conditions described in the Command Usage section.

```
Console(config)#interface ge1/1
```

```
Console(config-if)#qos map trust-mode dscp
Console(config-if)#
```

show qos map cos-dscp

This command shows ingress CoS/CFI to internal DSCP map.

Syntax

show qos map cos-dscp interface *interface*
interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode

Privileged Exec

Example

```
Console#show qos map cos-dscp interface ethernet 1/5
CoS Information of Eth 1/5
 CoS-DSCP map.(x,y),x: phb,y: drop precedence:
 CoS  : CFI  0          1
 --------------------------------
 0            (0,0)       (0,0)
 1            (1,0)       (1,0)
 2            (2,0)       (2,0)
 3            (3,0)       (3,0)
 4            (4,0)       (4,0)
 5            (5,0)       (5,0)
 6            (6,0)       (6,0)
 7            (7,0)       (7,0)
Console#
```

show qos map dscp-mutation

This command shows the ingress DSCP to internal DSCP map.

Syntax

show qos map dscp-mutation interface *interface*
interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode
Privileged Exec

Command Usage
This map is only used when the QoS mapping mode is set to "DSCP" by the qos map trust-mode command, and the ingress packet type is IPv4.

Example
The ingress DSCP is composed of "d1" (most significant digit in the left column) and "d2" (least significant digit in the top row (in other words, ingress DSCP = d1 * 10 + d2); and the corresponding Internal DSCP and drop precedence is shown at the intersecting cell in the table.

```
Console#show qos map dscp-mutation interface ethernet 1/5
DSCP mutation map.(x,y),x: PHB,y: drop precedence:
 d1: d2 0     1     2     3     4     5     6     7     8     9
 ----------------------------------------------------------------
 0 :    (0,0) (0,1) (0,0) (0,3) (0,0) (0,1) (0,0) (0,3) (1,0) (1,1)
 1 :    (1,0) (1,3) (1,0) (1,1) (1,0) (1,3) (2,0) (2,1) (2,0) (2,3)
 2 :    (2,0) (2,1) (2,0) (2,3) (3,0) (3,1) (3,0) (3,3) (3,0) (3,1)
 3 :    (3,0) (3,3) (4,0) (4,1) (4,0) (4,3) (4,0) (4,1) (4,0) (4,3)
 4 :    (5,0) (5,1) (5,0) (5,3) (5,0) (5,1) (6,0) (5,3) (6,0) (6,1)
 5 :    (6,0) (6,3) (6,0) (6,1) (6,0) (6,3) (7,0) (7,1) (7,0) (7,3)
 6 :    (7,0) (7,1) (7,0) (7,3)
Console#
```

show qos map ip-prec-dscp

This command shows the ingress IP precedence to internal DSCP map.

Syntax

show qos map ip-prec-dscp interface *interface*
interface

ethernet *unit/port*

unit - Stack unit.

port - Port number.

port-channel *channel-id*

Command Mode
Privileged Exec

Command Usage
If the QoS mapping mode is set to IP Precedence and the ingress packet type is IPv4, then the IP Precedence-to-DSCP mapping table is used to generate per-hop behavior and drop precedence values for internal processing.

Example

```
Console#show qos map ip-prec-dscp interface ethernet 1/5
Information of Eth 1/5
```

```
 IP-prec-DSCP map:
 IP-prec:         0     1     2     3     4     5     6     7
 ---------------------------------------------------------------
 PHB:             0     1     2     3     4     5     6     7
 drop precedence: 0     0     0     0     0     0     0     0
Console#
```

show qos map phb-queue

This command shows internal per-hop behavior to hardware queue map.

Syntax

show qos map phb-queue interface *interface*
interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode

Privileged Exec

Example

```
Console#show qos map phb-queue interface ethernet 1/5
Information of Eth 1/5
 PHB-queue map:
 PHB:       0     1     2     3     4     5     6     7
 ---------------------------------------------------------
 queue:     2     0     1     3     4     5     6     7
Console#
```

show qos map trust-mode

This command shows the QoS mapping mode.

Syntax

show qos map trust-mode interface *interface*
interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

Command Mode

Privileged Exec

Example

The following shows that the trust mode is set to CoS:

```
Console#show qos map trust-mode interface ethernet 1/5
Information of Eth 1/5
  CoS Map Mode:          CoS mode
Console#
```

25 Quality of Service Commands

The commands described in this section are used to configure Differentiated Services (DiffServ) classification criteria and service policies. You can classify traffic based on access lists, IP Precedence or DSCP values, or VLANs. Using access lists allows you select traffic based on Layer 2, Layer 3, or Layer 4 information contained in each packet.

Table 102: Quality of Service Commands

Command	Function	Mode
class-map	Creates a class map for a type of traffic	GC
description	Specifies the description of a class map	CM
match	Defines the criteria used to classify traffic	CM
rename	Redefines the name of a class map	CM
policy-map	Creates a policy map for multiple interfaces	GC
description	Specifies the description of a policy map	PM
class	Defines a traffic classification for the policy to act on	PM
rename	Redefines the name of a policy map	PM
police flow	Defines an enforcer for classified traffic based on a metered flow rate	PM-C
police srtcm-color	Defines an enforcer for classified traffic based on a single rate three color meter	PM-C
police trtcm-color	Defines an enforcer for classified traffic based on a two rate three color meter	PM-C
set cos	Services IP traffic by setting a class of service value for matching packets for internal processing	PM-C
set ip dscp	Services IP traffic by setting a IP DSCP value for matching packets for internal processing	PM-C
set phb	Services IP traffic by setting a per-hop behavior value for matching packets for internal processing	PM-C
service-policy	Applies a policy map defined by the policy-map command to the input of a particular interface	IC
show class-map	Displays the QoS class maps which define matching criteria used for classifying traffic	PE
show policy-map	Displays the QoS policy maps which define classification criteria for incoming traffic, and may include policers for bandwidth limitations	PE
show policy-map interface	Displays the configuration of all classes configured for all service policies on the specified interface	PE

To create a service policy for a specific category of ingress traffic, follow these steps:

1. Use the class-map command to designate a class name for a specific category of traffic, and enter the Class Map configuration mode.
2. Use the match command to select a specific type of traffic based on an access list, an IPv4 DSCP value, IPv4 Precedence value, a VLAN, or a CoS value.
3. Use the policy-map command to designate a policy name for a specific manner in which ingress traffic will be handled, and enter the Policy Map configuration mode.
4. Use the class command to identify the class map, and enter Policy Map Class configuration mode. A policy map can contain up to 16 class maps.
5. Use the set phb or set cos or set ip dscp command to modify the per-hop behavior, the class of service value in the VLAN tag, or the priority bits in the IP header (IP DSCP value) for the matching traffic class, and use one of the **police** commands to monitor parameters such as the average flow and burst rate, and drop any traffic that exceeds the specified rate, or just reduce the DSCP service level for traffic exceeding the specified rate.
6. Use the service-policy command to assign a policy map to a specific interface.

Note: Create a Class Map before creating a Policy Map.

class-map

This command creates a class map used for matching packets to the specified class, and enters Class Map configuration mode. Use the **no** form to delete a class map.

Syntax

class-map *class-map-name* **match-any**

no class-map *class-map-name*

class-map-name - Name of the class map. (Range: 1-32 characters)

match-any - Match any condition within a class map.

Default Setting

None

Command Mode

Global Configuration

Command Usage

- First enter this command to designate a class map and enter the Class Map configuration mode. Then use match commands to specify the criteria for ingress traffic that will be classified under this class map.
- One or more class maps can be assigned to a policy map (page 606).
- The policy map is then bound by a service policy to an interface (page 617). A service policy defines packet classification, service tagging, and bandwidth policing.

Example

This example creates a class map call "rd-class," and sets it to match packets marked for DSCP service value 3:

```
Console(config)#class-map rd-class match-any
Console(config-cmap)#match ip dscp 3
Console(config-cmap)#
```

description

This command specifies the description of a class map or policy map.Use the no form of the command to remove the description.

Syntax

description *string*

no description

string - Description of the class map or policy map. (Range: 1-64 characters)

Command Mode

Class Map Configuration
Policy Map Configuration

Example

```
Console(config)#class-map rd-class#1
Console(config-cmap)#description matches packets marked for DSCP service
  value 3
Console(config-cmap)#
```

match

This command defines the criteria used to classify traffic. Use the **no** form to delete the matching criteria.

Syntax

[no] **match** {**access-list** *acl-name* | **cos** *cos* | **ip dscp** *dscp* | **ip precedence** *ip-precedence* | **vlan** *vlan*}

acl-name - Name of the access control list. Any type of ACL can be specified, including standard or extended IP ACLs and MAC ACLs. (Range: 1-16 characters)

cos - A Class of Service value. (Range: 0-7)

dscp - A Differentiated Service Code Point value. (Range: 0-63)

ip-precedence - An IP Precedence value. (Range: 0-7)

vlan - A VLAN. (Range:1-4094)

Default Setting

None

Command Mode

Class Map Configuration

Command Usage

- First enter the class-map command to designate a class map and enter the Class Map configuration mode. Then use **match** commands to specify the fields within ingress packets that must match to qualify for this class map.
- If an ingress packet matches an ACL specified by this command, any deny rules included in the ACL will be ignored.
- If match criteria includes an IP ACL or IP priority rule, then a VLAN rule cannot be included in the same class map.
- If match criteria includes a MAC ACL or VLAN rule, then neither an IP ACL nor IP priority rule can be included in the same class map.
- Up to 16 match entries can be included in a class map.

Example

This example creates a class map called "rd-class#1," and sets it to match packets marked for DSCP service value 3.

```
Console(config)#class-map rd-class#1 match-any
Console(config-cmap)#match ip dscp 3
Console(config-cmap)#
```

This example creates a class map call "rd-class#2," and sets it to match packets marked for IP Precedence service value 5.

```
Console(config)#class-map rd-class#2 match-any
Console(config-cmap)#match ip precedence 5
Console(config-cmap)#
```

This example creates a class map call "rd-class#3," and sets it to match packets marked for VLAN 1.

```
Console(config)#class-map rd-class#3 match-any
Console(config-cmap)#match vlan 1
Console(config-cmap)#
```

rename

This command redefines the name of a class map or policy map.

Syntax

rename *map-name*

map-name - Name of the class map or policy map. (Range: 1-32 characters)

Command Mode

Class Map Configuration
Policy Map Configuration

Example

```
Console(config)#class-map rd-class#1
Console(config-cmap)#rename rd-class#9
Console(config-cmap)#
```

policy-map

This command creates a policy map that can be attached to multiple interfaces, and enters Policy Map configuration mode. Use the **no** form to delete a policy map.

Syntax

[**no**] **policy-map** *policy-map-name*

policy-map-name - Name of the policy map. (Range: 1-32 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Use the **policy-map** command to specify the name of the policy map, and then use the class command to configure policies for traffic that matches the criteria defined in a class map.
- A policy map can contain multiple class statements that can be applied to the same interface with the service-policy command.
- Create a Class Map (page 606) before assigning it to a Policy Map.

Example

This example creates a policy called "rd-policy," uses the class command to specify the previously defined "rd-class," uses the **set** command to classify the service that incoming packets will receive, and then uses the police flow command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4000 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set cos 0
Console(config-pmap-c)#police flow 10000 4000 conform-action transmit
  violate-action drop
Console(config-pmap-c)#
```

class

This command defines a traffic classification upon which a policy can act, and enters Policy Map Class configuration mode. Use the **no** form to delete a class map.

Syntax

[**no**] **class** *class-map-name*

class-map-name - Name of the class map. (Range: 1-32 characters)

Default Setting

None

Command Mode

Policy Map Configuration

Command Usage

- Use the policy-map command to specify a policy map and enter Policy Map configuration mode. Then use the **class** command to enter Policy Map Class configuration mode. And finally, use the **set** command and one of the **police** commands to specify the match criteria, where the:
  - set phb command sets the per-hop behavior value in matching packets. (This modifies packet priority for internal processing only.)

- set cos command sets the class of service value in matching packets. (This modifies packet priority in the VLAN tag.)
- **police** commands define parameters such as the maximum throughput, burst rate, and response to non-conforming traffic.

- Up to 16 classes can be included in a policy map.

Example

This example creates a policy called "rd-policy," uses the **class** command to specify the previously defined "rd-class," uses the set phb command to classify the service that incoming packets will receive, and then uses the police flow command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4,000 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set phb 3
Console(config-pmap-c)#police flow 10000 4000 conform-action transmit
  violate-action drop
Console(config-pmap-c)#
```

police flow

This command defines an enforcer for classified traffic based on the metered flow rate. Use the no form to remove a policer.

Syntax

[no] **police flow** *committed-rate committed-burst*
conform-action {**transmit** | *new-dscp*}
violate-action {**drop** | *new-dscp*}

committed-rate - Committed information rate (CIR) in kilobits per second. (Range: 0-10000000 kbps or maximum port speed, whichever is lower)

committed-burst - Committed burst size (BC) in bytes. (Range: 4000-16000000 bytes)

conform-action - Action to take when packet is within the CIR and BC. (There are enough tokens to service the packet, the packet is set green).

violate-action - Action to take when packet exceeds the CIR and BC. (There are not enough tokens to service the packet, the packet is set red).

transmit - Transmits without taking any action.

drop - Drops packet as required by violate-action.

new-dscp - Differentiated Service Code Point (DSCP) value. (Range: 0-63)

Default Setting

None

Command Mode
Policy Map Class Configuration

Command Usage
- You can configure up to 16 policers (i.e., class maps) for ingress ports.
- Policing is based on a token bucket, where bucket depth (i.e., the maximum burst before the bucket overflows) is by specified the *committed-burst* field, and the average rate tokens are added to the bucket is by specified by the *committed-rate* option. Note that the token bucket functions similar to that described in RFC 2697 and RFC 2698.
- The behavior of the meter is specified in terms of one token bucket (C), the rate at which the tokens are incremented (CIR – Committed Information Rate), and the maximum size of the token bucket (BC – Committed Burst Size).

  The token bucket C is initially full, that is, the token count Tc(0) = BC. Thereafter, the token count Tc is updated CIR times per second as follows:
  - If Tc is less than BC, Tc is incremented by one, else
  - Tc is not incremented.

  When a packet of size B bytes arrives at time t, the following happens:
  - If Tc(t)-B ≥ 0, the packet is green and Tc is decremented by B down to the minimum value of 0, else
  - else the packet is red and Tc is not decremented.

Example
This example creates a policy called "rd-policy," uses the class command to specify the previously defined "rd-class," uses the set phb command to classify the service that incoming packets will receive, and then uses the **police flow** command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4000 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set phb 3
Console(config-pmap-c)#police flow 100000 4000 conform-action transmit
  violate-action drop
Console(config-pmap-c)#
```

police srtcm-color

This command defines an enforcer for classified traffic based on a single rate three color meter (srTCM). Use the **no** form to remove a policer.

Syntax

[no] police {srtcm-color-blind | srtcm-color-aware}
committed-rate committed-burst excess-burst
conform-action {transmit | *new-dscp*}
exceed-action {drop | *new-dscp*}
violate action {drop | *new-dscp*}

srtcm-color-blind - Single rate three color meter in color-blind mode.

srtcm-color-aware - Single rate three color meter in color-aware mode.

committed-rate - Committed information rate (CIR) in kilobits per second. (Range: 0-10000000 kbps or maximum port speed, whichever is lower)

committed-burst - Committed burst size (BC) in bytes. (Range: 4000-16000000 bytes)

excess-burst - Excess burst size (BE) in bytes. (Range: 4000-16000000 bytes)

conform-action - Action to take when rate is within the CIR and BC. (There are enough tokens in bucket BC to service the packet, packet is set green).

exceed-action - Action to take when rate exceeds the CIR and BC but is within the BE. (There are enough tokens in bucket BE to service the packet, the packet is set yellow.)

violate-action - Action to take when rate exceeds the BE. (There are not enough tokens in bucket BE to service the packet, the packet is set red.)

transmit - Transmits without taking any action.

drop - Drops packet as required by exceed-action or violate-action.

new-dscp - Differentiated Service Code Point (DSCP) value. (Range: 0-63)

Default Setting

None

Command Mode

Policy Map Class Configuration

Command Usage

- You can configure up to 16 policers (i.e., class maps) for ingress ports.
- The srTCM as defined in RFC 2697 meters a traffic stream and processes its packets according to three traffic parameters – Committed Information Rate (CIR), Committed Burst Size (BC), and Excess Burst Size (BE).
- The PHB label is composed of five bits, three bits for per-hop behavior, and two bits for the color scheme used to control queue congestion. A packet is marked

green if it doesn't exceed the CIR and BC, yellow if it does exceed the CIR and BC, but not the BE, and red otherwise.

- The meter operates in one of two modes. In the color-blind mode, the meter assumes that the packet stream is uncolored. In color-aware mode the meter assumes that some preceding entity has pre-colored the incoming packet stream so that each packet is either green, yellow, or red. The marker (re)colors an IP packet according to the results of the meter. The color is coded in the DS field [RFC 2474] of the packet.

- The behavior of the meter is specified in terms of its mode and two token buckets, C and E, which both share the common rate CIR. The maximum size of the token bucket C is BC and the maximum size of the token bucket E is BE.

  The token buckets C and E are initially full, that is, the token count Tc(0) = BC and the token count Te(0) = BE. Thereafter, the token counts Tc and Te are updated CIR times per second as follows:

  - If Tc is less than BC, Tc is incremented by one, else
  - if Te is less then BE, Te is incremented by one, else
  - neither Tc nor Te is incremented.

  When a packet of size B bytes arrives at time t, the following happens if srTCM is configured to operate in color-blind mode:

  - If Tc(t)-B ≥ 0, the packet is green and Tc is decremented by B down to the minimum value of 0, else
  - if Te(t)-B ≥ 0, the packets is yellow and Te is decremented by B down to the minimum value of 0,
  - else the packet is red and neither Tc nor Te is decremented.

  When a packet of size B bytes arrives at time t, the following happens if srTCM is configured to operate in color-aware mode:

  - If the packet has been precolored as green and Tc(t)-B ≥ 0, the packet is green and Tc is decremented by B down to the minimum value of 0, else
  - If the packet has been precolored as yellow or green and if
  - Te(t)-B ≥ 0, the packets is yellow and Te is decremented by B down to the minimum value of 0, else the packet is red and neither Tc nor Te is decremented.

  The metering policy guarantees a deterministic behavior where the volume of green packets is never smaller than what has been determined by the CIR and BC, that is, tokens of a given color are always spent on packets of that color. Refer to RFC 2697 for more information on other aspects of srTCM.

Example

This example creates a policy called "rd-policy," uses the class command to specify the previously defined "rd-class," uses the set phb command to classify the service that incoming packets will receive, and then uses the **police srtcm-color-blind** command to limit the average bandwidth to 100,000 Kbps, the committed burst rate to 4000 bytes, the excess burst rate to 6000 bytes, to remark any packets

exceeding the committed burst size, and to drop any packets exceeding the excess burst size.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set phb 3
Console(config-pmap-c)#police srtcm-color-blind 100000 4000 6000 conform-
  action transmit exceed-action 0 violate-action drop
Console(config-pmap-c)#
```

police trtcm-color

This command defines an enforcer for classified traffic based on a two rate three color meter (trTCM). Use the **no** form to remove a policer.

Syntax

[no] police {trtcm-color-blind | trtcm-color-aware}
committed-rate committed-burst peak-rate peak-burst
conform-action {transmit | *new-dscp*}
exceed-action {drop | *new-dscp*}
violate action {drop | *new-dscp*}

trtcm-color-blind - Two rate three color meter in color-blind mode.

trtcm-color-aware - Two rate three color meter in color-aware mode.

committed-rate - Committed information rate (CIR) in kilobits per second. (Range: 0-10000000 kbps or maximum port speed, whichever is lower)

committed-burst - Committed burst size (BC) in bytes. (Range: 4000-16000000 bytes)

peak-rate - Peak information rate (PIR) in kilobits per second. (Range: 0-1000000 kbps or maximum port speed, whichever is lower)

peak-burst - Peak burst size (BP) in bytes. (Range: 0-10000000 bytes)

conform-action - Action to take when rate is within the CIR and BP. (Packet size does not exceed BP and there are enough tokens in bucket BC to service the packet, the packet is set green.)

exceed-action - Action to take when rate exceeds the CIR but is within the PIR. (Packet size exceeds BC but there are enough tokens in bucket BP to service the packet, the packet is set yellow.)

violate-action - Action to take when rate exceeds the PIR. (There are not enough tokens in bucket BP to service the packet, the packet is set red.)

drop - Drops packet as required by exceed-action or violate-action.

transmit - Transmits without taking any action.

new-dscp - Differentiated Service Code Point (DSCP) value. (Range: 0-63)

Default Setting

None

Command Mode
Policy Map Class Configuration

Command Usage
- You can configure up to 16 policers (i.e., class maps) for ingress ports.
- The trTCM as defined in RFC 2698 meters a traffic stream and processes its packets based on two rates – Committed Information Rate (CIR) and Peak Information Rate (PIR), and their associated burst sizes - Committed Burst Size (BC) and Peak Burst Size (BP).
- The PHB label is composed of five bits, three bits for per-hop behavior, and two bits for the color scheme used to control queue congestion. A packet is marked red if it exceeds the PIR. Otherwise it is marked either yellow or green depending on whether it exceeds or doesn't exceed the CIR.

  The trTCM is useful for ingress policing of a service, where a peak rate needs to be enforced separately from a committed rate.
- The meter operates in one of two modes. In the color-blind mode, the meter assumes that the packet stream is uncolored. In color-aware mode the meter assumes that some preceding entity has pre-colored the incoming packet stream so that each packet is either green, yellow, or red. The marker (re)colors an IP packet according to the results of the meter. The color is coded in the DS field [RFC 2474] of the packet.
- The behavior of the meter is specified in terms of its mode and two token buckets, P and C, which are based on the rates PIR and CIR, respectively. The maximum size of the token bucket P is BP and the maximum size of the token bucket C is BC.
- The token buckets P and C are initially (at time 0) full, that is, the token count Tp(0) = BP and the token count Tc(0) = BC. Thereafter, the token count Tp is incremented by one PIR times per second up to BP and the token count Tc is incremented by one CIR times per second up to BC.

  When a packet of size B bytes arrives at time t, the following happens if trTCM is configured to operate in color-blind mode:

  - If Tp(t)-B < 0, the packet is red, else
  - if Tc(t)-B < 0, the packet is yellow and Tp is decremented by B, else
  - the packet is green and both Tp and Tc are decremented by B.

  When a packet of size B bytes arrives at time t, the following happens if trTCM is configured to operate in color-aware mode:

  - If the packet has been precolored as red or if Tp(t)-B < 0, the packet is red, else
  - if the packet has been precolored as yellow or if Tc(t)-B < 0, the packet is yellow and Tp is decremented by B, else
  - the packet is green and both Tp and Tc are decremented by B.

- The trTCM can be used to mark a IP packet stream in a service, where different, decreasing levels of assurances (either absolute or relative) are given to packets which are green, yellow, or red. Refer to RFC 2698 for more information on other aspects of trTCM.

Example

This example creates a policy called "rd-policy," uses the class command to specify the previously defined "rd-class," uses the set phb command to classify the service that incoming packets will receive, and then uses the **police trtcm-color-blind** command to limit the average bandwidth to 100,000 Kbps, the committed burst rate to 4000 bytes, the peak information rate to 1,000,000 kbps, the peak burst size to 6000, to remark any packets exceeding the committed burst size, and to drop any packets exceeding the peak information rate.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set phb 3
Console(config-pmap-c)#police trtcm-color-blind 100000 4000 100000 6000
  conform-action transmit exceed-action 0 violate-action drop
Console(config-pmap-c)#
```

set cos

This command modifies the class of service (CoS) value for a matching packet (as specified by the match command) in the packet's VLAN tag. Use the **no** form to remove this setting.

Syntax

[**no**] **set cos** *cos-value*

cos-value - Class of Service value. (Range: 0-7)

Default Setting

None

Command Mode

Policy Map Class Configuration

Command Usage

- The **set cos** command is used to set the CoS value in the VLAN tag for matching packets.

- The **set cos** and set phb command function at the same level of priority. Therefore setting either of these commands will overwrite any action already configured by the other command.

Example

This example creates a policy called "rd-policy," uses the class command to specify the previously defined "rd-class," uses the **set cos** command to classify the service that incoming packets will receive, and then uses the police flow command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4000 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set cos 3
Console(config-pmap-c)#police flow 100000 4000 conform-action transmit
  violate-action drop
Console(config-pmap-c)#
```

set ip dscp

This command modifies the IP DSCP value in a matching packet (as specified by the match command). Use the **no** form to remove this traffic classification.

Syntax

[**no**] **set ip dscp** *new-dscp*

new-dscp - New Differentiated Service Code Point (DSCP) value. (Range: 0-63)

Default Setting

None

Command Mode

Policy Map Class Configuration

Command Usage

The **set ip dscp** command is used to set the priority values in the packet's ToS field for matching packets.

Example

This example creates a policy called "rd-policy," uses the class command to specify the previously defined "rd-class," uses the **set ip dscp** command to classify the service that incoming packets will receive, and then uses the police flow command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4000 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set ip dscp 3
Console(config-pmap-c)#police flow 10000 4000 conform-action transmit
  violate-action drop
Console(config-pmap-c)#
```

set phb

This command services IP traffic by setting a per-hop behavior value for a matching packet (as specified by the match command) for internal processing. Use the **no** form to remove this setting.

Syntax

[**no**] **set phb** *phb-value*

phb-value - Per-hop behavior value. (Range: 0-7)

Default Setting

None

Command Mode

Policy Map Class Configuration

Command Usage

- The **set phb** command is used to set an internal QoS value in hardware for matching packets (see Table 99, "Default Mapping of CoS/CFI to Internal PHB/ Drop Precedence"). The QoS label is composed of five bits, three bits for per-hop behavior, and two bits for the color scheme used to control queue congestion by the police srtcm-color command and police trtcm-color command.

- The set cos and **set phb** command function at the same level of priority. Therefore setting either of these commands will overwrite any action already configured by the other command.

Example

This example creates a policy called "rd-policy," uses the class command to specify the previously defined "rd-class," uses the **set phb** command to classify the service that incoming packets will receive, and then uses the police flow command to limit the average bandwidth to 100,000 Kbps, the burst rate to 4000 bytes, and configure the response to drop any violating packets.

```
Console(config)#policy-map rd-policy
Console(config-pmap)#class rd-class
Console(config-pmap-c)#set phb 3
Console(config-pmap-c)#police flow 10000 4000 conform-action transmit
  violate-action drop
Console(config-pmap-c)#
```

service-policy

This command applies a policy map defined by the **policy-map** command to the ingress side of a particular interface. Use the **no** form to remove this mapping.

Syntax

[no] **service-policy** {**input** | **output**} *policy-map-name*

input - Apply to the input traffic.

output - Apply to the output traffic.

policy-map-name - Name of the policy map for this interface. (Range: 1-32 characters)

Default Setting

No policy map is attached to an interface.

Command Mode

Interface Configuration (Ethernet)

Command Usage

- Only one policy map can be assigned to an interface.
- First define a class map, then define a policy map, and finally use the **service-policy** command to bind the policy map to the required interface.
- The switch does not allow a policy map to be bound to an interface for egress traffic.

Example

This example applies a service policy to an ingress interface.

```
Console(config)#interface ethernet 1/1
Console(config-if)#service-policy input rd-policy
Console(config-if)#
```

show class-map

This command displays the QoS class maps which define matching criteria used for classifying traffic.

Syntax

show class-map [*class-map-name*]

class-map-name - Name of the class map. (Range: 1-32 characters)

Default Setting

Displays all class maps.

Command Mode

Privileged Exec

Example

```
Console#show class-map
Class Map match-any rd-class#1
Description:
 Match IP DSCP 10
 Match access-list rd-access
 Match IP DSCP 0

Class Map match-any rd-class#2
 Match IP Precedence 5

Class Map match-any rd-class#3
 Match VLAN 1

Console#
```

show policy-map

This command displays the QoS policy maps which define classification criteria for incoming traffic, and may include policers for bandwidth limitations.

Syntax

show policy-map [*policy-map-name* [**class** *class-map-name*]]

policy-map-name - Name of the policy map. (Range: 1-32 characters)

class-map-name - Name of the class map. (Range: 1-32 characters)

Default Setting

Displays all policy maps and all classes.

Command Mode

Privileged Exec

Example

```
Console#show policy-map
Policy Map rd-policy
Description:
 class rd-class
 set phb 3
Console#show policy-map rd-policy class rd-class
Policy Map rd-policy
 class rd-class
 set phb 3
Console#
```

show policy-map interface

This command displays the service policy assigned to the specified interface.

Syntax

show policy-map interface *interface* input

interface

unit/port

unit - Unit identifier.

port - Port number.

Command Mode

Privileged Exec

Example

```
Console#show policy-map interface 1/5 input
Service-policy rd-policy
Console#
```

26 Control Plane Commands

Network control packets that are received by the switch are handled by the CPU. This traffic can potentially overwhelm the switch CPU and impact the overall system performance. To prevent the switch CPU from receiving too much traffic, QoS class maps and policy maps can be defined and applied as a service policy to ingress traffic on the CPU's "control-plane" interface.

For details on configuring QoS class maps and policy maps, see "Quality of Service Commands" on page 602.

Table 103: Control Plane Commands

Command	Function	Mode
control-plane	Enters control-plane interface mode	GC
service-policy	Applies a policy map to the input of the control-plane interface	CP
show policy-map control-plane	Shows the configuration of service policies on the control-plane interface	PE

control-plane

Use this command to enter control-plane interface configuration mode.

Syntax

control-plane

Command Mode

Global Configuration

Command Usage

You must enter control-plane interface configuration mode to bind a service policy to the control-plane interface.

Example

```
Console(config)#control-plane
Console(config-cp)#
```

service-policy

This command applies a QoS policy map defined by the policy-map command to the ingress side of the control-plane interface. Use the **no** form to remove this mapping.

Syntax

[**no**] **service-policy input** *policy-map-name*

input - Apply to the input traffic.

policy-map-name - Name of the policy map for this interface. (Range: 1-32 characters)

Default Setting

No policy map is attached to the control-plane interface.

Command Mode

Control-Plane Interface Configuration

Command Usage

- Only one policy map can be assigned to the control-plane interface.
- First define a class map, then define a policy map, and finally use the **service-policy** command to bind the policy map to the control-plane interface.
- The switch does not allow a policy map to be bound to an interface for egress traffic.

Example

This example applies a service policy to the control-plane interface.

```
Console(config)#control-plane
Console(config-cp)#service-policy input cpu-policy
Console(config-cp)#
```

show policy-map control-plane

This command displays the QoS policy map that defines classification criteria for incoming traffic on the control-plane interface.

Syntax

show policy-map control-plane input [**class** *class-map-name*] [**hardware counters**]

class-map-name - Name of the class map. (Range: 1-32 characters)

hardware counters - Shows statistics for the policy or class.

Command Mode

Privileged Exec

Example

```
Console#show policy-map control-plane input

Console# show policy-map control-plane input class cp-class hardware counters
Service-policy cpu-rate-limit-policy
  Class-map cp-class
    Receive Packets:          95
       Drop Packets:           0

Console#
```

27 Multicast Filtering Commands

This switch uses IGMP (Internet Group Management Protocol) to check for any attached hosts that want to receive a specific multicast service. It identifies the ports containing hosts requesting a service and sends data out to those ports only. It then propagates the service request up to any neighboring multicast switch/router to ensure that it will continue to receive the multicast service.

Table 104: Multicast Filtering Commands

Command Group	Function
IGMP Snooping	Configures multicast groups via IGMP snooping or static assignment, sets the IGMP version, enables proxy reporting, displays current snooping settings, and displays the multicast service and group members
Static Multicast Routing	Configures static multicast router ports which forward all inbound multicast traffic to the attached VLANs
IGMP Filtering and Throttling	Configures IGMP filtering and throttling
MLD Snooping	Configures multicast snooping for IPv6
MLD Filtering and Throttling	Configures MLD filtering and throttling for IPv6.
IGMP (Layer 3)	Configures the IGMP protocol used with multicast routing in IPv4 networks
MVR for IPv4	Configures a single network-wide multicast VLAN shared by hosts residing in other standard or private VLAN groups, preserving security and data isolation for normal traffic
MVR for IPv6	Configures a single network-wide multicast VLAN shared by hosts residing in other standard or private VLAN groups, preserving security and data isolation for normal traffic

IGMP Snooping

This section describes commands used to configure IGMP snooping on the switch.

Table 105: IGMP Snooping Commands

Command	Function	Mode
ip igmp snooping	Enables IGMP snooping	GC
ip igmp snooping priority	Assigns a priority to all multicast traffic	GC
ip igmp snooping proxy-reporting	Enables IGMP Snooping with Proxy Reporting	GC
ip igmp snooping querier	Allows this device to act as the querier for IGMP snooping	GC

Table 105: IGMP Snooping Commands (Continued)

Command	Function	Mode
ip igmp snooping router-alert-option-check	Discards any IGMPv2/v3 packets that do not include the Router Alert option	GC
ip igmp snooping router-port-expire-time	Configures the querier timeout	GC
ip igmp snooping tcn-flood	Floods multicast traffic when a Spanning Tree topology change occurs	GC
ip igmp snooping tcn-query-solicit	Sends an IGMP Query Solicitation when a Spanning Tree topology change occurs	GC
ip igmp snooping unregistered-data-flood	Floods unregistered multicast traffic into the attached VLAN	GC
ip igmp snooping unsolicited-report-interval	Specifies how often the upstream interface should transmit unsolicited IGMP reports (when proxy reporting is enabled)	GC
ip igmp snooping version	Configures the IGMP version for snooping	GC
ip igmp snooping version-exclusive	Discards received IGMP messages which use a version different to that currently configured	GC
ip igmp snooping vlan general-query-suppression	Suppresses general queries except for ports attached to downstream multicast hosts	GC
ip igmp snooping vlan immediate-leave	Immediately deletes a member port of a multicast service if a leave packet is received at that port and immediate-leave is enabled for the parent VLAN	GC
ip igmp snooping vlan last-memb-query-count	Configures the number of IGMP proxy query messages that are sent out before the system assumes there are no local members	GC
ip igmp snooping vlan last-memb-query-intvl	Configures the last-member-query interval	GC
ip igmp snooping vlan mrd	Sends multicast router solicitation messages	GC
ip igmp snooping vlan proxy-address	Configures a static address for proxy IGMP query and reporting	GC
ip igmp snooping vlan proxy-reporting	Enables IGMP Snooping with Proxy Reporting	GC
ip igmp snooping vlan query-interval	Configures the interval between sending IGMP general queries	GC
ip igmp snooping vlan query-resp-intvl	Configures the maximum time the system waits for a response to general queries	GC
ip igmp snooping vlan static	Adds an interface as a member of a multicast group	GC
ip igmp snooping vlan version	Configures the IGMP version for snooping	GC
ip igmp snooping vlan version-exclusive	Discards received IGMP messages which use a version different to that currently configured	GC
clear ip igmp snooping groups dynamic	Clears multicast group information dynamically learned through IGMP snooping	PE
clear ip igmp snooping statistics	Clears IGMP snooping statistics	PE
show ip igmp snooping	Shows the IGMP snooping, proxy, and query configuration	PE

Table 105: IGMP Snooping Commands (Continued)

Command	Function	Mode
show ip igmp snooping group	Shows known multicast group, source, and host port mapping	PE
show ip igmp snooping mrouter	Shows multicast router ports	PE
show ip igmp snooping statistics	Shows IGMP snooping protocol statistics for the specified interface	PE

ip igmp snooping

This command enables IGMP snooping globally on the switch or on a selected VLAN interface. Use the **no** form to disable it.

Syntax

[**no**] **ip igmp snooping** [**vlan** *vlan-id*]

vlan-id - VLAN ID (Range: 1-4094)

Default Setting

Enabled

Command Mode

Global Configuration

Command Usage

- When IGMP snooping is enabled globally, the per VLAN interface settings for IGMP snooping take precedence.
- When IGMP snooping is disabled globally, snooping can still be configured per VLAN interface, but the interface settings will not take effect until snooping is re-enabled globally.

Example

The following example enables IGMP snooping globally.

```
Console(config)#ip igmp snooping
Console(config)#
```

ip igmp snooping priority

This command assigns a priority to all multicast traffic. Use the **no** form to restore the default setting.

Syntax

ip igmp snooping priority *priority*

no ip igmp snooping priority

priority - The CoS priority assigned to all multicast traffic. (Range: 0-7, where 7 is the highest priority)

Default Setting
2

Command Mode
Global Configuration

Command Usage
This command can be used to set a high priority for low-latency multicast traffic such as a video-conference, or to set a low priority for normal multicast traffic not sensitive to latency.

Example
```
Console(config)#ip igmp snooping priority 6
Console(config)#
```

ip igmp snooping proxy-reporting

This command enables IGMP Snooping with Proxy Reporting. Use the **no** form to restore the default setting.

Syntax
[no] ip igmp snooping proxy-reporting

ip igmp snooping vlan *vlan-id* proxy-reporting {enable | disable}
no ip igmp snooping vlan *vlan-id* proxy-reporting

vlan-id - VLAN ID (Range: 1-4094)

enable - Enable on the specified VLAN.

disable - Disable on the specified VLAN.

Default Setting
Global: Disabled
VLAN: Based on global setting

Command Mode
Global Configuration

Command Usage
- When proxy reporting is enabled with this command, the switch performs "IGMP Snooping with Proxy Reporting" (as defined in DSL Forum TR-101, April 2006), including last leave, and query suppression. Last leave sends out a proxy query when the last member leaves a multicast group, and query suppression means that specific queries are not forwarded from an upstream multicast router to hosts downstream from this device.

- If the IGMP proxy reporting is configured on a VLAN, this setting takes precedence over the global configuration.

Example

```
Console(config)#ip igmp snooping proxy-reporting
Console(config)#
```

ip igmp snooping querier

This command enables the switch as an IGMP querier. Use the **no** form to disable it.

Syntax

[no] ip igmp snooping querier

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- IGMP snooping querier is not supported for IGMPv3 snooping (see ip igmp snooping version).
- If enabled, the switch will serve as querier if elected. The querier is responsible for asking hosts if they want to receive multicast traffic.

Example

```
Console(config)#ip igmp snooping querier
Console(config)#
```

ip igmp snooping router-alert-option-check

This command discards any IGMPv2/v3 packets that do not include the Router Alert option. Use the **no** form to ignore the Router Alert Option when receiving IGMP messages.

Syntax

[no] ip igmp snooping router-alert-option-check

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

As described in Section 9.1 of RFC 3376 for IGMP Version 3, the Router Alert Option can be used to protect against DOS attacks. One common method of attack is launched by an intruder who takes over the role of querier, and starts overloading multicast hosts by sending a large number of group-and-source-specific queries, each with a large source list and the Maximum Response Time set to a large value.

To protect against this kind of attack, (1) routers should not forward queries. This is easier to accomplish if the query carries the Router Alert option. (2) Also, when the switch is acting in the role of a multicast host (such as when using proxy routing), it should ignore version 2 or 3 queries that do not contain the Router Alert option.

Example

```
Console(config)#ip igmp snooping router-alert-option-check
Console(config)#
```

ip igmp snooping router-port-expire-time

This command configures the querier timeout. Use the **no** form to restore the default.

Syntax

ip igmp snooping router-port-expire-time *seconds*

no ip igmp snooping router-port-expire-time

seconds - The time the switch waits after the previous querier stops before it considers it to have expired. (Range: 1-65535; Recommended Range: 300-500)

Default Setting

300 seconds

Command Mode

Global Configuration

Example

The following shows how to configure the timeout to 400 seconds:

```
Console(config)#ip igmp snooping router-port-expire-time 400
Console(config)#
```

ip igmp snooping tcn-flood

This command enables flooding of multicast traffic if a spanning tree topology change notification (TCN) occurs. Use the **no** form to disable flooding.

Syntax

[no] ip igmp snooping tcn-flood

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- When a spanning tree topology change occurs, the multicast membership information learned by the switch may be out of date. For example, a host linked to one port before the topology change (TC) may be moved to another port after the change. To ensure that multicast data is delivered to all receivers, by default, a switch in a VLAN (with IGMP snooping enabled) that receives a Bridge Protocol Data Unit (BPDU) with the TC bit set (by the root bridge) will enter into "multicast flooding mode" for a period of time until the topology has stabilized and the new locations of all multicast receivers are learned.

- If a topology change notification (TCN) is received, and all the uplink ports are subsequently deleted, a timeout mechanism is used to delete all of the currently learned multicast channels.

- When a new uplink port starts up, the switch sends unsolicited reports for all current learned channels out through the new uplink port.

- By default, the switch immediately enters into "multicast flooding mode" when a spanning tree topology change occurs. In this mode, multicast traffic will be flooded to all VLAN ports. If many ports have subscribed to different multicast groups, flooding may cause excessive loading on the link between the switch and the end host. Flooding may be disabled to avoid this, causing multicast traffic to be delivered only to those ports on which multicast group members have been learned.

- When the spanning tree topology changes, the root bridge sends a proxy query to quickly re-learn the host membership/port relations for multicast channels. The root bridge also sends an unsolicited Multicast Router Discover (MRD) request to quickly locate the multicast routers in this VLAN.

  The proxy query and unsolicited MRD request are flooded to all VLAN ports except for the receiving port when the switch receives such packets.

Example
The following example enables TCN flooding.

```
Console(config)#ip igmp snooping tcn-flood
Console(config)#
```

ip igmp snooping tcn-query-solicit

This command instructs the switch to send out an IGMP general query solicitation when a spanning tree topology change notification (TCN) occurs. Use the **no** form to disable this feature.

Syntax

[no] ip igmp snooping tcn-query-solicit

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
- When the root bridge in a spanning tree receives a topology change notification for a VLAN where IGMP snooping is enabled, it issues a global IGMP leave message (query solicitation). When a switch receives this solicitation, it floods it to all ports in the VLAN where the spanning tree change occurred. When an upstream multicast router receives this solicitation, it will also immediately issues an IGMP general query.

- The **ip igmp snooping tcn query-solicit** command can be used to send a query solicitation whenever it notices a topology change, even if the switch is not the root bridge in the spanning tree.

Example
The following example instructs the switch to issue an IGMP general query whenever it receives a spanning tree topology change notification.

```
Console(config)#ip igmp snooping tcn query-solicit
Console(config)#
```

ip igmp snooping unregistered-data-flood

This command floods unregistered multicast traffic into the attached VLAN. Use the no form to drop unregistered multicast traffic.

Syntax

[no] ip igmp snooping unregistered-data-flood

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

Once the table used to store multicast entries for IGMP snooping and multicast routing is filled, no new entries are learned. If no router port is configured in the attached VLAN, and unregistered-flooding is disabled, any subsequent multicast traffic not found in the table is dropped, otherwise it is flooded throughout the VLAN.

Example

```
Console(config)#ip igmp snooping unregistered-data-flood
Console(config)#
```

ip igmp snooping unsolicited-report-interval

This command specifies how often the upstream interface should transmit unsolicited IGMP reports when proxy reporting is enabled. Use the no form to restore the default value.

Syntax

ip igmp snooping unsolicited-report-interval *seconds*

no ip igmp snooping unsolicited-report-interval

seconds - The interval at which to issue unsolicited reports. (Range: 1-65535 seconds)

Default Setting

400 seconds

Command Mode

Global Configuration

Command Usage

- When a new upstream interface (that is, uplink port) starts up, the switch sends unsolicited reports for all currently learned multicast channels out through the new upstream interface.
- This command only applies when proxy reporting is enabled (see page 626).

Example

```
Console(config)#ip igmp snooping unsolicited-report-interval 5
Console(config)#
```

ip igmp snooping version

This command configures the IGMP snooping version. Use the **no** form to restore the default.

Syntax

ip igmp snooping [**vlan** *vlan-id*] **version** {**1** | **2** | **3**}

no ip igmp snooping version

vlan-id - VLAN ID (Range: 1-4094)

1 - IGMP Version 1

2 - IGMP Version 2

3 - IGMP Version 3

Default Setting

Global: IGMP Version 2
VLAN: Not configured, based on global setting

Command Mode

Global Configuration

Command Usage

- This command configures the IGMP report/query version used by IGMP snooping. Versions 1 - 3 are all supported, and versions 2 and 3 are backward compatible, so the switch can operate with other devices, regardless of the snooping version employed.
- If the IGMP snooping version is configured on a VLAN, this setting takes precedence over the global configuration.

Example

The following configures the global setting for IGMP snooping to version 1.

```
Console(config)#ip igmp snooping version 1
Console(config)#
```

ip igmp snooping version-exclusive

This command discards any received IGMP messages (except for multicast protocol packets) which use a version different to that currently configured by the ip igmp snooping version command. Use the **no** form to disable this feature.

Syntax

ip igmp snooping [**vlan** *vlan-id*] **version-exclusive**

no ip igmp snooping version-exclusive

vlan-id - VLAN ID (Range: 1-4094)

Default Setting

Global: Disabled
VLAN: Disabled

Command Mode

Global Configuration

Command Usage

- If version exclusive is disabled on a VLAN, then this setting is based on the global setting. If it is enabled on a VLAN, then this setting takes precedence over the global setting.
- When this function is disabled, the currently selected version is backward compatible (see the ip igmp snooping version command.

Example

```
Console(config)#ip igmp snooping version-exclusive
Console(config)#
```

ip igmp snooping vlan general-query-suppression

This command suppresses general queries except for ports attached to downstream multicast hosts. Use the **no** form to flood general queries to all ports except for the multicast router port.

Syntax

[**no**] **ip igmp snooping vlan** *vlan-id* **general-query-suppression**

vlan-id - VLAN ID (Range: 1-4094)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- By default, general query messages are flooded to all ports, except for the multicast router through which they are received.
- If general query suppression is enabled, then these messages are forwarded only to downstream ports which have joined a multicast service.

Example

```
Console(config)#ip igmp snooping vlan 1 general-query-suppression
Console(config)#
```

ip igmp snooping vlan immediate-leave

This command immediately deletes a member port of a multicast service if a leave packet is received at that port and immediate-leave is enabled for the parent VLAN. Use the **no** form to restore the default.

Syntax

ip igmp snooping vlan *vlan-id* **immediate-leave** [**by-host-ip**]

no ip igmp snooping vlan *vlan-id* **immediate-leave**

vlan-id - VLAN ID (Range: 1-4094)

by-host-ip - Specifies that the member port will be deleted only when there are no hosts joining this group.

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- If immediate-leave is *not* used, a multicast router (or querier) will send a group-specific query message when an IGMPv2/v3 group leave message is received. The router/querier stops forwarding traffic for that group only if no host replies to the query within the timeout period. (The timeout for this release is currently defined by ip igmp snooping vlan last-memb-query-intvl.
- If immediate-leave is used, the switch assumes that only one host is connected to the interface. Therefore, immediate leave should only be enabled on an interface if it is connected to only one IGMP-enabled device, either a service host or a neighbor running IGMP snooping.
- If the "by-host-ip" option is used, the router/querier will not send out a group-specific query when an IGMPv2/v3 leave message is received. But will check if there are other hosts joining the multicast group. Only when all hosts on that port leave the group will the member port be deleted.

- This command is only effective if IGMP snooping is enabled, and IGMPv2 or IGMPv3 snooping is used.

Example
The following shows how to enable immediate leave.

```
Console(config)#ip igmp snooping vlan 1 immediate-leave
Console(config)#
```

ip igmp snooping vlan last-memb-query-count

This command configures the number of IGMP proxy group-specific or group-and-source-specific query messages that are sent out before the system assumes there are no more local members. Use the **no** form to restore the default.

Syntax

ip igmp snooping vlan *vlan-id* **last-memb-query-count** *count*

no ip igmp snooping vlan *vlan-id* **last-memb-query-count**

vlan-id - VLAN ID (Range: 1-4094)

count - The number of proxy group-specific or group-and-source-specific query messages to issue before assuming that there are no more group members. (Range: 1-255)

Default Setting
2

Command Mode
Global Configuration

Command Usage
This command will take effect only if IGMP snooping proxy reporting or IGMP querier is enabled (page 626).

Example

```
Console(config)#ip igmp snooping vlan 1 last-memb-query-count 7
Console(config)#
```

ip igmp snooping vlan last-memb-query-intvl

This command configures the last-member-query interval. Use the **no** form to restore the default.

Syntax

ip igmp snooping vlan *vlan-id* **last-memb-query-intvl** *interval*

no ip igmp snooping vlan *vlan-id* **last-memb-query-intvl**

vlan-id - VLAN ID (Range: 1-4094)

interval - The interval to wait for a response to a group-specific or group-and-source-specific query message. (Range: 1-31744 tenths of a second)

Default Setting
10 (1 second)

Command Mode
Global Configuration

Command Usage
- When a multicast host leaves a group, it sends an IGMP leave message. When the leave message is received by the switch, it checks to see if this host is the last to leave the group by sending out an IGMP group-specific or group-and-source-specific query message, and starts a timer. If no reports are received before the timer expires, the group record is deleted, and a report is sent to the upstream multicast router.
- A reduced value will result in reduced time to detect the loss of the last member of a group or source, but may generate more bursty traffic.
- This command will take effect only if IGMP snooping proxy reporting is enabled (page 626).

Example
```
Console(config)#ip igmp snooping vlan 1 last-memb-query-intvl 700
Console(config)#
```

ip igmp snooping vlan mrd

This command enables sending of multicast router solicitation messages. Use the **no** form to disable these messages.

Syntax
[**no**] **ip igmp snooping vlan** *vlan-id* **mrd**

vlan-id - VLAN ID (Range: 1-4094)

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
- Multicast Router Discovery (MRD) uses multicast router advertisement, multicast router solicitation, and multicast router termination messages to discover multicast routers. Devices send solicitation messages in order to solicit advertisement messages from multicast routers. These messages are used to

discover multicast routers on a directly attached link. Solicitation messages are also sent whenever a multicast forwarding interface is initialized or re-initialized. Upon receiving a solicitation on an interface with IP multicast forwarding and MRD enabled, a router will respond with an advertisement.

- Advertisements are sent by routers to advertise that IP multicast forwarding is enabled. These messages are sent unsolicited periodically on all router interfaces on which multicast forwarding is enabled. They are sent upon the expiration of a periodic timer, as a part of a router's start up procedure, during the restart of a multicast forwarding interface, and on receipt of a solicitation message. When the multicast services provided to a VLAN is relatively stable, the use of solicitation messages is not required and may be disabled using the **no ip igmp snooping vlan** mrd command.

- This command may also be used to disable multicast router solicitation messages when the upstream router does not support MRD, to reduce the loading on a busy upstream router, or when IGMP snooping is disabled in a VLAN.

Example

This example disables sending of multicast router solicitation messages on VLAN 1.

```
Console(config)#no ip igmp snooping vlan 1 mrd
Console(config)#
```

ip igmp snooping vlan proxy-address

This command configures a static source address for locally generated query and report messages used by IGMP proxy reporting. Use the **no** form to restore the default source address.

Syntax

[**no**] **ip igmp snooping vlan** *vlan-id* **proxy-address** *source-address*

vlan-id - VLAN ID (Range: 1-4094)

source-address - The source address used for proxied IGMP query and report, and leave messages. (Any valid IP unicast address)

Default Setting

0.0.0.0

Command Mode

Global Configuration

Command Usage

IGMP Snooping uses a null IP address of 0.0.0.0 for the source of IGMP query messages which are proxied to downstream hosts to indicate that it is not the elected querier, but is only proxying these messages as defined in RFC 4541. The switch also uses a null address in IGMP reports sent to upstream ports.

Many hosts do not implement RFC 4541, and therefore do not understand query messages with the source address of 0.0.0.0. These hosts will therefore not reply to the queries, causing the multicast router to stop sending traffic to them.

To resolve this problem, the source address in proxied IGMP query and report messages can be replaced with any valid unicast address (other than the router's own address) using this command.

Rules Used for Proxy Reporting

When IGMP Proxy Reporting is disabled, the switch will use a null IP address for the source of IGMP query and report messages unless a proxy query address has been set.

When IGMP Proxy Reporting is enabled, the source address is based on the following criteria:

- If a proxy query address is configured, the switch will use that address as the source IP address in general and group-specific query messages sent to downstream hosts, and in report and leave messages sent upstream from the multicast router port.
- If a proxy query address is not configured, the switch will use the VLAN's IP address as the IP source address in general and group-specific query messages sent downstream, and use the source address of the last IGMP message received from a downstream host in report and leave messages sent upstream from the multicast router port.

Example

The following example sets the source address for proxied IGMP query messages to 10.0.1.8.

```
Console(config)#ip igmp snooping vlan 1 proxy-address 10.0.1.8
Console(config)#
```

ip igmp snooping vlan query-interval

This command configures the interval between sending IGMP general queries. Use the **no** form to restore the default.

Syntax

ip igmp snooping vlan *vlan-id* **query-interval** *interval*

no ip igmp snooping vlan *vlan-id* **query-interval**

vlan-id - VLAN ID (Range: 1-4094)

interval - The interval between sending IGMP general queries. (Range: 2-31744 seconds)

Default Setting

125 seconds

Command Mode
Global Configuration

Command Usage
- An IGMP general query message is sent by the switch at the interval specified by this command. When this message is received by downstream hosts, all receivers build an IGMP report for the multicast groups they have joined.
- This command applies when the switch is serving as the querier (page 627), or as a proxy host when IGMP snooping proxy reporting is enabled (page 626).

Example
```
Console(config)#ip igmp snooping vlan 1 query-interval 150
Console(config)#
```

ip igmp snooping vlan query-resp-intvl

This command configures the maximum time the system waits for a response to general queries. Use the **no** form to restore the default.

Syntax
ip igmp snooping vlan *vlan-id* **query-resp-intvl** *interval*

no ip igmp snooping vlan *vlan-id* **query-resp-intvl**

vlan-id - VLAN ID (Range: 1-4094)

interval - The maximum time the system waits for a response to general queries. (Range: 10-31740 tenths of a second)

Default Setting
100 (10 seconds)

Command Mode
Global Configuration

Command Usage
This command applies when the switch is serving as the querier (page 627), or as a proxy host when IGMP snooping proxy reporting is enabled (page 626).

Example
```
Console(config)#ip igmp snooping vlan 1 query-resp-intvl 20
Console(config)#
```

ip igmp snooping vlan static

This command adds a port to a multicast group. Use the **no** form to remove the port.

Syntax

[no] **ip igmp snooping vlan** *vlan-id* **static** *ip-address interface*

vlan-id - VLAN ID (Range: 1-4094)

ip-address - IP address for multicast group

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Static multicast entries are never aged out.
- When a multicast entry is assigned to an interface in a specific VLAN, the corresponding traffic can only be forwarded to ports within that VLAN.

Example

The following shows how to statically configure a multicast group on a port.

```
Console(config)#ip igmp snooping vlan 1 static 224.0.0.12 ethernet 1/5
Console(config)#
```

clear ip igmp snooping groups dynamic

This command clears multicast group information dynamically learned through IGMP snooping.

Syntax

clear ip igmp snooping groups dynamic

Command Mode

Privileged Exec

Command Usage
This command only clears entries learned though IGMP snooping. Statically configured multicast address are not cleared.

Example
```
Console#clear ip igmp snooping groups dynamic
Console#
```

clear ip igmp snooping statistics
This command clears IGMP snooping statistics.

Syntax
clear ip igmp snooping statistics [**interface** *interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* - VLAN identifier (Range: 1-4094)

Command Mode
Privileged Exec

Example
```
Console#clear ip igmp snooping statistics
Console#
```

show ip igmp snooping
This command shows the IGMP snooping, proxy, and query configuration settings.

Syntax
show ip igmp snooping [**vlan** *vlan-id*]

vlan-id - VLAN ID (1-4094)

Command Mode
Privileged Exec

Command Usage
This command displays global and VLAN-specific IGMP configuration settings.

Example

The following shows the current IGMP snooping configuration:

```
Console#show ip igmp snooping
 IGMP Snooping                        : Enabled
 Router Port Expire Time              : 300 s
 Router Alert Check                   : Disabled
 Router Port Mode                     : Forward
 TCN Flood                            : Disabled
 TCN Query Solicit                    : Disabled
 Unregistered Data Flood              : Disabled
 802.1p Forwarding Priority           : Disabled
 Unsolicited Report Interval          : 400 s
 Version Exclusive                    : Disabled
 Version                              : 2
 Proxy Reporting                      : Disabled
 Report Suppression                   : Disabled
 Querier                              : Disabled

 VLAN 1:
 --------
 IGMP Snooping                        : Enabled
 IGMP Snooping Running Status         : Inactive
 Version                              : Using global Version (2)
 Version Exclusive                    : Using global status (Disabled)
 Immediate Leave                      : Disabled
 Last Member Query Interval           : 10 (unit: 1/10s)
 Last Member Query Count              : 2
 General Query Suppression            : Disabled
 Query Interval                       : 125
 Query Response Interval              : 100 (unit: 1/10s)
 Proxy Query Address                  : 0.0.0.0
 Proxy Reporting                      : Using global status (Disabled)
 Report Suppression                   : Using global status (Disabled)
 Multicast Router Discovery           : Disabled

 VLAN Static Group    Port
 ---- --------------- --------
 1    224.1.1.1       Eth 1/ 1
⋮
```

show ip igmp snooping group

This command shows known multicast group, source, and host port mappings for the specified VLAN interface, or for all interfaces if none is specified.

Syntax

show ip igmp snooping group [**host-ip-addr** *ip-address interface* | **igmpsnp** | **sort-by-port** | **user** | **vlan** *vlan-id* [**user** | **igmpsnp**]]

ip-address - IP address for multicast group

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

igmpsnp - Display only entries learned through IGMP snooping.

sort-by-port - Display entries sorted by port.

user - Display only the user-configured multicast entries.

vlan-id - VLAN ID (1-4094)

Default Setting
None

Command Mode
Privileged Exec

Command Usage
Member types displayed include IGMP or USER, depending on selected options.

Example
The following shows the multicast entries learned through IGMP snooping for VLAN 1.

```
Console#show ip igmp snooping group vlan 1
Bridge Multicast Forwarding Entry Count:1
Flag: R - Router port, M - Group member port
      H - Host counts (number of hosts join the group on this port).
      P - Port counts (number of ports join the group).
 Up time: Group elapsed time (d:h:m:s).
 Expire : Group remaining time (m:s).

VLAN Group           Port        Up time     Expire Count
---- --------------- ----------- ----------- ------ --------
   1 224.1.1.1                   00:00:00:37            2(P)
                     Eth 1/ 1(R)
                     Eth 1/ 2(M)                        0(H)
Console#
```

show ip igmp snooping mrouter

This command displays information on statically configured and dynamically learned multicast router ports.

Syntax

show ip igmp snooping mrouter [**vlan** *vlan-id*]

vlan-id - VLAN ID (Range: 1-4094)

Default Setting
Displays multicast router ports for all configured VLANs.

Command Mode
Privileged Exec

Command Usage
Multicast router port types displayed include Static or Dynamic.

Example
The following shows the ports in VLAN 1 which are attached to multicast routers.

```
Console#show ip igmp snooping mrouter vlan 1
 VLAN M'cast Router Port Type    Expire
 ---- ------------------ ------- --------
 1    Eth 1/4            Dynamic 0:4:28
 1    Eth 1/10           Static
Console#
```

show ip igmp snooping statistics

This command shows IGMP snooping protocol statistics for the specified interface.

Syntax

show ip igmp snooping statistics
{**input** [**interface** *interface*] |
output [**interface** *interface*] |
query [**vlan** *vlan-id*]}

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* - VLAN ID (Range: 1-4094)

query - Displays IGMP snooping-related statistics.

Default Setting
None

Command Mode
Privileged Exec

Example

The following shows IGMP protocol statistics input:

```
Console#show ip igmp snooping statistics input interface ethernet 1/1
 Input Statistics:
 Interface Report   Leave    G Query  G(-S)-S Query Drop     Join Succ Group
 --------- -------- -------- -------- ------------- -------- --------- ------
 Eth 1/ 1        23       11        4            10        5        14      5
Console#
```

The following shows IGMP protocol statistics output:

```
Console#show ip igmp snooping statistics output interface ethernet 1/1
 Output Statistics:
 Interface  Report   Leave    G Query  G(-S)-S Query Drop     Group
 ---------- -------- -------- -------- ------------- -------- ------
 Eth 1/ 1        12        0        1             0        0      0
Console#
```

The following shows IGMP query-related statistics for VLAN 1:

```
Console#show ip igmp snooping statistics query vlan 1
 Other Querier             : None
 Other Querier Expire      : 0(m):0(s)
 Other Querier Uptime      : 0(h):0(m):0(s)
 Self Querier              : 192.168.2.12
 Self Querier Expire       : 0(m):0(s)
 Self Querier Uptime       : 0(h):0(m):0(s)
 General Query Received    : 0
 General Query Sent        : 0
 Specific Query Received   : 0
 Specific Query Sent       : 0
 Warn Rate Limit           : 0 sec.
 V1 Warning Count          : 0
 V2 Warning Count          : 0
 V3 Warning Count          : 0
Console#
```

Static Multicast Routing

This section describes commands used to configure static multicast routing on the switch.

Table 106: Static Multicast Interface Commands

Command	Function	Mode
ip igmp snooping vlan mrouter	Adds a multicast router port	GC
show ip igmp snooping mrouter	Shows multicast router ports	PE

ip igmp snooping vlan mrouter

This command statically configures a (Layer 2) multicast router port on the specified VLAN. Use the **no** form to remove the configuration.

Syntax

[no] **ip igmp snooping vlan** *vlan-id* **mrouter** *interface*

vlan-id - VLAN ID (Range: 1-4094)

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting

No static multicast router ports are configured.

Command Mode

Global Configuration

Command Usage

- Depending on your network connections, IGMP snooping may not always be able to locate the IGMP querier. Therefore, if the IGMP querier is a known multicast router or switch connected over the network to an interface (port or trunk) on this switch, that interface can be manually configured to join all the current multicast groups.
- IGMP Snooping must be enabled globally on the switch (using the ip igmp snooping command) before a multicast router port can take effect.

Example

The following shows how to configure port 10 as a multicast router port within VLAN 1.

```
Console(config)#ip igmp snooping vlan 1 mrouter ethernet 1/10
Console(config)#
```

IGMP Filtering and Throttling

In certain switch applications, the administrator may want to control the multicast services that are available to end users. For example, an IP/TV service based on a specific subscription plan. The IGMP filtering feature fulfills this requirement by restricting access to specified multicast services on a switch port, and IGMP throttling limits the number of simultaneous multicast groups a port can join.

Table 107: IGMP Filtering and Throttling Commands

Command	Function	Mode
ip igmp filter	Enables IGMP filtering and throttling on the switch	GC
ip igmp profile	Sets a profile number and enters IGMP filter profile configuration mode	GC
permit, deny	Sets a profile access mode to permit or deny	IPC
range	Specifies one or a range of multicast addresses for a profile	IPC
ip igmp authentication	Enables RADIUS authentication for IGMP JOIN requests.	IC
ip igmp filter	Assigns an IGMP filter profile to an interface	IC
ip igmp max-groups	Specifies an IGMP throttling number for an interface	IC
ip igmp max-groups action	Sets the IGMP throttling action for an interface	IC
ip igmp query-drop	Drops any received IGMP query packets	IC
ip multicast-data-drop	Drops all multicast data packets	IC
show ip igmp authentication	Displays IGMP authentication settings for interfaces	PE
show ip igmp filter	Displays the IGMP filtering status	PE
show ip igmp profile	Displays IGMP profiles and settings	PE
show ip igmp query-drop	Shows if the interface is configured to drop IGMP query packets	PE
show ip igmp throttle interface	Displays the IGMP throttling setting for interfaces	PE
show ip multicast-data-drop	Shows if the interface is configured to drop multicast data packets	PE

ip igmp filter (Global Configuration)

This command globally enables IGMP filtering and throttling on the switch. Use the **no** form to disable the feature.

Syntax

[no] ip igmp filter

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- IGMP filtering enables you to assign a profile to a switch port that specifies multicast groups that are permitted or denied on the port. An IGMP filter profile can contain one or more, or a range of multicast addresses; but only one profile can be assigned to a port. When enabled, IGMP join reports received on the port are checked against the filter profile. If a requested multicast group is permitted, the IGMP join report is forwarded as normal. If a requested multicast group is denied, the IGMP join report is dropped.
- IGMP filtering and throttling only applies to dynamically learned multicast groups, it does not apply to statically configured groups.
- The IGMP filtering feature operates in the same manner when MVR is used to forward multicast traffic.

Example

```
Console(config)#ip igmp filter
Console(config)#
```

ip igmp profile

This command creates an IGMP filter profile number and enters IGMP profile configuration mode. Use the **no** form to delete a profile number.

Syntax

[no] ip igmp profile *profile-number*

profile-number - An IGMP filter profile number. (Range: 1-4294967295)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

A profile defines the multicast groups that a subscriber is permitted or denied to join. The same profile can be applied to many interfaces, but only one profile can be assigned to one interface. Each profile has only one access mode; either permit or deny.

Example

```
Console(config)#ip igmp profile 19
Console(config-igmp-profile)#
```

permit, deny

This command sets the access mode for an IGMP filter profile. Use the **no** form to delete a profile number.

Syntax

{**permit** | **deny**}

Default Setting

Deny

Command Mode

IGMP Profile Configuration

Command Usage

- Each profile has only one access mode; either permit or deny.
- When the access mode is set to permit, IGMP join reports are processed when a multicast group falls within the controlled range. When the access mode is set to deny, IGMP join reports are only processed when a multicast group is not in the controlled range.

Example

```
Console(config)#ip igmp profile 19
Console(config-igmp-profile)#permit
Console(config-igmp-profile)#
```

range

This command specifies multicast group addresses for a profile. Use the **no** form to delete addresses from a profile.

Syntax

[**no**] **range** *low-ip-address* [*high-ip-address*]

low-ip-address - A valid IP address of a multicast group or start of a group range.

high-ip-address - A valid IP address for the end of a multicast group range.

Default Setting
None

Command Mode
IGMP Profile Configuration

Command Usage
Enter this command multiple times to specify more than one multicast address or address range for a profile.

Example

```
Console(config)#ip igmp profile 19
Console(config-igmp-profile)#range 239.1.1.1
Console(config-igmp-profile)#range 239.2.3.1 239.2.3.100
Console(config-igmp-profile)#
```

ip igmp authentication

This command enables IGMP authentication on the specified interface. When enabled and an IGMP JOIN request is received, an authentication request is sent to a configured RADIUS server. Use the **no** form to disable IGMP authentication.

Syntax

[no] ip igmp authentication

Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
- If IGMP authentication is enabled on an interface, and a join report is received on the interface, the switch will send an access request to the RADIUS server to perform authentication.
- Only when the RADIUS server responds with an authentication success message will the switch learn the group report. Once the group is learned, the switch will not send an access request to the RADIUS server when receiving the same report again within a one (1) day period.
- If the RADIUS server responds that authentication failed or the timer expires, the report will be dropped and the group will not be learned. The entry (host MAC, port number, VLAN ID, and group IP) will be put in the "authentication failed list".
- The "authentication failed list" is valid for the period of the interval defined by the command ip igmp snooping vlan query-interval. When receiving the same

report during this interval, the switch will not send the access request to the RADIUS server.

- If the interface leaves the group and subsequently rejoins the same group, the join report needs to again be authenticated.

- When receiving an IGMP v3 report message, the switch will send the access request to the RADIUS server only when the record type is either IS_EX or TO_EX, and the source list is empty. Other types of packets will not initiate RADIUS authentication.

  IS_EX (MODE_IS_EXCLUDE) - Indicates that the interface's filter mode is EXCLUDE for the specified multicast address. The Source Address fields in this Group Record contain the interface's source list for the specified multicast address, if not empty.

  TO_EX (CHANGE_TO_EXCLUDE_MODE) - Indicates that the interface has changed to EXCLUDE filter mode for the specified multicast address. The Source Address fields in this Group Record contain the interface's new source list for the specified multicast address, if not empty.

- When a report is received for the first time and is being authenticated, whether authentication succeeds or fails, the report will still be sent to the multicast-router port.

- The following table shows the RADIUS server Attribute Value Pairs used for authentication:

Table 108: IGMP Authentication RADIUS Attribute Value Pairs

Attribute Name	AVP Type	Entry
USER_NAME	1	User MAC address
USER_PASSWORD	2	User MAC address
NAS_IP_ADDRESS	4	Switch IP address
NAS_PORT	5	User Port Number
FRAMED_IP_ADDRESS	8	Multicast Group ID

Example

This example shows how to enable IGMP Authentication on all of the switch's Ethernet interfaces.

```
Console(config)#interface ethernet 1/1-54
Console(config-if)#ip igmp authentication
Console#
```

ip igmp filter (Interface Configuration)

This command assigns an IGMP filtering profile to an interface on the switch. Use the **no** form to remove a profile from an interface.

Syntax

[**no**] **ip igmp filter** *profile-number*

profile-number - An IGMP filter profile number. (Range: 1-4294967295)

Default Setting

None

Command Mode

Interface Configuration

Command Usage

- The IGMP filtering profile must first be created with the ip igmp profile command before being able to assign it to an interface.
- Only one profile can be assigned to an interface.
- A profile can also be assigned to a trunk interface. When ports are configured as trunk members, the trunk uses the filtering profile assigned to the first port member in the trunk.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip igmp filter 19
Console(config-if)#
```

ip igmp max-groups

This command sets the IGMP throttling number for an interface on the switch. Use the **no** form to restore the default setting.

Syntax

ip igmp max-groups *number*

no ip igmp max-groups

number - The maximum number of multicast groups an interface can join at the same time. (Range: 1-4095)

Default Setting

4095

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- IGMP throttling sets a maximum number of multicast groups that a port can join at the same time. When the maximum number of groups is reached on a port, the switch can take one of two actions; either "deny" or "replace" (see the ip igmp max-groups action command). If the action is set to deny, any new IGMP join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.

- IGMP throttling can also be set on a trunk interface. When ports are configured as trunk members, the trunk uses the throttling settings of the first port member in the trunk.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip igmp max-groups 10
Console(config-if)#
```

ip igmp max-groups action

This command sets the IGMP throttling action for an interface on the switch.

Syntax

ip igmp max-groups action {deny | replace}

deny - The new multicast group join report is dropped.

replace - The new multicast group replaces an existing group.

Default Setting

Deny

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

When the maximum number of groups is reached on a port, the switch can take one of two actions; either "deny" or "replace." If the action is set to deny, any new IGMP join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip igmp max-groups action replace
Console(config-if)#
```

ip igmp query-drop

This command drops any received IGMP query packets. Use the no form to restore the default setting.

Syntax

[no] ip igmp query-drop

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This command can be used to drop any query packets received on the specified interface. If this switch is acting as a Querier, this prevents it from being affected by messages received from another Querier.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip igmp query-drop
Console(config-if)#
```

ip multicast-data-drop

This command drops all multicast data packets. Use the **no** form to disable this feature.

Syntax

[no] ip multicast-data-drop

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This command can be used to stop multicast services from being forwarded to users attached to the downstream port (i.e., the interfaces specified by this command).

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ip multicast-data-drop
Console(config-if)#
```

show ip igmp authentication

This command displays the interface settings for IGMP authentication.

Syntax

show ip igmp authentication interface [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Using this command without specifying an interface displays information for all interfaces.

Example

```
Console#show ip igmp authentication
Ethernet 1/1: Enabled
Ethernet 1/2: Enabled
Ethernet 1/3: Enabled
:
Ethernet 1/27: Enabled
Ethernet 1/28: Enabled
Other ports/port channels are Disable
Console#
```

show ip igmp filter

This command displays the global and interface settings for IGMP filtering.

Syntax

show ip igmp filter [**interface** *interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting

None

Command Mode
Privileged Exec

Example

```
Console#show ip igmp filter
IGMP Filter enabled
Console#show ip igmp filter interface ethernet 1/1
Ethernet 1/1 information
--------------------------------
 IGMP Profile 19
  Deny
  Range 239.1.1.1 239.1.1.1
  Range 239.2.3.1 239.2.3.100
Console#
```

show ip igmp profile

This command displays IGMP filtering profiles created on the switch.

Syntax

show ip igmp profile [*profile-number*]

profile-number - An existing IGMP filter profile number. (Range: 1-4294967295)

Default Setting
None

Command Mode
Privileged Exec

Example

```
Console#show ip igmp profile
IGMP Profile 19
IGMP Profile 50
Console#show ip igmp profile 19
IGMP Profile 19
  Deny
  Range 239.1.1.1 239.1.1.1
  Range 239.2.3.1 239.2.3.100
Console#
```

show ip igmp query-drop

This command shows if the specified interface is configured to drop IGMP query packets.

Syntax

show ip igmp throttle interface [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Using this command without specifying an interface displays all interfaces.

Example

```
Console#show ip igmp query-drop interface ethernet 1/1
Ethernet 1/1: Enabled
Console#
```

show ip igmp throttle interface

This command displays the interface settings for IGMP throttling.

Syntax

show ip igmp throttle interface [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting

None

Command Mode

Privileged Exec

Command Usage
Using this command without specifying an interface displays information for all interfaces.

Example

```
Console#show ip igmp throttle interface ethernet 1/1
Eth  1/1 Information
                   Status : FALSE
                   Action : Deny
     Max Multicast Groups : 1024
 Current Multicast Groups : 0

Console#
```

show ip multicast-data-drop

This command shows if the specified interface is configured to drop multicast data packets.

Syntax

show ip igmp throttle interface [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
None

Command Mode
Privileged Exec

Command Usage
Using this command without specifying an interface displays all interfaces.

Example

```
Console#show ip multicast-data-drop interface ethernet 1/1
Ethernet 1/1: Enabled
Console#
```

MLD Snooping

Multicast Listener Discovery (MLD) snooping operates on IPv6 traffic and performs a similar function to IGMP snooping for IPv4. That is, MLD snooping dynamically configures switch ports to limit IPv6 multicast traffic so that it is forwarded only to ports with users that want to receive it. This reduces the flooding of IPv6 multicast packets in the specified VLANs.

There are two versions of the MLD protocol, version 1 and version 2. MLDv1 control packets include Listener Query, Listener Report, and Listener Done messages (equivalent to IGMPv2 query, report, and leave messages). MLDv2 control packets include MLDv2 query and report messages, as well as MLDv1 report and done messages.

Remember that IGMP Snooping and MLD Snooping are independent functions, and can therefore both function at the same time.

Table 109: MLD Snooping Commands

Command	Function	Mode
ipv6 mld snooping	Enables MLD Snooping globally	GC
ipv6 mld snooping proxy-reporting	Enables MLD Snooping with Proxy Reporting	GC
ipv6 mld snooping querier	Allows the switch to act as the querier for MLD snooping	GC
ipv6 mld snooping query-interval	Configures the interval between sending MLD general query messages	GC
ipv6 mld snooping query-max-response-time	Configures the maximum response time for a general queries	GC
ipv6 mld snooping robustness	Configures the robustness variable	GC
ipv6 mld snooping router-port-expire-time	Configures the router port expire time	GC
ipv6 mld snooping unknown-multicast mode	Sets an action for unknown multicast packets	GC
ipv6 mld snooping unsolicited-report-interval	Specifies how often the upstream interface should transmit unsolicited MLD snooping reports (when proxy reporting is enabled)	GC
ipv6 mld snooping version	Configures the MLD Snooping version	GC
ipv6 mld snooping vlan immediate-leave	Removes a member port of an IPv6 multicast service if a leave packet is received at that port and MLD immediate-leave is enabled for the parent VLAN	GC
ipv6 mld snooping vlan mrouter	Adds an IPv6 multicast router port	GC
ipv6 mld snooping vlan static	Adds an interface as a member of a multicast group	GC
clear ipv6 mld snooping groups dynamic	Clears multicast group information dynamically learned through MLD snooping	PE

Table 109: MLD Snooping Commands (Continued)

Command	Function	Mode
clear ipv6 mld snooping statistics	Clears MLD snooping statistics	PE
show ipv6 mld snooping	Displays MLD Snooping configuration	PE
show ipv6 mld snooping group	Displays the learned groups	PE
show ipv6 mld snooping group source-list	Displays the learned groups and corresponding source list	PE
show ipv6 mld snooping mrouter	Displays the information of multicast router ports	PE
show ipv6 mld snooping statistics	Shows IGMP snooping protocol statistics for the specified interface	PE

ipv6 mld snooping

This command enables MLD Snooping globally on the switch. Use the **no** form to disable MLD Snooping.

Syntax

[no] ipv6 mld snooping

Default Setting

Disabled

Command Mode

Global Configuration

Example

The following example enables MLD Snooping:

```
Console(config)#ipv6 mld snooping
Console(config)#
```

ipv6 mld snooping proxy-reporting

This command enables MLD Snooping with Proxy Reporting. Use the **no** form to restore the default setting.

Syntax

[no] ipv6 mld snooping proxy-reporting

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- When proxy reporting is enabled with this command, reports received from downstream hosts are summarized and used to build internal membership states. Proxy-reporting devices may use the all-zeros IP source address when forwarding any summarized reports upstream. For this reason, IGMP membership reports received by the snooping switch must not be rejected because the source IP address is set to 0.0.0.0.

Example

```
Console(config)#ipv6 mld snooping proxy-reporting
Console(config)#
```

ipv6 mld snooping querier

This command allows the switch to act as the querier for MLDv2 snooping. Use the no form to disable this feature.

Syntax

[no] ipv6 mld snooping querier

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- If enabled, the switch will serve as querier if elected. The querier is responsible for asking hosts if they want to receive multicast traffic.

- An IPv6 address must be configured on the VLAN interface from which the querier will act if elected. When serving as the querier, the switch uses its own IPv6 address as the query source address.

- The querier will not start or will disable itself after having started if it detects an IPv6 multicast router on the network.

Example

```
Console(config)#ipv6 mld snooping querier
Console(config)#
```

ipv6 mld snooping query-interval

This command configures the interval between sending MLD general queries. Use the no form to restore the default.

Syntax

ipv6 mld snooping query-interval *interval*

no ipv6 mld snooping query-interval

interval - The interval between sending MLD general queries. (Range: 60-125 seconds)

Default Setting

125 seconds

Command Mode

Global Configuration

Command Usage

- This command applies when the switch is serving as the querier.
- An MLD general query message is sent by the switch at the interval specified by this command. When this message is received by downstream hosts, all receivers build an MLD report for the multicast groups they have joined.

Example

```
Console(config)#ipv6 mld snooping query-interval 150
Console(config)#
```

ipv6 mld snooping query-max-response-time

This command configures the maximum response time advertised in MLD general queries. Use the no form to restore the default.

Syntax

ipv6 mld snooping query-max-response-time *seconds*

no ipv6 mld snooping query-max-response-time

seconds - The maximum response time allowed for MLD general queries. (Range: 5-25 seconds)

Default Setting

10 seconds

Command Mode

Global Configuration

Command Usage
This command controls how long the host has to respond to an MLD Query message before the switch deletes the group if it is the last member.

Example
```
Console(config)#ipv6 mld snooping query-max-response-time seconds 15
Console(config)#
```

ipv6 mld snooping robustness
This command configures the MLD Snooping robustness variable. Use the **no** form to restore the default value.

Syntax
ipv6 mld snooping robustness *value*

no ipv6 mld snooping robustness

value - The number of the robustness variable. (Range: 2-10)

Default Setting
2

Command Mode
Global Configuration

Command Usage
A port will be removed from the receiver list for a multicast service when no MLD reports are detected in response to a number of MLD queries. The robustness variable sets the number of queries on ports for which there is no report.

Example
```
Console(config)#ipv6 mld snooping robustness 2
Console(config)#
```

ipv6 mld snooping router-port-expire-time
This command configures the MLD query timeout. Use the **no** form to restore the default.

Syntax
ipv6 mld snooping router-port-expire-time *time*

no ipv6 mld snooping router-port-expire-time

time - Specifies the timeout of a dynamically learned router port. (Range: 300-500 seconds)

Default Setting
300 seconds

Command Mode
Global Configuration

Command Usage
The router port expire time is the time the switch waits after the previous querier stops before it considers the router port (i.e., the interface that had been receiving query packets) to have expired.

Example

```
Console(config)#ipv6 mld snooping router-port-expire-time 300
Console(config)#
```

ipv6 mld snooping unknown-multicast mode

This command sets the action for dealing with unknown multicast packets. Use the **no** form to restore the default.

Syntax

ipv6 mld snooping unknown-multicast mode {**flood** | **to-router-port**}

no ipv6 mld snooping unknown-multicast mode

flood - Floods the unknown multicast data packets to all ports.

to-router-port - Forwards the unknown multicast data packets to router ports.

Default Setting
to-router-port

Command Mode
Global Configuration

Command Usage
- When set to "flood," any received IPv6 multicast packets that have not been requested by a host are flooded to all ports in the VLAN.
- When set to "router-port," any received IPv6 multicast packets that have not been requested by a host are forwarded to ports that are connected to a detected multicast router.

Example

```
Console(config)#ipv6 mld snooping unknown-multicast mode flood
Console(config)#
```

ipv6 mld snooping unsolicited-report-interval

This command specifies how often the upstream interface should transmit unsolicited MLD snooping reports when proxy reporting is enabled. Use the **no** form to restore the default value.

Syntax

ipv6 mld snooping unsolicited-report-interval *seconds*

no ipv6 mld snooping unsolicited-report-interval

seconds - The interval at which to issue unsolicited reports. (Range: 1-65535 seconds)

Default Setting

400 seconds

Command Mode

Global Configuration

Command Usage

- When a new upstream interface (that is, uplink port) starts up, the switch sends unsolicited reports for all currently learned multicast channels out through the new upstream interface.
- This command only applies when proxy reporting is enabled (see page 660).

Example

```
Console(config)#ipv6 mld snooping unsolicited-report-interval 5
Console(config)#
```

ipv6 mld snooping version

This command configures the MLD snooping version. Use the **no** form to restore the default.

Syntax

ipv6 mld snooping version {**1** | **2**}

1 - MLD version 1.

2 - MLD version 2.

Default Setting

Version 1

Command Mode

Global Configuration

Example

```
Console(config)#ipv6 mld snooping version 1
Console(config)#
```

ipv6 mld snooping vlan immediate-leave

This command immediately deletes a member port of an IPv6 multicast service when a leave packet is received at that port and immediate-leave is enabled for the parent VLAN. Use the **no** form to restore the default.

Syntax

ipv6 mld snooping vlan *vlan-id* **immediate-leave** [**by-host-ip**]

vlan-id - A VLAN identification number. (Range: 1-4094)

by-host-ip - Specifies that the member port will be deleted only when there are no hosts joining this group.

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- If MLD immediate-leave is *not* used, a multicast router (or querier) will send a group-specific query message when an MLD group leave message is received. The router/querier stops forwarding traffic for that group only if no host replies to the query within the specified timeout period.
- If MLD immediate-leave is enabled, the switch assumes that only one host is connected to the interface. Therefore, immediate leave should only be enabled on an interface if it is connected to only one MLD-enabled device, either a service host or a neighbor running MLD snooping.
- If the "by-host-ip" option is used, the router/querier will not send out a group-specific query when an MLD leave message is received, but will check if there are other hosts joining the multicast group. Only when all hosts on that port leave the group will the member port be deleted.

Example

The following shows how to enable MLD immediate leave.

```
Console(config)#ipv6 mld snooping immediate-leave
Console(config}#
```

ipv6 mld snooping vlan mrouter

This command statically configures an IPv6 multicast router port. Use the **no** form to remove the configuration.

Syntax

[no] **ipv6 mld snooping vlan** *vlan-id* **mrouter** *interface*

vlan-id - VLAN ID (Range: 1-4094)

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting

No static multicast router ports are configured.

Command Mode

Global Configuration

Command Usage

Depending on your network connections, MLD snooping may not always be able to locate the MLD querier. Therefore, if the MLD querier is a known multicast router/switch connected over the network to an interface (port or trunk) on the switch, you can manually configure that interface to join all the current multicast groups.

Example

The following shows how to configure port 1 as a multicast router port within VLAN 1:

```
Console(config)#ipv6 mld snooping vlan 1 mrouter ethernet 1/1
Console(config)#
```

ipv6 mld snooping vlan static

This command adds a port to an IPv6 multicast group. Use the **no** form to remove the port.

Syntax

[no] **ipv6 mld snooping vlan** *vlan-id* **static** *ipv6-address interface*

vlan - VLAN ID (Range: 1-4094)

ipv6-address - An IPv6 address of a multicast group. (Format: X:X:X:X::X)

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
None

Command Mode
Global Configuration

Example

```
Console(config)#ipv6 mld snooping vlan 1 static ff00:0:0:0:0:0:0:10c ethernet
  1/6
Console(config)#
```

clear ipv6 mld snooping groups dynamic

This command clears multicast group information dynamically learned through MLD snooping.

Syntax

clear ipv6 mld snooping groups dynamic

Command Mode
Privileged Exec

Command Usage
This command only clears entries learned though MLD snooping. Statically configured multicast address are not cleared.

Example

```
Console#clear ipv6 mld snooping groups dynamic
Console#
```

clear ipv6 mld snooping statistics

This command clears MLD snooping statistics.

Syntax

clear ipv6 mld snooping statistics [**interface** *interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* - VLAN identifier (Range: 1-4094)

Command Mode
Privileged Exec

Example

```
Console#clear ipv6 mld snooping statistics
Console#
```

show ipv6 mld snooping

This command shows the current MLD Snooping configuration.

Syntax

show ipv6 mld snooping [**vlan** [*vlan-id*]]

vlan-id - VLAN ID (1-4094)

Command Mode
Privileged Exec

Command Usage
This command displays global and VLAN-specific MLD snooping configuration settings.

Example
The following shows MLD Snooping configuration information

```
Console#show ipv6 mld snooping
 Service Status              : Disabled
 Proxy Reporting             : Disabled
 Querier Status              : Disabled
 Robustness                  : 2
 Query Interval              : 125 sec
 Query Max Response Time     : 10 sec
 Router Port Expiry Time     : 300 sec
 Unsolicit Report Interval   : 400 sec
 Immediate Leave             : Disabled on all VLAN
 Immediate Leave By Host     : Disabled on all VLAN
 Unknown Flood Behavior      : To Router Port
 MLD Snooping Version        : Version 2

VLAN Group IPv6 Address                     Port
---- ---------------------------------------- ---------
   1                    ff05:0:1:2:3:4:5:6 Eth 1/1

Console#show ipv6 mld snooping vlan
VLAN 1
 Immediate Leave        : Disabled
```

```
 Unknown Flood Behavior : To Router Port
Console#
```

show ipv6 mld snooping group

This command shows known multicast groups, member ports, and the means by which each group was learned.

Syntax

show ipv6 mld snooping group

Command Mode

Privileged Exec

Example

The following shows MLD Snooping group configuration information:

```
Console#show ipv6 mld snooping group

Total Entries 3, limit 255

VLAN Multicast IPv6 Address                  Member Port Type
---- --------------------------------------- ----------- ---------------
   1 FF02::01:01:01:01                       Eth 1/1     MLD Snooping
   1 FF02::01:01:01:02                       Eth 1/1     Multicast Data
   1 FF02::01:01:01:02                       Eth 1/1     User

Console#
```

show ipv6 mld snooping group source-list

This command shows known multicast groups, member ports, the means by which each group was learned, and the corresponding source list.

Syntax

show ipv6 mld snooping group source-list [*ipv6-address* | vlan *vlan-id*]

ipv6-address - An IPv6 address of a multicast group. (Format: X:X:X:X::X)

vlan-id - VLAN ID (1-4094)

Command Mode

Privileged Exec

Example

The following shows MLD Snooping group mapping information:

```
Console#show ipv6 mld snooping group source-list

VLAN ID                    : 1
Mutlicast IPv6 Address     : FF02::01:01:01:01
Member Port                : Eth 1/1
```

```
MLD Snooping                : Multicast Data
Filter Mode                 : Include
(if exclude filter mode)
Filter Timer Elapse         : 10 sec.
Request List                : ::01:02:03:04, ::01:02:03:05, ::01:02:03:06,
                              ::01:02:03:07
Exclude List                : ::02:02:03:04, ::02:02:03:05, ::02:02:03:06,
                              ::02:02:03:07
(if include filter mode)
Include List                : ::02:02:03:04, ::02:02:03:05, ::02:02:03:06,
                              ::02:02:03:06

Option:
 Filter Mode: Include, Exclude

Console#
```

show ipv6 mld snooping mrouter

This command shows MLD Snooping multicast router information.

Syntax

show ipv6 mld snooping mrouter vlan *vlan-id*

vlan-id - A VLAN identification number. (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#show ipv6 mld snooping mrouter vlan 1
 VLAN Multicast Router Port Type      Expire
 ---- --------------------- --------- ------
    1 Eth 1/ 2              Static

Console#
```

show ipv6 mld snooping statistics

This command shows MLD snooping protocol statistics for the specified interface.

Syntax

show ipv6 mld snooping statistics
{**input** [**interface** *interface*] |
output [**interface** *interface*] |
query [**vlan** *vlan-id*] |
summary interface *interface*}

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* - VLAN ID (Range: 1-4094)

query - Displays MLD snooping query-related statistics.

Default Setting

None

Command Mode

Privileged Exec

Example

The following shows MLD snooping input-related message statistics:

```
Console#show ipv6 mld snooping statistics input interface ethernet 1/1
 Input Statistics:
 Interface Report   Leave    G Query  G(-S)-S Query Drop     Join Succ Group
 --------- -------- -------- -------- ------------- -------- --------- ------
 Eth 1/ 1         4        0        0             0        0         0      2
Console#
```

The following shows MLD snooping output-related message statistics:

```
Console#show ipv6 mld snooping statistics output interface ethernet 1/1
 Output Statistics:
 Interface Report   Leave    G Query  G(-S)-S Query Drop     Group
 --------- -------- -------- -------- ------------- -------- ------
 Eth 1/ 1         0        0        5             0        0      2

Console#
```

The following shows MLD snooping query-related message statistics:

```
Console#show ipv6 mld snooping statistics query vlan 1
 Other Querier Address     : None
 Other Querier Expire      : 0(m):0(s)
 Other Querier Uptime      : 0(h):0(m):0(s)
 Self Querier Address      : ::
 Self Querier Expire Time  : 1(m):49(s)
 Self Querier UpTime       : 0(h):9(m):6(s)
 General Query Received    : 0
 General Query Sent        : 6
 Specific Query Received   : 0
 Specific Query Sent       : 0
Console#
```

The following shows MLD snooping summary statistics:

```
Console#show ipv6 mld snooping statistics summary interface e 1/1
Number of Groups:  1
 Querier:         :                      Report & Leave:    :
  Transmit        :                       Transmit          :
   General        : 6                      Report           : 0
   Group Specific: 0                       Leave            : 0
  Recieved        :                       Recieved          :
   General        : 0                      Report           : 4
   Group Specific: 0                       Leave            : 0
                                           join Success     : 0
                                           Filter Drop      : 0
                                           Source Port Drop: 0
                                           Others Drop      : 0
Console#show ipv6 mld snooping statistics summary interface vlan 1
Number of Groups:  1
 Querier:         :                      Report & Leave:    :
  Other Querier   : None
                                           Host Addr         : None
  Other Uptime    : 0(h):0(m):0(s)         Unsolicit Expire : 0 sec
  Other Expire    : 0(m):0(s)
  Self Addr       : None
  Self Expire     :  2(m): 3(s)
  Self Uptime     : 0(h):10(m):58(s)
  Transmit        :                       Transmit          :
   General        : 7                      Report           : 0
   Group Specific: 0                       Leave            : 0
  Recieved        :                       Recieved          :
   General        : 0                      Report           : 4
   Group Specific: 0                       Leave            : 0
                                           join Success     : 0
                                           Filter Drop      : 0
                                           Source Port Drop: 0
                                           Others Drop      : 0
Console#
```

MLD Filtering and Throttling

In certain switch applications, the administrator may want to control the multicast services that are available to end users. For example, an IP/TV service based on a specific subscription plan. The MLD filtering feature fulfills this requirement by restricting access to specified multicast services on a switch port, and MLD throttling limits the number of simultaneous multicast groups a port can join.

Table 110: MLD Filtering and Throttling Commands

Command	Function	Mode
ipv6 mld filter	Enables MLD filtering and throttling on the switch	GC
ipv6 mld profile	Sets a profile number and enters MLD filter profile configuration mode	GC
permit, deny	Sets a profile access mode to permit or deny	IPC
range	Specifies one or a range of multicast addresses for a profile	IPC
ipv6 mld filter	Assigns an MLD filter profile to an interface	IC

Table 110: MLD Filtering and Throttling Commands (Continued)

Command	Function	Mode
ipv6 mld max-groups	Specifies an M:D throttling number for an interface	IC
ipv6 mld max-groups action	Sets the MLD throttling action for an interface	IC
ipv6 mld query-drop	Drops any received MLD query packets	IC
ipv6 multicast-data-drop	Enable multicast data guard mode on a port interface	IC
show ipv6 mld filter	Displays the MLD filtering status	PE
show ipv6 mld profile	Displays MLD profiles and settings	PE
show ipv6 mld query-drop	Shows if the interface is configured to drop MLD query packets	PE
show ipv6 mld throttle interface	Displays the MLD throttling setting for interfaces	PE

ipv6 mld filter (Global Configuration)

This command globally enables MLD filtering and throttling on the switch. Use the **no** form to disable the feature.

Syntax

[no] ipv6 mld filter

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- MLD filtering enables you to assign a profile to a switch port that specifies multicast groups that are permitted or denied on the port. An MLD filter profile can contain one or more, or a range of multicast addresses; but only one profile can be assigned to a port. When enabled, MLD join reports received on the port are checked against the filter profile. If a requested multicast group is permitted, the MLD join report is forwarded as normal. If a requested multicast group is denied, the MLD join report is dropped.
- MLD filtering and throttling only applies to dynamically learned multicast groups, it does not apply to statically configured groups.
- The MLD filtering feature operates in the same manner when MVR6 is used to forward multicast traffic.

Example

```
Console(config)#ipv6 mld filter
Console(config)#
```

ipv6 mld profile

This command creates an MLD filter profile number and enters MLD profile configuration mode. Use the **no** form to delete a profile number.

Syntax

[no] **ipv6 mld profile** *profile-number*

profile-number - An MLD filter profile number. (Range: 1-4294967295)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

A profile defines the multicast groups that a subscriber is permitted or denied to join. The same profile can be applied to many interfaces, but only one profile can be assigned to one interface. Each profile has only one access mode; either permit or deny.

Example

```
Console(config)#ipv6 mld profile 19
Console(config-mld-profile)#
```

permit, deny

This command sets the access mode for an MLD filter profile. Use the **no** form to delete a profile number.

Syntax

{**permit** | **deny**}

Default Setting

deny

Command Mode

MLD Profile Configuration

Command Usage

- Each profile has only one access mode; either permit or deny.
- When the access mode is set to permit, MLD join reports are processed when a multicast group falls within the controlled range. When the access mode is set to deny, MLD join reports are only processed when a multicast group is not in the controlled range.

Example

```
Console(config)#ipv6 mld profile 19
Console(config-mld-profile)#permit
Console(config-mld-profile)#
```

range

This command specifies multicast group addresses for a profile. Use the **no** form to delete addresses from a profile.

Syntax

[**no**] **range** *low-ipv6-address* [*high-ipv6-address*]

low-ipv6-address - A valid IPv6 address (X:X:X:X::X) of a multicast group or start of a group range.

high-ipv6-address - A valid IPv6 address (X:X:X:X::X) for the end of a multicast group range.

Default Setting

None

Command Mode

MLD Profile Configuration

Command Usage

Enter this command multiple times to specify more than one multicast address or address range for a profile.

Example

```
Console(config-mld-profile)#range ff01::0101 ff01::0202
Console(config-mld-profile)#
```

ipv6 mld filter (Interface Configuration)

This command assigns an MLD filtering profile to an interface on the switch. Use the **no** form to remove a profile from an interface.

Syntax

[**no**] **ipv6 mld filter** *profile-number*

profile-number - An MLD filter profile number. (Range: 1-4294967295)

Default Setting

None

Command Mode

Interface Configuration

Command Usage

- The MLD filtering profile must first be created with the ipv6 mld profile command before being able to assign it to an interface.
- Only one profile can be assigned to an interface.
- A profile can also be assigned to a trunk interface. When ports are configured as trunk members, the trunk uses the filtering profile assigned to the first port member in the trunk.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 mld filter 19
Console(config-if)#
```

ipv6 mld max-groups

This command configures the maximum number of MLD groups that an interface can join. Use the **no** form to restore the default setting.

Syntax

ipv6 mld max-groups *number*

no ipv6 mld max-groups

number - The maximum number of multicast groups an interface can join at the same time. (Range: 1-255)

Default Setting

255

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- MLD throttling sets a maximum number of multicast groups that a port can join at the same time. When the maximum number of groups is reached on a port, the switch can take one of two actions; either “deny” or “replace.” If the action is set to deny, any new MLD join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.
- MLD throttling can also be set on a trunk interface. When ports are configured as trunk members, the trunk uses the throttling settings of the first port member in the trunk.
- If the maximum number of MLD groups is set to the default value, the running status of MLD throttling will change to false. This means that any configuration for MLD throttling will have no effect until the maximum number of MLD groups is configured to another value.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 mld max-groups 10
Console(config-if)#
```

ipv6 mld max-groups action

This command sets the MLD throttling action for an interface on the switch.

Syntax

ipv6 mld max-groups action {deny | replace}

deny - The new multicast group join report is dropped.

replace - The new multicast group replaces an existing group.

Default Setting

Deny

Command Mode

Interface Configuration (Ethernet)

Command Usage

When the maximum number of groups is reached on a port, the switch can take one of two actions; either "deny" or "replace." If the action is set to deny, any new MLD join reports will be dropped. If the action is set to replace, the switch randomly removes an existing group and replaces it with the new multicast group.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 mld max-groups action replace
Console(config-if)#
```

ipv6 mld query-drop

This command drops any received MLD query packets. Use the no form to restore the default setting.

Syntax

[no] ipv6 mld query-drop

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage
This command can be used to drop any query packets received on the specified interface. If this switch is acting as a Querier, this prevents it from being affected by messages received from another Querier.

Example
```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 mld query-drop
Console(config-if)#
```

ipv6 multicast-data-drop
Use this command to enable multicast data drop mode on a port interface. Use the no form of the command to disable multicast data drop.

Syntax
[no] ipv6 multicast-data-drop

Default Setting
Disabled

Command Mode
Interface Configuration

Example
```
Console(config)#interface ethernet 1/3
Console(config-if)#ipv6 multicast-data-drop
Console(config-if)#
```

show ipv6 mld filter
This command displays the global and interface settings for MLD filtering.

Syntax
show ipv6 mld filter [interface *interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
None

Command Mode
Privileged Exec

Example

```
Console#show ipv6 mld filter
 MLD filter Enabled
Console#show ipv6 mld filter interface ethernet 1/3
Ethernet 1/3 information
--------------------------------
 MLD  Profile 19
 Deny
 Range  ff01::101         ff01::faa
Console#
```

show ipv6 mld profile

This command displays MLD filtering profiles created on the switch.

Syntax

show ipv6 mld profile [*profile-number*]

profile-number - An existing MLD filter profile number. (Range: 1-4294967295)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show ipv6 mld profile
 MLD Profile 19
 MLD Profile 50
Console#show ipv6 mld profile 5
 MLD  Profile 19
 Deny
 Range  ff01::101         ff01::faa
Console#
```

show ipv6 mld query-drop

This command shows if the specified interface is configured to drop MLD query packets.

Syntax

show ipv6 mld query-drop interface [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
None

Command Mode
Privileged Exec

Command Usage
Using this command without specifying an interface displays all interfaces.

Example

```
Console#show ipv6 mld query-drop interface ethernet 1/1
Ethernet 1/1: Enabled
Console#
```

show ipv6 mld throttle interface

This command displays the interface settings for MLD throttling.

Syntax

show ipv6 mld throttle interface [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
None

Command Mode
Privileged Exec

Command Usage
Using this command without specifying an interface displays information for all interfaces.

Example

```
Console#show ipv6 mld throttle interface ethernet 1/3
Eth  1/3 Information
 Status                   : TRUE
 Action                   : Replace
 Max Multicast Groups     : 10
 Current Multicast Groups : 0

Console#
```

IGMP (Layer 3)

This section describes commands used to configure Layer 3 Internet Group Management Protocol (IGMP) on the switch.

Table 111: IGMP Commands (Layer 3)

Command	Function	Mode
ip igmp	Enables IGMP for the specified interface	IC
ip igmp last-member-query-interval	Configures the frequency at which to send query messages in response to receiving a leave message	IC
ip igmp max-resp-interval	Configures the maximum host response time	IC
ip igmp query-interval	Configures frequency for sending host query messages	IC
ip igmp static-group	Configures the router to be a static member of a multicast group on the specified VLAN interface	IC
ip igmp version	Configures IGMP version used on this interface	IC
clear ip igmp group	Deletes entries from the IGMP cache	PE
show ip igmp groups	Displays information for IGMP groups	PE
show ip igmp interface	Displays multicast information for the specified interface	PE

ip igmp

This command enables IGMP on a VLAN interface. Use the **no** form of this command to disable IGMP on the specified interface.

Syntax

[no] ip igmp

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- IGMP (including query functions) can be enabled for specific VLAN interfaces at Layer 3 through the **ip igmp** command.
- When a multicast routing protocol, such as PIM, is enabled, IGMP is also enabled.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip igmp
Console(config-if)#end
Console#show ip igmp interface
```

```
  IGMP                              : Enabled
  IGMP Version                      : 2
  IGMP Proxy                        : Disabled
  IGMP Unsolicited Report Interval  : 400 sec
  Robustness Variable               : 2
  Query Interval                    : 125 sec
  Query Max Response Time           : 100 (resolution in 0.1 sec)
  Last Member Query Interval        : 10  (resolution in 0.1 sec)
  Querier                           : 0.0.0.0
  Joined Groups :
  Static Groups :

Console#
```

ip igmp last-member-query-interval

This command configures the frequency at which to send IGMP group-specific or IGMPv3 group-source-specific query messages in response to receiving a group-specific or group-source-specific leave message. Use the **no** form to restore the default setting.

Syntax

ip igmp last-member-query-interval *seconds*

no ip igmp last-member-query-interval

seconds - The frequency at which the switch sends group-specific or group-source-specific queries upon receipt of a leave message. (Range: 1-255 tenths of a second)

Default Setting

10 (1 second)

Command Mode

Interface Configuration (VLAN)

Command Usage

When the switch receives an IGMPv2 or IGMPv3 leave message from a host that wants to leave a multicast group, source or channel, it sends a number of group-specific or group-source-specific query messages at intervals defined by this command. If no response is received after this period, the switch stops forwarding for the group, source or channel.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip igmp last-member-query-interval 20
Console(config-if)#
```

ip igmp max-resp-interval

This command configures the maximum response time advertised in IGMP queries. Use the **no** form of this command to restore the default.

Syntax

ip igmp max-resp-interval *seconds*

no ip igmp max-resp-interval

seconds - The report delay advertised in IGMP queries. (Range: 1-255 tenths of a second)

Default Setting

100 (10 seconds)

Command Mode

Interface Configuration (VLAN)

Command Usage

- By varying the Maximum Response Interval, the burstiness of IGMP messages passed on the subnet can be tuned; where larger values make the traffic less bursty, as host responses are spread out over a larger interval.
- The number of seconds represented by the maximum response interval must be less than the Query Interval (page 684).

Example

The following shows how to configure the maximum response time to 20 seconds.

```
Console(config-if)#ip igmp max-resp-interval 200
Console(config-if)#
```

ip igmp query-interval

This command configures the frequency at which host query messages are sent. Use the **no** form to restore the default.

Syntax

ip igmp query-interval *seconds*

no ip igmp query-interval

seconds - The frequency at which the switch sends IGMP host-query messages. (Range: 1-255 seconds)

Default Setting

125 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

- Multicast routers send host query messages to determine the interfaces that are connected to downstream hosts requesting a specific multicast service. Only the designated multicast router for a subnet sends host query messages, which are addressed to the multicast address 224.0.0.1, and uses a time-to-live (TTL) value of 1.

- For IGMP Version 2 and 3, the designated querier is the lowest IP-addressed multicast router on the subnet.

Example

The following shows how to configure the query interval to 100 seconds.

```
Console(config-if)#ip igmp query-interval 100
Console(config-if)#
```

ip igmp static-group

This command configures the router to be a static member of a multicast group on the specified VLAN interface. Use the **no** form to remove the static mapping.

Syntax

ip igmp static-group *group-address* [**source** *source-address*]

no ip igmp static-group

group-address - IP multicast group address. (The group addresses specified cannot be in the range of 224.0.0.1 - 239.255.255.255.)

source-address - Source address for a multicast server transmitting traffic to the corresponding multicast group address.

Default Setting

None

Command Mode

Interface Configuration (VLAN)

Command Usage

- Group addresses within the entire multicast group address range can be specified with this command. However, if any address within the source-specific multicast (SSM) address range (default 232/8) is specified, but no source address is included in the command, the request to join the multicast group will fail unless the next node up the reverse path tree has statically mapped this group to a specific source address. Also, if an address outside of the SSM address range is specified, and a specific source address is included in the command, the request to join the multicast group will also fail if the next node up the reverse path tree has enabled the PIM-SSM protocol.

- If a static group is configured for an any-source multicast (*,G), a source address cannot subsequently be defined for this group without first deleting the entry.
- If a static group is configured for one or more source-specific multicasts (S,G), an any-source multicast (*,G) cannot subsequently be defined for this group without first deleting all of the associated (S,G) entries.
- Using the no form of this command to delete a static group without specifying the source address will delete all any-source and source-specific multicast entries for the specified group.
- The switch supports a maximum of 16 static group entries.

Example

The following example assigns VLAN 1 as a static member of the specified multicast group.

```
Console(config)#interface vlan1
Console(config-if)#ip igmp static-group 225.1.1.1
```

ip igmp version

This command configures the IGMP version used on an interface. Use the no form of this command to restore the default.

Syntax

ip igmp version {2 | 3}

no ip igmp version

2 - IGMP Version 2

3 - IGMP Version 3

Default Setting

IGMP Version 3

Command Mode

Interface Configuration (VLAN)

Command Usage

- All routers on the subnet must support the same version. However, the multicast hosts on the subnet may support any of the IGMP versions 2 - 3.
- The switch must be set to version 3 to enable support for source-specific multicasting (SSM).

Example

```
Console(config-if)#ip igmp version 3
Console(config-if)#
```

clear ip igmp group

This command deletes entries from the IGMP cache.

Syntax

clear ip igmp group

Default Setting

Deletes all entries in the cache.

Command Mode

Privileged Exec

Example

```
Console#clear ip igmp group
Console#
```

show ip igmp groups

This command displays information on multicast groups active on the switch and learned through IGMP.

Syntax

show ip igmp groups [{*group-address* | *interface*} [**detail**] | **detail**]

group-address - IP multicast group address.

interface

vlan *vlan-id* - VLAN ID. (Range: 1-4094)

detail - Displays detailed information about the multicast process and source addresses when available.

Command Mode

Privileged Exec

Command Usage

To display information about multicast groups, IGMP must first be enabled on the interface to which a group has been assigned using the ip igmp command, and multicast routing must be enabled globally on the system using the ip multicast-routing command.

Example

The following shows options for displaying IGMP group information by interface, group address, and static listing.

```
Console#show ip igmp groups
Group Address   Interface VLAN  Last Reporter   Uptime   Expire   V1 Timer
--------------- --------------- --------------- -------- -------- --------
    224.0.17.17               1    192.168.1.10    0:0:1   0:4:19    0:0:0
Console#show ip igmp groups 234.5.6.8
Group Address   Interface VLAN  Last Reporter   Uptime   Expire   V1 Timer
--------------- --------------- --------------- -------- -------- --------
    224.0.17.17               1    192.168.1.10    0:0:1   0:4:19    0:0:0
Console#show ip igmp groups interface vlan 1
Group Address   Interface VLAN  Last Reporter   Uptime   Expire   V1 Timer
--------------- --------------- --------------- -------- -------- --------
    224.0.17.17               1    192.168.1.10    0:0:1   0:4:19    0:0:0
Console#
```

The following shows the information displayed in a detailed listing for a dynamically learned multicast group.

```
Console#show ip igmp groups detail
Interface        : VLAN 1
Group            : 224.1.2.3
Uptime           : 0h:0m:12s
Group mode       : Include
Last reporter    : 0.0.0.0
Group Source List:
Source Address  Uptime      v3 Exp      Fwd
--------------- ----------- ----------- ---
      192.1.2.3   0h:0m:12s    0h:0m:0s Yes
Console#
```

show ip igmp interface

This command shows multicast information for the specified interface.

Syntax

show ip igmp interface [*interface*]

interface

vlan *vlan-id* - VLAN ID. (Range: 1-4094)

Command Mode

Privileged Exec

Example

The following example shows the IGMP configuration for VLAN 1, as well as the device currently serving as the IGMP querier for active multicast services on this interface.

```
switch#show ip igmp interface vlan 1
Vlan 1 : up
  IGMP                            : Disabled
  IGMP Version                    : 3
  IGMP Unsolicited-report-interval : 400 sec
  Robustness variable             : 2
```

```
  Query Interval                  : 125 sec
  Query Max Response Time         : 100 (resolution in 0.1 sec)
  Last Member Query Interval      : 10  (resolution in 0.1 sec)
  Querier                         : 0.0.0.0
  Joined Groups :
  Static Groups :
switch#
```

MVR for IPv4

This section describes commands used to configure Multicast VLAN Registration for IPv4 (MVR). A single network-wide VLAN can be used to transmit multicast traffic (such as television channels) across a service provider's network. Any multicast traffic entering an MVR VLAN is sent to all subscribers. This can significantly reduce to processing overhead required to dynamically monitor and establish the distribution tree for a normal multicast VLAN. Also note that MVR maintains the user isolation and data security provided by VLAN segregation by passing only multicast traffic into other VLANs to which the subscribers belong.

Table 112: Multicast VLAN Registration for IPv4 Commands

Command	Function	Mode
mvr	Globally enables MVR	GC
mvr associated-profile	Binds the MVR group addresses specified in a profile to an MVR domain	GC
mvr domain	Enables MVR for a specific domain	GC
mvr priority	Assigns a priority to all multicast traffic in the MVR VLAN	GC
mvr profile	Maps a range of MVR group addresses to a profile	GC
mvr proxy-query-interval	Configures the interval at which the receiver port sends out general queries.	GC
mvr proxy-switching	Enables MVR proxy switching, where the source port acts as a host, and the receiver port acts as an MVR router with querier service enabled	GC
mvr robustness-value	Configures the expected packet loss, and thereby the number of times to generate report and group-specific queries	GC
mvr source-port-mode dynamic	Configures the switch to only forward multicast streams which the source port has dynamically joined	GC
mvr upstream-source-ip	Configures the source IP address assigned to all control packets sent upstream	GC
mvr vlan	Specifies the VLAN through which MVR multicast data is received	GC
mvr immediate-leave	Enables immediate leave capability	IC
mvr type	Configures an interface as an MVR receiver or source port	IC
mvr vlan group	Statically binds a multicast group to a port	IC
clear mrv groups dynamic	Clears multicast group information dynamically learned through MVR	PE

Table 112: Multicast VLAN Registration for IPv4 Commands (Continued)

Command	Function	Mode
clear mrv statistics	Clears MRV statistics	PE
show mvr	Shows information about MVR domain settings, including MVR operational status, the multicast VLAN, the current number of group addresses, and the upstream source IP address	PE
show mvr associated-profile	Shows the profiles bound the specified domain	PE
show mvr interface	Shows MVR settings for interfaces attached to the MVR VLAN	PE
show mvr members	Shows information about the current number of entries in the forwarding database, or detailed information about a specific multicast address	PE
show mvr profile	Shows all configured MVR profiles	PE
show mvr statistics	Shows MVR protocol statistics for the specified interface	PE

mvr

This command enables Multicast VLAN Registration (MVR) globally on the switch. Use the **no** form of this command to globally disable MVR.

Syntax

[no] mvr

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

Only IGMP version 2 or 3 hosts can issue multicast join or leave messages. If MVR must be configured for an IGMP version 1 host, the multicast groups must be statically assigned using the mvr vlan group command.

Example

The following example enables MVR globally.

```
Console(config)#mvr
Console(config)#
```

mvr associated-profile

This command binds the MVR group addresses specified in a profile to an MVR domain. Use the **no** form of this command to remove the binding.

Syntax

[no] **mvr domain** *domain-id* **associated-profile** *profile-name*

domain-id - An independent multicast domain. (Range: 1-5)

profile-name - The name of a profile containing one or more MVR group addresses. (Range: 1-21 characters)

Default Setting

Disabled

Command Mode

Global Configuration

Example

The following an MVR group address profile to domain 1:

```
Console(config)#mvr domain 1 associated-profile rd
Console(config)#
```

mvr domain

This command enables Multicast VLAN Registration (MVR) for a specific domain. Use the **no** form of this command to disable MVR for a domain.

Syntax

[no] **mvr domain** *domain-id*

domain-id - An independent multicast domain. (Range: 1-5)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

Only IGMP version 2 or 3 hosts can issue multicast join or leave messages. If MVR must be configured for an IGMP version 1 host, the multicast groups must be statically assigned using the mvr vlan group command.

Example

The following example enables MVR for domain 1:

```
Console(config)#mvr domain 1
Console(config)#
```

mvr priority

This command assigns a priority to all multicast traffic in the MVR VLAN. Use the **no** form of this command to restore the default setting.

Syntax

mvr priority *priority*

no mvr priority

priority - The CoS priority assigned to all multicast traffic forwarded into the MVR VLAN. (Range: 0-7, where 7 is the highest priority)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

This command can be used to set a high priority for low-latency multicast traffic such as a video-conference, or to set a low priority for normal multicast traffic not sensitive to latency.

Example

```
Console(config)#mvr priority 6
Console(config)#
```

mvr profile

This command maps a range of MVR group addresses to a profile. Use the **no** form of this command to remove the profile.

Syntax

mvr profile *profile-name start-ip-address end-ip-address*

no mvr profile *profile-name*

profile-name - The name of a profile containing one or more MVR group addresses. (Range: 1-21 characters)

start-ip-address - Starting IPv4 address for an MVR multicast group. (Range: 224.0.1.0 - 239.255.255.255)

end-ip-address - Ending IPv4 address for an MVR multicast group. (Range: 224.0.1.0 - 239.255.255.255)

Default Setting
No profiles are defined

Command Mode
Global Configuration

Command Usage
- Use this command to statically configure all multicast group addresses that will join the MVR VLAN. Any multicast data associated an MVR group is sent from all source ports to all receiver ports that have registered to receive data from that multicast group.
- The IP address range from 224.0.0.0 to 239.255.255.255 is used for multicast streams. MVR group addresses cannot fall within the reserved IP multicast address range of 224.0.0.x.
- IGMP snooping and MVR share a maximum number of 4095 groups. Any multicast streams received in excess of this limitation will be flooded to all ports in the associated domain.

Example
The following example maps a range of MVR group addresses to a profile:

```
Console(config)#mvr profile rd 228.1.23.1 228.1.23.10
Console(config)#
```

mvr proxy-query-interval

This command configures the interval at which the receiver port sends out general queries. Use the **no** form to restore the default setting.

Syntax

mvr proxy-query-interval *interval*

no mvr proxy-query-interval

interval - The interval at which the receiver port sends out general queries. (Range: 2-31744 seconds)

Default Setting
125 seconds

Command Mode
Global Configuration

Command Usage
This command sets the general query interval at which active receiver ports send out general queries. This interval is only effective when proxy switching is enabled with the mvr proxy-switching command.

Example
This example sets the proxy query interval for MVR proxy switching.

```
Console(config)#mvr proxy-query-interval 250
Console(config)#
```

mvr proxy-switching

This command enables MVR proxy switching, where the source port acts as a host, and the receiver port acts as an MVR router with querier service enabled. Use the **no** form to disable this function.

Syntax

[no] mvr proxy-switching

Default Setting
Enabled

Command Mode
Global Configuration

Command Usage
- When MVR proxy-switching is enabled, an MVR source port serves as the upstream or host interface. The source port performs only the host portion of MVR by sending summarized membership reports, and automatically disables MVR router functions.
- Receiver ports are known as downstream or router interfaces. These interfaces perform the standard MVR router functions by maintaining a database of all MVR subscriptions on the downstream interface. Receiver ports must therefore be configured on all downstream interfaces which require MVR proxy service.
- When the source port receives report and leave messages, it only forwards them to other source ports.
- When receiver ports receive any query messages, they are dropped.
- When changes occurring in the downstream MVR groups are learned by the receiver ports through report and leave messages, an MVR state change report is created and sent to the upstream source port, which in turn forwards this information upstream.

- When MVR proxy switching is disabled:
  - Any membership reports received from receiver/source ports are forwarded to all source ports.
  - When a source port receives a query message, it will be forwarded to all downstream receiver ports.
  - When a receiver port receives a query message, it will be dropped.

Example

The following example enable MVR proxy switching.

```
Console(config)#mvr proxy-switching
Console(config)#
```

mvr robustness-value

This command configures the expected packet loss, and thereby the number of times to generate report and group-specific queries. Use the **no** form to restore the default setting.

Syntax

mvr robustness-value *value*

no mvr robustness-value

value - The robustness used for all interfaces. (Range: 1-255)

Default Setting

2

Command Mode

Global Configuration

Command Usage

- This command is used to set the number of times report messages are sent upstream when changes are learned about downstream groups, and the number of times group-specific queries are sent to downstream receiver ports.
- This command only takes effect when MVR proxy switching is enabled.

Example

```
Console(config)#mvr robustness-value 5
Console(config)#
```

mvr source-port-mode dynamic

This command configures the switch to only forward multicast streams which the source port has dynamically joined. Use the **no** form to restore the default setting.

Syntax

[no] mvr source-port-mode dynamic

Default Setting

Forwards all multicast streams which have been specified in a profile and bound to a domain.

Command Mode

Global Configuration

Command Usage

- By default, the switch forwards any multicast streams within the address range set by a profile, and bound to a domain. The multicast streams are sent to all source ports on the switch and to all receiver ports that have elected to receive data on that multicast address.
- When the **mvr source-port-mode dynamic** command is used, the switch only forwards multicast streams which the source port has dynamically joined. In other words, both the receiver port and source port must subscribe to a multicast group before a multicast stream is forwarded to any attached client. Note that the requested streams are still restricted to the address range which has been specified in a profile and bound to a domain.

Example

```
Console(config)#mvr source-port-mode dynamic
Console(config)#
```

mvr upstream-source-ip

This command configures the source IP address assigned to all MVR control packets sent upstream on all domains or on a specified domain. Use the **no** form to restore the default setting.

Syntax

mvr [**domain** *domain-id*] **upstream-source-ip** *source-ip-address*

no mvr [**domain** *domain-id*] **upstream-source-ip**

domain-id - An independent multicast domain. (Range: 1-5)

source-ip-address – The source IPv4 address assigned to all MVR control packets sent upstream.

Default Setting

All MVR reports sent upstream use a null source IP address

Command Mode
Global Configuration

Example

```
Console(config)#mvr domain 1 upstream-source-ip 192.168.0.3
Console(config)#
```

mvr vlan

This command specifies the VLAN through which MVR multicast data is received. Use the **no** form of this command to restore the default MVR VLAN.

Syntax

mvr [**domain** *domain-id*] **vlan** *vlan-id*

no mvr [**domain** *domain-id*] **vlan**

domain-id - An independent multicast domain. (Range: 1-5)

vlan-id - Specifies the VLAN through which MVR multicast data is received. This is also the VLAN to which all source ports must be assigned. (Range: 1-4094)

Default Setting
VLAN 1

Command Mode
Global Configuration

Command Usage
- This command specifies the VLAN through which MVR multicast data is received. This is the VLAN to which all source ports must be assigned.
- The VLAN specified by this command must be an existing VLAN configured with the vlan command.
- MVR source ports can be configured as members of the MVR VLAN using the switchport allowed vlan command and switchport native vlan command, but MVR receiver ports should not be statically configured as members of this VLAN.

Example
The following example sets the MVR VLAN to VLAN 2:

```
Console(config)#mvr
Console(config)#mvr domain 1 vlan 2
Console(config)#
```

mvr immediate-leave

This command causes the switch to immediately remove an interface from a multicast stream as soon as it receives a leave message for that group. Use the **no** form to restore the default settings.

Syntax

mvr [**domain** *domain-id*] **immediate-leave** [**by-host-ip**]

no mvr [**domain** *domain-id*] **immediate-leave**

domain-id - An independent multicast domain. (Range: 1-5)

by-host-ip - Specifies that the member port will be deleted only when there are no hosts joining this group.

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Immediate leave applies only to receiver ports. When enabled, the receiver port is immediately removed from the multicast group identified in the leave message. When immediate leave is disabled, the switch follows the standard rules by sending a group-specific query to the receiver port and waiting for a response to determine if there are any remaining subscribers for that multicast group before removing the port from the group list.

- If the "by-host-ip" option is used, the router/querier will not send out a group-specific query when an IGMPv2/v3 leave message is received (the same as it would without this option having been used). Instead of immediately deleting that group, it will look up the record, and only delete the group if there are no other subscribers for it on the member port. Only when all hosts on that port leave the group will the member port be deleted.

- Using immediate leave can speed up leave latency, but should only be enabled on a port attached to only one multicast subscriber to avoid disrupting services to other group members attached to the same interface.

- Immediate leave does not apply to multicast groups which have been statically assigned to a port with the mvr vlan group command.

Example

The following enables immediate leave on a receiver port.

```
Console(config)#interface ethernet 1/5
Console(config-if)#mvr domain 1 immediate-leave
Console(config-if)#
```

mvr type

This command configures an interface as an MVR receiver or source port. Use the **no** form to restore the default settings.

Syntax

[**no**] **mvr** [**domain** *domain-id*] **type** {**receiver** | **source**}

domain-id - An independent multicast domain. (Range: 1-5)

receiver - Configures the interface as a subscriber port that can receive multicast data.

source - Configures the interface as an uplink port that can send and receive multicast data for the configured multicast groups.

Default Setting

The port type is not defined.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- A port which is not configured as an MVR receiver or source port can use IGMP snooping to join or leave multicast groups using the standard rules for multicast filtering.
- Receiver ports can belong to different VLANs, but should not normally be configured as a member of the MVR VLAN. IGMP snooping can also be used to allow a receiver port to dynamically join or leave multicast groups not sourced through the MVR VLAN. Also, note that VLAN membership for MVR receiver ports cannot be set to access mode (see the switchport mode command).
- One or more interfaces may be configured as MVR source ports. A source port is able to both receive and send data for multicast groups which it has joined through the MVR protocol or which have been assigned through the mvr vlan group command.
- Only IGMP version 2 or 3 hosts can issue multicast join or leave messages. If MVR must be configured for an IGMP version 1 host, the multicast groups must be statically assigned using the mvr vlan group command.

Example

The following configures one source port and several receiver ports on the switch.

```
Console(config)#interface ethernet 1/5
Console(config-if)#mvr domain 1 type source
Console(config-if)#exit
Console(config)#interface ethernet 1/6
Console(config-if)#mvr domain 1 type receiver
Console(config-if)#exit
Console(config)#interface ethernet 1/7
```

```
Console(config-if)#mvr domain 1 type receiver
Console(config-if)#
```

mvr vlan group

This command statically binds a multicast group to a port which will receive long-term multicast streams associated with a stable set of hosts. Use the **no** form to restore the default settings.

Syntax

[**no**] **mvr** [**domain** *domain-id*] **vlan** *vlan-id* **group** *ip-address*

domain-id - An independent multicast domain. (Range: 1-5)

vlan-id - Receiver VLAN to which the specified multicast traffic is flooded. (Range: 1-4094)

group - Defines a multicast service sent to the selected port.

ip-address - Statically configures an interface to receive multicast traffic from the IPv4 address specified for an MVR multicast group. (Range: 224.0.1.0 - 239.255.255.255)

Default Setting

No receiver port is a member of any configured multicast group.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Multicast groups can be statically assigned to a receiver port using this command.
- The IP address range from 224.0.0.0 to 239.255.255.255 is used for multicast streams. MVR group addresses cannot fall within the reserved IP multicast address range of 224.0.0.x.
- Only IGMP version 2 or 3 hosts can issue multicast join or leave messages. If MVR must be configured for an IGMP version 1 host, the multicast groups must be statically assigned using the **mvr vlan group** command.
- The MVR VLAN cannot be specified as the receiver VLAN for static bindings.

Example

The following statically assigns a multicast group to a receiver port:

```
Console(config)#interface ethernet 1/7
Console(config-if)#mvr domain 1 type receiver
Console(config-if)#mvr domain 1 vlan 3 group 225.0.0.5
Console(config-if)#
```

clear mrv groups dynamic

This command clears multicast group information dynamically learned through MVR.

Syntax

clear mvr groups dynamic

Command Mode

Privileged Exec

Command Usage

This command only clears entries learned though MVR. Statically configured multicast address are not cleared.

Example

```
Console#clear mvr groups dynamic
Console#
```

clear mrv statistics

This command clears MVR statistics.

Syntax

clear mvr statistics [interface *interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* - VLAN identifier (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#clear mvr statistics
Console#
```

show mvr

This command shows information about MVR domain settings, including MVR operational status, the multicast VLAN, the current number of group addresses, and the upstream source IP address.

Syntax

show mvr [**domain** *domain-id*]

domain-id - An independent multicast domain. (Range: 1-5)

Default Setting

Displays configuration settings for all MVR domains.

Command Mode

Privileged Exec

Example

The following shows the MVR settings:

```
Console#show mvr
 MVR 802.1p Forwarding Priority : Disabled
 MVR Proxy Switching            : Enabled
 MVR Robustness Value           : 1
 MVR Proxy Query Interval       : 125(sec.)
 MVR Source Port Mode           : Always Forward

 MVR Domain                     : 1
 MVR Config Status              : Enabled
 MVR Running Status             : Active
 MVR Multicast VLAN             : 1
 MVR Current Learned Groups     : 10
 MVR Upstream Source IP         : 192.168.0.3
:
```

show mvr associated-profile

This command shows the profiles bound the specified domain.

Syntax

show mvr [**domain** *domain-id*] **associated-profile**

domain-id - An independent multicast domain. (Range: 1-5)

Default Setting

Displays profiles bound to all MVR domains.

Command Mode

Privileged Exec

Example

The following displays the profiles bound to domain 1:

```
Console#show mvr domain 1 associated-profile
Domain ID : 1
 MVR Profile Name     Start IP Addr.  End IP Addr.
 -------------------- --------------- ---------------
 rd                        228.1.23.1     228.1.23.10
 testing                   228.2.23.1     228.2.23.10
Console#
```

show mvr interface

This command shows MVR configuration settings for interfaces attached to the MVR VLAN.

Syntax

show mvr [**domain** *domain-id*] **interface**

domain-id - An independent multicast domain. (Range: 1-5)

Default Setting

Displays configuration settings for all attached interfaces.

Command Mode

Privileged Exec

Example

The following displays information about the interfaces attached to the MVR VLAN in domain 1:

```
Console#show mvr domain 1 interface
MVR Domain : 1
 Flag: H - immediate leave by host ip
 Port     Type     Status              Immediate  Static Group Address
 -------- -------- ------------------- ---------  -------------------------
 Eth 1/ 1 Source   Active/Forwarding
 Eth 1/ 2 Receiver Inactive/Discarding Disabled   234.5.6.8(VLAN2)
 Eth 1/ 3 Source   Inactive/Discarding
 Eth 1/ 1 Receiver Active/Forwarding   Disabled   225.0.0.1(VLAN1)
                                                  225.0.0.9(VLAN3)
 Eth 1/ 4 Receiver Active/Discarding   Disabled
Console#
```

show mvr members

This command shows information about the current number of entries in the forwarding database, detailed information about a specific multicast address, the IP address of the hosts subscribing to all active multicast groups, or the multicast groups associated with each port.

Syntax

show mvr [**domain** *domain-id*] **members** [*ip-address* | **host-ip-address** [*interface*] | **igmp** | **sort-by-port** [*interface*] | **unknown** | **user**]]]

domain-id - An independent multicast domain. (Range: 1-5)

ip-address - IPv4 address for an MVR multicast group. (Range: 224.0.1.0 - 239.255.255.255)

members - The multicast groups assigned to the MVR VLAN.

host-ip-address - The subscriber IP addresses.

igmp - Entry created by IGMP protocol.

sort-by-port - The multicast groups associated with an interface.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

unknown - Entry created by receiving a multicast stream.

user - Snooping entry learned from user's configuration settings.

Default Setting

Displays configuration settings for all domains and all forwarding entries.

Command Mode

Privileged Exec

Example

The following shows information about the number of multicast forwarding entries currently active in domain 1:

```
Console#show mvr domain 1 members
 MVR Domain : 1
 MVR Forwarding Entry Count :1
 Flag: S - Source port, R - Receiver port.
       H - Host counts (number of hosts joined to group on this port).
       P - Port counts (number of ports joined to group).
 Up time: Group elapsed time (d:h:m:s).
 Expire : Group remaining time (m:s).

 Group Address   VLAN Port        Up time     Expire Count
 --------------- ---- ----------- ----------- ------ --------
 234.5.6.7          1             00:00:09:17            2(P)
                    1 Eth 1/ 1(S)
                    2 Eth 1/ 2(R)

Console#
```

The following example shows detailed information about a specific multicast address:

```
Console#show mvr domain 1 members 234.5.6.7
 MVR Domain : 1
```

```
MVR Forwarding Entry Count :1
Flag: S - Source port, R - Receiver port.
      H - Host counts (number of hosts joined to group on this port).
      P - Port counts (number of ports joined to group).
Up time: Group elapsed time (d:h:m:s).
Expire : Group remaining time (m:s).

Group Address   VLAN Port        Up time     Expire Count
--------------- ---- ----------- ----------- ------ --------
234.5.6.7          1                                   2(P)
                   1 Eth 1/ 1(S)
                   2 Eth 1/ 2(R)

Console#
```

show mvr profile

This command shows all configured MVR profiles.

Command Mode

Privileged Exec

Example

The following shows all configured MVR profiles:

```
Console#show mvr profile
 MVR Profile Name     Start IP Addr.  End IP Addr.
 -------------------- --------------- ---------------
 rd                        228.1.23.1     228.1.23.10
 testing                   228.2.23.1     228.2.23.10
Console#
```

show mvr statistics

This command shows MVR protocol-related statistics for the specified interface.

Syntax

show mvr [**domain** *domain-id*] **statistics**
{**input** [**interface** *interface*] | **output** [**interface** *interface*] |
query | **summary interface** [*interface* | **mvr-vlan**]}

domain-id - An independent multicast domain. (Range: 1-5)

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* - VLAN ID (Range: 1-4094)

query - Displays MVR query-related statistics.

summary - Displays summary of MVR statistics.

mvr vlan - Displays summary statistics for the MVR VLAN.

Default Setting
Displays statistics for all domains.

Command Mode
Privileged Exec

Example
The following shows MVR protocol-related statistics received:

```
Console#show mvr domain 1 statistics input
 MVR Domain : 1 , MVR VLAN: 2
 Input Statistics:
 Interface Report   Leave    G Query  G(-S)-S Query Drop     Join Succ Group
 --------- -------- -------- -------- ------------- -------- --------- ------
 Eth 1/ 1        23       11        4            10        5        20      9
 Eth 1/ 2        12       15        8             3        5        19      4
 DVLAN   1        2        0        0             2        2        20      9
 MVLAN   1        2        0        0             2        2        20      9
Console#
```

The following shows MVR protocol-related statistics sent:

```
Console#show mvr domain 1 statistics output
 MVR Domain : 1 , MVR VLAN: 2
 Output Statistics:
 Interface  Report   Leave    G Query  G(-S)-S Query Drop     Group
 ---------- -------- -------- -------- ------------- -------- ------
 Eth 1/ 1        12        0        1             0        0      0
 Eth 1/ 1        12        0        1             0        0      0
 Eth 1/ 2         5        1        4             1        0      0
 DVLAN   1        7        2        3             0        0      0
 MVLAN   1        7        2        3             0        0      0
Console#
```

The following shows MVR query-related statistics:

```
Console#show mvr domain 1 statistics query
Domain 1:
 Other Querier             : None
 Other Querier Expire      : 0(m):0(s)
 Other Querier Uptime      : 0(h):0(m):0(s)
 Self Querier              : 192.168.2.4
 Self Querier Expire       : 0(m):30(s)
 Self Querier Uptime       : 0(h):9(m):55(s)
 General Query Received    : 0
 General Query Sent        : 8
 Specific Query Received   : 0
 Specific Query Sent       : 3
 Warn Rate Limit           : 0 sec.
 V1 Warning Count          : 0
 V2 Warning Count          : 0
 V3 Warning Count          : 0
Console#
```

The following shows MVR summary statistics for an interface:

```
Console#show mvr domain 1 statistics summary interface ethernet 1/1
Domain 1:
Number of Groups:  0
 Querier:          :                   Report & Leave:   :
  Transmit         :                    Transmit         :
   General         : 0                   Report          : 7
   Group Specific  : 0                   Leave           : 4
  Received         :                    Received         :
   General         : 0                   Report          : 0
   Group Specific  : 0                   Leave           : 0
   V1 Warning Count: 0                   Join Success    : 0
   V2 Warning Count: 0                   Filter Drop     : 0
   V3 Warning Count: 0
                                         Source Port Drop: 0
                                         Others Drop     : 0
Console#
```

MVR for IPv6

This section describes commands used to configure Multicast VLAN Registration for IPv6 (MVR6). A single network-wide VLAN can be used to transmit multicast traffic (such as television channels) across a service provider's network. Any multicast traffic entering an MVR6 VLAN is sent to all subscribers. This can significantly reduce to processing overhead required to dynamically monitor and establish the distribution tree for a normal multicast VLAN. Also note that MVR6 maintains the user isolation and data security provided by VLAN segregation by passing only multicast traffic into other VLANs to which the subscribers belong.

Table 113: Multicast VLAN Registration for IPv6 Commands

Command	Function	Mode
mvr6 associated-profile	Binds the MVR6 group addresses specified in a profile to an MVR6 domain	GC
mvr6 domain	Enables MVR6 for a specific domain	GC
mvr6 priority	Assigns a priority to all multicast traffic in the MVR6 VLAN	GC
mvr6 profile	Maps a range of MVR6 group addresses to a profile	GC
mvr6 proxy-query-interval	Configures the interval at which the receiver port sends out general queries.	GC
mvr6 proxy-switching	Enables MVR6 proxy switching, where the source port acts as a host, and the receiver port acts as an MVR6 router with querier service enabled	GC
mvr6 robustness-value	Configures the expected packet loss, and thereby the number of times to generate report and group-specific queries	GC
mvr6 source-port-mode dynamic	Configures the switch to only forward multicast streams which the source port has dynamically joined	GC
mvr6 upstream-source-ip	Configures the source IP address assigned to all control packets sent upstream	GC
mvr6 vlan	Specifies the VLAN through which MVR6 multicast data is received	GC
mvr6 immediate-leave	Enables immediate leave capability	IC
mvr6 type	Configures an interface as an MVR6 receiver or source port	IC
mvr6 vlan group	Statically binds a multicast group to a port	IC
clear mvr6 groups dynamic	Clears multicast group information dynamically learned through MVR6	PE
clear mvr6 statistics	Clears the MVR6 statistics globally or on a per-interface basis	PE
show mvr6	Shows information about MVR6 domain settings, including MVR6 operational status, the multicast VLAN, the current number of group addresses, and the upstream source IP address	PE
show mvr6 associated-profile	Shows the profiles bound the specified domain	PE
show mvr6 interface	Shows MVR6 settings for interfaces attached to the MVR6 VLAN	PE

Table 113: Multicast VLAN Registration for IPv6 Commands (Continued)

Command	Function	Mode
show mvr6 members	Shows information about the current number of entries in the forwarding database, or detailed information about a specific multicast address	PE
show mvr6 profile	Shows all configured MVR6 profiles	PE
show mvr6 statistics	Shows MVR6 protocol statistics for the specified interface	PE

mvr6 associated-profile

This command binds the MVR6 group addresses specified in a profile to an MVR6 domain. Use the **no** form of this command to remove the binding.

Syntax

[no] **mvr6 domain** *domain-id* **associated-profile** *profile-name*

domain-id - An independent multicast domain. (Range: 1-5)

profile-name - The name of a profile containing one or more MVR6 group addresses. (Range: 1-21 characters)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

MVR6 domains can be associated with more than one MVR6 profile. But since MVR6 domains cannot share the group range, an MVR6 profile can only be associated with one MVR6 domain.

Example

The following an MVR6 group address profile to domain 1:

```
Console(config)#mvr6 domain 1 associated-profile rd
Console(config)#
```

mvr6 domain

This command enables Multicast VLAN Registration for IPv6 (MVR6) for a specific domain. Use the **no** form of this command to disable MVR6 for a domain.

Syntax

[no] **mvr6 domain** *domain-id*

domain-id - An independent multicast domain. (Range: 1-5)

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
When MVR6 is enabled on a domain, any multicast data associated with an MVR6 group is sent from all designated source ports, to all receiver ports that have registered to receive data from that multicast group.

Example
The following example enables MVR6 for domain 1:

```
Console(config)#mvr6 domain 1
Console(config)#
```

mvr6 priority
This command assigns a priority to all multicast traffic in the MVR6 VLAN. Use the **no** form of this command to restore the default setting.

Syntax
mvr6 priority *priority*

no mvr6 priority

priority - The CoS priority assigned to all multicast traffic forwarded into the MVR6 VLAN. (Range: 0-7, where 7 is the highest priority)

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
This command can be used to set a high priority for low-latency multicast traffic such as a video-conference, or to set a low priority for normal multicast traffic not sensitive to latency.

Example
```
Console(config)#mvr6 priority 6
Console(config)#
```

mvr6 profile

This command maps a range of MVR6 group addresses to a profile. Use the **no** form of this command to remove the profile.

Syntax

mvr6 profile *profile-name start-ip-address end-ip-address*

profile-name - The name of a profile containing one or more MVR6 group addresses. (Range: 1-21 characters)

start-ip-address - Starting IPv6 address for an MVR6 multicast group. This parameter must be a full IPv6 address including the network prefix and host address bits.

end-ip-address - Ending IPv6 address for an MVR6 multicast group. This parameter must be a full IPv6 address including the network prefix and host address bits.

Default Setting

No profiles are defined

Command Mode

Global Configuration

Command Usage

- Use this command to statically configure all multicast group addresses that will join the MVR6 VLAN. Any multicast data associated with an MVR6 group is sent from all source ports, and to all receiver ports that have registered to receive data from that multicast group.
- IGMP snooping and MVR6 share a maximum number of 4095 groups. Any multicast streams received in excess of this limitation will be flooded to all ports in the associated domain.
- All IPv6 addresses must be according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields. (Note that the IP address ff02::X is reserved.)
- The MVR6 group address range assigned to a profile cannot overlap with the group address range of any other profile.

Example

The following example maps a range of MVR6 group addresses to a profile:

```
Console(config)#mvr6 profile rd ff01:0:0:0:0:0:0:fe ff01:0:0:0:0:0:0:ff
Console(config)#
```

mvr6 proxy-query-interval

This command configures the interval at which the receiver port sends out general queries. Use the **no** form to restore the default setting.

Syntax

mvr6 proxy-query-interval *interval*

no mvr6 proxy-query-interval

interval - The interval at which the receiver port sends out general queries. (Range: 2-31744 seconds)

Default Setting

125 seconds

Command Mode

Global Configuration

Command Usage

This command sets the general query interval at which active receiver ports send out general queries. This interval is only effective when proxy switching is enabled with the mvr6 proxy-switching command.

Example

This example sets the proxy query interval for MVR6.

```
Console(config)#mvr6 proxy-query-interval 228
Console(config)#
```

mvr6 proxy-switching

This command enables MVR6 proxy switching, where the source port acts as a host, and the receiver port acts as an MVR6 router with querier service enabled. Use the **no** form to disable this function.

Syntax

[no] **mvr6 proxy-switching**

Default Setting

Enabled

Command Mode

Global Configuration

Command Usage

- When MVR6 proxy-switching is enabled, an MVR6 source port serves as the upstream or host interface, and the MVR6 receiver port serves as the querier. The source port performs only the host portion of MVR6 by sending

summarized membership reports, and automatically disables MVR6 router functions.

- Receiver ports are known as downstream or router interfaces. These interfaces perform the standard MVR6 router functions by maintaining a database of all MVR6 subscriptions on the downstream interface. Receiver ports must therefore be configured on all downstream interfaces which require MVR6 proxy service.
- When the source port receives report and leave messages, it only forwards them to other source ports.
- When receiver ports receive any query messages, they are dropped.
- When changes occurring in the downstream MVR6 groups are learned by the receiver ports through report and leave messages, an MVR6 state change report is created and sent to the upstream source port, which in turn forwards this information upstream.
- When MVR6 proxy switching is disabled:
  - Any membership reports received from receiver/source ports are forwarded to all source ports.
  - When a source port receives a query message, it will be forwarded to all downstream receiver ports.
  - When a receiver port receives a query message, it will be dropped.

Example

The following example enable MVR6 proxy switching.

```
Console(config)#mvr6 proxy-switching
Console(config)#
```

mvr6 robustness-value

This command configures the expected packet loss, and thereby the number of times to generate report and group-specific queries. Use the **no** form to restore the default setting.

Syntax

mvr6 robustness-value *value*

no mvr6 robustness-value

value - The robustness used for all interfaces. (Range: 1-10)

Default Setting

2

Command Mode

Global Configuration

Command Usage

- This command sets the number of times report messages are sent upstream when changes are learned about downstream groups, and the number of times group-specific queries are sent to downstream receiver ports.
- This command only takes effect when MVR6 proxy switching is enabled.

Example

```
Console(config)#mvr6 robustness-value 5
Console(config)#
```

mvr6 source-port-mode dynamic

This command configures the switch to only forward multicast streams which the source port has dynamically joined. Use the **no** form to restore the default setting.

Syntax

[no] mvr6 source-port-mode dynamic

Default Setting

Forwards all multicast streams which have been specified in a profile and bound to a domain.

Command Mode

Global Configuration

Command Usage

- By default, the switch forwards any multicast streams within the address range set by a profile, and bound to a domain. The multicast streams are sent to all source ports on the switch and to all receiver ports that have elected to receive data on that multicast address.
- When the **mvr6 source-port-mode dynamic** command is used, the switch only forwards multicast streams which the source port has dynamically joined. In other words, both the receiver port and source port must subscribe to a multicast group before a multicast stream is forwarded to any attached client. Note that the requested streams are still restricted to the address range which has been specified in a profile and bound to a domain.

Example

```
Console(config)#mvr6 source-port-mode dynamic
Console(config)#
```

mvr6 upstream-source-ip

This command configures the source IPv6 address assigned to all MVR6 control packets sent upstream on the specified domain. Use the **no** form to restore the default setting.

Syntax

mvr6 domain *domain-id* **upstream-source-ip** *source-ip-address*

no mvr6 domain *domain-id* **upstream-source-ip**

domain-id - An independent multicast domain. (Range: 1-5)

source-ip-address – The source IPv6 address assigned to all MVR6 control packets sent upstream. This parameter must be a full IPv6 address including the network prefix and host address bits.

Default Setting

All MVR6 reports sent upstream use a null source IP address

Command Mode

Global Configuration

Command Usage

All IPv6 addresses must be according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields. (Note that the IP address ff02::X is reserved.)

Example

```
Console(config)#mvr6 domain 1 upstream-source-ip 2001:DB8:2222:7223::72
Console(config)#
```

mvr6 vlan

This command specifies the VLAN through which MVR6 multicast data is received. Use the **no** form of this command to restore the default MVR6 VLAN.

Syntax

mvr6 domain *domain-id* **vlan** *vlan-id*

no mvr6 domain *domain-id* **vlan**

domain-id - An independent multicast domain. (Range: 1-5)

vlan-id - Specifies the VLAN through which MVR6 multicast data is received. This is also the VLAN to which all source ports must be assigned. (Range: 1-4094)

Default Setting

VLAN 1

Command Mode
Global Configuration

Command Usage
MVR6 source ports can be configured as members of the MVR6 VLAN using the switchport allowed vlan command and switchport native vlan command, but MVR6 receiver ports should not be statically configured as members of this VLAN.

Example
The following example sets the MVR6 VLAN to VLAN 1:

```
Console(config)#mvr6 domain 1 vlan 1
Console(config)#
```

mvr6 immediate-leave

This command causes the switch to immediately remove an interface from a multicast stream as soon as it receives a leave message for that group. Use the **no** form to restore the default settings.

Syntax

[**no**] **mvr6 domain** *domain-id* **immediate-leave** [**by-host-ip**]

domain-id - An independent multicast domain. (Range: 1-5)

by-host-ip - Specifies that the member port will be deleted only when there are no hosts joining this group.

Default Setting
Disabled

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
- Immediate leave applies only to receiver ports. When enabled, the receiver port is immediately removed from the multicast group identified in the leave message. When immediate leave is disabled, the switch follows the standard rules by sending a group-specific query to the receiver port and waiting for a response to determine if there are any remaining subscribers for that multicast group before removing the port from the group list.

- If the "by-host-ip" option is enabled, the switch will not send out a group-specific query to the receiver port. But it will check if there are other hosts joining the multicast group. Only when all hosts on that port leave the group will the member port be deleted.

- Using immediate leave can speed up leave latency, but should only be enabled on a port attached to only one multicast subscriber to avoid disrupting services to other group members attached to the same interface.

- Immediate leave does not apply to multicast groups which have been statically assigned to a port with the mvr6 vlan group command.

Example

The following enables immediate leave on a receiver port.

```
Console(config)#interface ethernet 1/5
Console(config-if)#mvr6 domain 1 immediate-leave
Console(config-if)#
```

mvr6 type

This command configures an interface as an MVR6 receiver or source port. Use the **no** form to restore the default settings.

Syntax

[**no**] **mvr6 domain** *domain-id* **type** {**receiver** | **source**}

domain-id - An independent multicast domain. (Range: 1-5)

receiver - Configures the interface as a subscriber port that can receive multicast data.

source - Configures the interface as an uplink port that can send and receive multicast data for the configured multicast groups. Note that the source port must be manually configured as a member of the MVR6 VLAN using the switchport allowed vlan command.

Default Setting

The port type is not defined.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- A port configured as an MVR6 receiver or source port can join or leave multicast groups configured under MVR6. A port which is not configured as an MVR6 receiver or source port can use MLD snooping to join or leave multicast groups using the standard rules for multicast filtering (see "MLD Snooping" on page 659).

- Receiver ports can belong to different VLANs, but should not be configured as a member of the MVR6 VLAN. MLD snooping can be used to allow a receiver port to dynamically join or leave multicast groups not sourced through the MVR6 VLAN. Also, note that VLAN membership for MVR6 receiver ports cannot be set to access mode (see the switchport mode command).

- One or more interfaces may be configured as MVR6 source ports. A source port is able to both receive and send data for multicast groups which it has joined through the MVR6 protocol or which have been assigned through the mvr6 vlan group command.

  All source ports must belong to the MVR6 VLAN.

  Subscribers should not be directly connected to source ports.

- The same port cannot be configured as a source port in one MVR6 domain and as a receiver port in another domain.

Example

The following configures one source port and several receiver ports on the switch.

```
Console(config)#interface ethernet 1/5
Console(config-if)#mvr6 domain 1 type source
Console(config-if)#exit
Console(config)#interface ethernet 1/6
Console(config-if)#mvr6 domain 1 type receiver
Console(config-if)#exit
Console(config)#interface ethernet 1/7
Console(config-if)#mvr6 domain 1 type receiver
Console(config-if)#
```

mvr6 vlan group

This command statically binds a multicast group to a port which will receive long-term multicast streams associated with a stable set of hosts. Use the **no** form to restore the default settings.

Syntax

[**no**] **mvr6 domain** *domain-id* **vlan** *vlan-id* **group** *ip-address*

domain-id - An independent multicast domain. (Range: 1-5)

vlan-id - Receiver VLAN to which the specified multicast traffic is flooded. (Range: 1-4094)

group - Defines a multicast service sent to the selected port.

ip-address - Statically configures an interface to receive multicast traffic from the IPv6 address specified for an MVR6 multicast group. This parameter must be a full IPv6 address including the network prefix and host address bits.

Default Setting

No receiver port is a member of any configured multicast group.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Multicast groups can be statically assigned to a receiver port using this command. The assigned address must fall within the range set by the mvr6 associated-profile command.
- All IPv6 addresses must be according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields. (Note that the IP address ff02::X is reserved.)
- The MVR6 VLAN cannot be specified as the receiver VLAN for static bindings.

Example

The following statically assigns a multicast group to a receiver port:

```
Console(config)#interface ethernet 1/2
Console(config-if)#mvr6 domain 1 type receiver
Console(config-if)#mvr6 domain 1 vlan 2 group ff00::1
Console(config-if)#
```

clear mvr6 groups dynamic

This command clears multicast group information dynamically learned through MVR6.

Syntax

clear mvr6 groups dynamic [~~**domain**~~ *domain-id*]

domain-id - An independent multicast domain. (Range: 1-5)

Command Mode

Privileged Exec

Command Usage

This command only clears entries learned though MVR6. Statically configured multicast addresses are not cleared.

Example

```
Console#clear mvr6 groups dynamic
Console#
```

clear mvr6 statistics

Use this command to clear MVR6 statistics.

Syntax

clear mvr6 statistics [**interface** *interface*]

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* (Range: 1-4094)

Command Mode
Privileged Exec

Command Usage
If the interface option is not used then all MVR6 statistics are cleared. Otherwise using the interface option will only clear MVR6 statistics for the specified interface.

Example
The following shows how to clear all the MVR6 statistics:

```
Console#clear mvr6 statistics
Console#
```

show mvr6
This command shows information about MVR6 domain settings, including MVR6 operational status, the multicast VLAN, the current number of group addresses, and the upstream source IP address.

Syntax
show mvr6 [**domain** *domain-id*]

domain-id - An independent multicast domain. (Range: 1-5)

Default Setting
Displays configuration settings for all MVR6 domains.

Command Mode
Privileged Exec

Example
The following shows the MVR6 settings:

```
Console#show mvr6
 MVR6 802.1p Forwarding Priority: Disabled
 MVR6 Proxy Switching           : Enabled
 MVR6 Robustness Value          : 1
 MVR6 Proxy Query Interval      : 125(sec.)
 MVR6 Source Port Mode          : Always Forward

 Domain                    : 1
 MVR6 Config Status        : Enabled
```

```
MVR6 Running Status          : Active
MVR6 Multicast VLAN          : 1
MVR6 Current Learned Groups : 0
MVR6 Upstream Source IP      : FF05::25
⋮
```

show mvr6 associated-profile

This command shows the profiles bound the specified domain.

Syntax

show mvr6 [**domain** *domain-id*] **associated-profile**

domain-id - An independent multicast domain. (Range: 1-5)

Default Setting

Displays profiles bound to all MVR6 domains.

Command Mode

Privileged Exec

Example

The following displays the profiles bound to domain 1:

```
Console#show mvr6 domain 1 associated-profile
Domain ID : 1
 MVR6 Profile Name    Start IPv6 Addr.          End IPv6 Addr.
 -------------------- ------------------------ ------------------------
 rd                                  ff01::fe                  ff01::ff
Console#
```

show mvr6 interface

This command shows MVR6 configuration settings for interfaces attached to the MVR6 VLAN.

Syntax

show mvr6 [**domain** *domain-id*] **interface**

domain-id - An independent multicast domain. (Range: 1-5)

Default Setting

Displays configuration settings for all attached interfaces.

Command Mode

Privileged Exec

Example

The following displays information about the interfaces attached to the MVR6 VLAN in domain 1:

```
Console#show mvr6 domain 1 interface
 MVR6 Domain : 1
 Port     Type     Status              Immediate Leave  Static Group Address
 -------- -------- ------------------- ---------------- ---------------------
 Eth1/ 1  Source   Active/Forwarding
 Eth1/ 2  Receiver Active/Forwarding   Disabled         ff00::1(VLAN2)
Console#
```

show mvr6 members

This command shows information about the current number of entries in the forwarding database, or detailed information about a specific multicast address.

Syntax

show mvr6 [**domain** *domain-id*] **members** [*ip-address*]

domain-id - An independent multicast domain. (Range: 1-5)

ip-address - IPv6 address for an MVR6 multicast group.

Default Setting

Displays configuration settings for all domains and all forwarding entries.

Command Mode

Privileged Exec

Example

The following shows information about the number of multicast forwarding entries currently active in domain 1:

```
Console#show mvr6 domain 1 members
 MVR6 Domain : 1
 MVR6 Forwarding Entry Count :1
 Flag: S - Source port, R - Receiver port.
       H - Host counts (number of hosts join the group on this port).
       P - Port counts (number of forwarding ports).
 Up time: Group elapsed time (d:h:m:s).
 Expire : Group remaining time (m:s).

 Group Address                 VLAN Port        Up time     Expire Count
 ----------------------------- ---- ----------- ----------- ------ --------
 ff05::101                        2             00:00:00:19            2(P)
                                  2  Eth1/ 2(S)
                                  1  Eth1/ 4(R)                        0(H)
Console#
```

The following example shows detailed information about a specific multicast address:

```
Console#show mvr6 domain 1 members ff00::1
 MVR6 Domain : 1
 MVR6 Forwarding Entry Count :1
 Flag: S - Source port, R - Receiver port.
       H - Host counts (number of hosts join the group on this port).
       P - Port counts (number of forwarding ports).
 Up time: Group elapsed time (d:h:m:s).
 Expire : Group remaining time (m:s).

 Group Address                  VLAN Port        Up time     Expire Count
 ------------------------------ ---- ----------- ----------- ------ --------
 ff05::101                         2             00:00:03:18            2(P)
                                   2  Eth1/ 2(S)
                                   1  Eth1/ 4(R)                        0(H)

Console#
```

show mvr6 profile

This command shows all configured MVR6 profiles.

Command Mode

Privileged Exec

Example

The following shows all configured MVR6 profiles:

```
Console#show mvr6 profile
 MVR6 Profile Name    Start IPv6 Addr.          End IPv6 Addr.
 -------------------- ------------------------- -------------------------
 rd                                   ff01::fe                  ff01::ff
Console#
```

show mvr6 statistics

This command shows MVR protocol-related statistics for the specified interface.

Syntax

show mvr6 statistics {**input** | **output**} [**interface** *interface*]

show mvr6 domain *domain-id* **statistics**
{**input** [**interface** *interface*] | **output** [**interface** *interface*] | **query**}

domain-id - An independent multicast domain. (Range: 1-5)

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

vlan *vlan-id* - VLAN ID

query - Displays MVR query-related statistics.

Default Setting

Displays statistics for all domains.

Command Mode

Privileged Exec

Example

The following shows MVR6 protocol-related statistics received:

```
Console#show mvr6 domain 1 statistics input
 MVR6 Domain 1, MVR6 VLAN 2:
 Input Statistics:
 Interface Report   Leave    G Query  G(-S)-S Query Drop     Join Succ Group
 --------- -------- -------- -------- ------------- -------- --------- ------
 Eth 1/ 1        23       11        4            10        5        20      9
 Eth 1/ 2        12       15        8             3        5        19      4
 DVLAN   1        2        0        0             2        2        20      9
 MVLAN   2        2        0        0             2        2        20      9
Console#
```

The following shows MVR6 protocol-related statistics sent:

```
Console#show mvr6 domain 1 statistics output
 MVR6 Domain 1, MVR6 VLAN 2:
 Output Statistics:
 Interface  Report   Done     G Query  G(-S)-S Query Drop     Group
 ---------- -------- -------- -------- ------------- -------- ------
 Eth 1/ 1         12        0        1             0        0      0
 Eth 1/ 3          5        1        4             1        0      0
 DVLAN   1         7        2        3             0        0      0
 MVLAN   2         7        2        3             0        0      0
Console#
```

The following shows MVR6 query-related statistics:

```
Console#show mvr6 domain 1 statistics query
 Other Querier Address     : fe80::2e0:cff:fe00:fb/64
 Other Querier Uptime      : 0(h):0(m):0(s)
 Other Querier Expire Time : 0(m):0(s)
 Self Querier Address      : None
 Self Querier Uptime       : 0(h):13(m):16(s)
 Self Querier Expire Time  : 3(m):23(s)
 General Query Received    : 0
 General Query Sent        : 0
 Specific Query Received   : 0
```

```
 Specific Query Sent        : 0
Console#
```

28 LLDP Commands

Link Layer Discovery Protocol (LLDP) is used to discover basic information about neighboring devices on the local broadcast domain. LLDP is a Layer 2 protocol that uses periodic broadcasts to advertise information about the sending device. Advertised information is represented in Type Length Value (TLV) format according to the IEEE 802.1AB standard, and can include details such as device identification, capabilities and configuration settings. LLDP also defines how to store and maintain information gathered about the neighboring network nodes it discovers.

Link Layer Discovery Protocol - Media Endpoint Discovery (LLDP-MED) is an extension of LLDP intended for managing endpoint devices such as Voice over IP phones and network switches. The LLDP-MED TLVs advertise information such as network policy, power, inventory, and device location details. LLDP and LLDP-MED information can be used by SNMP applications to simplify troubleshooting, enhance network management, and maintain an accurate network topology.

Table 114: LLDP Commands

Command	Function	Mode
lldp	Enables LLDP globally on the switch	GC
lldp holdtime-multiplier	Configures the time-to-live (TTL) value sent in LLDP advertisements	GC
lldp med-fast-start-count	Configures how many medFastStart packets are transmitted	GC
lldp notification-interval	Configures the allowed interval for sending SNMP notifications about LLDP changes	GC
lldp refresh-interval	Configures the periodic transmit interval for LLDP advertisements	GC
lldp reinit-delay	Configures the delay before attempting to re-initialize after LLDP ports are disabled or the link goes down	GC
lldp tx-delay	Configures a delay between the successive transmission of advertisements initiated by a change in local LLDP MIB variables	GC
lldp portid-subtype	Configures the LLDP port ID subtype to either the MAC address or interface name	GC
lldp admin-status	Enables LLDP transmit, receive, or transmit and receive mode on the specified port	IC
lldp basic-tlv management-ip-address	Configures an LLDP-enabled port to advertise the management address for this device	IC

Table 114: LLDP Commands (Continued)

Command	Function	Mode
lldp basic-tlv management-ipv6-address	Configures an LLDP-enabled port to advertise the management address for this device	IC
lldp basic-tlv port-description	Configures an LLDP-enabled port to advertise its port description	IC
lldp basic-tlv system-capabilities	Configures an LLDP-enabled port to advertise its system capabilities	IC
lldp basic-tlv system-description	Configures an LLDP-enabled port to advertise the system description	IC
lldp basic-tlv system-name	Configures an LLDP-enabled port to advertise its system name	IC
lldp dot1-tlv proto-ident*	Configures an LLDP-enabled port to advertise the supported protocols	IC
lldp dot1-tlv proto-vid*	Configures an LLDP-enabled port to advertise port-based protocol related VLAN information	IC
lldp dot1-tlv pvid*	Configures an LLDP-enabled port to advertise its default VLAN ID	IC
lldp dot1-tlv vlan-name*	Configures an LLDP-enabled port to advertise its VLAN name	IC
lldp dot3-tlv link-agg	Configures an LLDP-enabled port to advertise its link aggregation capabilities	IC
lldp dot3-tlv mac-phy	Configures an LLDP-enabled port to advertise its MAC and physical layer specifications	IC
lldp dot3-tlv max-frame	Configures an LLDP-enabled port to advertise its maximum frame size	IC
lldp med-location civic-addr	Configures an LLDP-MED-enabled port to advertise its location identification details	IC
lldp med-notification	Enables the transmission of SNMP trap notifications about LLDP-MED changes	IC
lldp med-tlv inventory	Configures an LLDP-MED-enabled port to advertise its inventory identification details	IC
lldp med-tlv location	Configures an LLDP-MED-enabled port to advertise its location identification details	IC
lldp med-tlv med-cap	Configures an LLDP-MED-enabled port to advertise its Media Endpoint Device capabilities	IC
lldp med-tlv network-policy	Configures an LLDP-MED-enabled port to advertise its network policy configuration	IC
lldp notification	Enables the transmission of SNMP trap notifications about LLDP changes	IC
show lldp config	Shows LLDP configuration settings for all ports	PE
show lldp info local-device	Shows LLDP global and interface-specific configuration settings for this device	PE
show lldp info remote-device	Shows LLDP global and interface-specific configuration settings for remote devices	PE
show lldp info statistics	Shows statistical counters for all LLDP-enabled interfaces	PE

* Vendor-specific options may or may not be advertised by neighboring devices.

lldp

This command enables LLDP globally on the switch. Use the **no** form to disable LLDP.

Syntax

[no] lldp

Default Setting

Enabled

Command Mode

Global Configuration

Example

```
Console(config)#lldp
Console(config)#
```

lldp holdtime-multiplier

This command configures the time-to-live (TTL) value sent in LLDP advertisements. Use the **no** form to restore the default setting.

Syntax

lldp holdtime-multiplier *value*

no lldp holdtime-multiplier

value - Calculates the TTL in seconds based on the following rule: minimum of ((Transmission Interval * Holdtime Multiplier), or 65536)

(Range: 2 - 10)

Default Setting

Holdtime multiplier: 4
TTL: 4*30 = 120 seconds

Command Mode

Global Configuration

Command Usage

- The time-to-live tells the receiving LLDP agent how long to retain all information pertaining to the sending LLDP agent if it does not transmit updates in a timely manner.

Example

```
Console(config)#lldp holdtime-multiplier 10
Console(config)#
```

lldp med-fast-start-count

This command specifies the amount of MED Fast Start LLDPDUs to transmit during the activation process of the LLDP-MED Fast Start mechanism. Use the **no** form to restore the default setting.

Syntax

lldp med-fast-start-count *packet-number*

no lldp med-fast-start-count

packet-number - Amount of packets. (Range: 1-10 packets; Default: 4 packets)

Default Setting

4 packets

Command Mode

Global Configuration

Command Usage

This parameter is part of the timer which ensures that the LLDP-MED Fast Start mechanism is active for the port. LLDP-MED Fast Start is critical to the timely startup of LLDP, and therefore integral to the rapid availability of Emergency Call Service.

Example

```
Console(config)#lldp med-fast-start-count 6
Console(config)#
```

lldp notification-interval

This command configures the allowed interval for sending SNMP notifications about LLDP MIB changes. Use the **no** form to restore the default setting.

Syntax

lldp notification-interval *seconds*

no lldp notification-interval

seconds - Specifies the periodic interval at which SNMP notifications are sent. (Range: 5 - 3600 seconds)

Default Setting

5 seconds

Command Mode
Global Configuration

Command Usage
- This parameter only applies to SNMP applications which use data stored in the LLDP MIB for network monitoring or management.
- Information about changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a notification are included in the transmission. An SNMP agent should therefore periodically check the value of lldpStatsRemTableLastChangeTime to detect any lldpRemTablesChange notification-events missed due to throttling or transmission loss.

Example
```
Console(config)#lldp notification-interval 30
Console(config)#
```

lldp refresh-interval

This command configures the periodic transmit interval for LLDP advertisements. Use the **no** form to restore the default setting.

Syntax
lldp refresh-interval *seconds*

no lldp refresh-delay

seconds - Specifies the periodic interval at which LLDP advertisements are sent. (Range: 5 - 32768 seconds)

Default Setting
30 seconds

Command Mode
Global Configuration

Example
```
Console(config)#lldp refresh-interval 60
Console(config)#
```

lldp reinit-delay

This command configures the delay before attempting to re-initialize after LLDP ports are disabled or the link goes down. Use the **no** form to restore the default setting.

Syntax

lldp reinit-delay *seconds*

no lldp reinit-delay

seconds - Specifies the delay before attempting to re-initialize LLDP. (Range: 1 - 10 seconds)

Default Setting

2 seconds

Command Mode

Global Configuration

Command Usage

When LLDP is re-initialized on a port, all information in the remote systems LLDP MIB associated with this port is deleted.

Example

```
Console(config)#lldp reinit-delay 10
Console(config)#
```

lldp tx-delay

This command configures a delay between the successive transmission of advertisements initiated by a change in local LLDP MIB variables. Use the no form to restore the default setting.

Syntax

lldp tx-delay *seconds*

no lldp tx-delay

seconds - Specifies the transmit delay. (Range: 1 - 8192 seconds)

Default Setting

2 seconds

Command Mode

Global Configuration

Command Usage

- The transmit delay is used to prevent a series of successive LLDP transmissions during a short period of rapid changes in local LLDP MIB objects, and to increase the probability that multiple, rather than single changes, are reported in each transmission.

- This attribute must comply with the following rule:
  (4 * tx-delay) ≤ refresh-interval

Example

```
Console(config)#lldp tx-delay 10
Console(config)#
```

lldp portid-subtype

This command configures the LLDP port ID subtype to either the MAC address or the interface name.

Syntax

lldp portid-subtype {interface-name | mac-address}

interface-name - Specifies LLDP interface name subtype.

mac-address - Specifies LLDP MAC address subtype.

Default Setting

MAC address

Command Mode

Global Configuration

Command Usage

When the port ID subtype is set to interface-name, the port ID is displayed in the format "Ethernet 1/1."

Example

```
Console(config)#lldp portid-subtype interface-name
Console(config)#
```

lldp admin-status

This command enables LLDP transmit, receive, or transmit and receive mode on the specified port. Use the no form to disable this feature.

Syntax

lldp admin-status {rx-only | tx-only | tx-rx}

no lldp admin-status

rx-only - Only receive LLDP PDUs.

tx-only - Only transmit LLDP PDUs.

tx-rx - Both transmit and receive LLDP Protocol Data Units (PDUs).

Default Setting

tx-rx

Command Mode
Interface Configuration (Ethernet, Port Channel)

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp admin-status rx-only
Console(config-if)#
```

lldp basic-tlv management-ip-address

This command configures an LLDP-enabled port to advertise the management address for this device. Use the **no** form to disable this feature.

Syntax

[no] lldp basic-tlv management-ip-address

Default Setting
Enabled

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
- The management address protocol packet includes the IPv4 address of the switch. If no management address is available, the address should be the MAC address for the CPU or for the port sending this advertisement.
- The management address TLV may also include information about the specific interface associated with this address, and an object identifier indicating the type of hardware component or protocol entity associated with this address. The interface number and OID are included to assist SNMP applications to perform network discovery by indicating enterprise specific or other starting points for the search, such as the Interface or Entity MIB.
- Since there are typically a number of different addresses associated with a Layer 3 device, an individual LLDP PDU may contain more than one management address TLV.
- Every management address TLV that reports an address that is accessible on a port and protocol VLAN through the particular port should be accompanied by a port and protocol VLAN TLV that indicates the VLAN identifier (VID) associated with the management address reported by this TLV.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv management-ip-address
Console(config-if)#
```

lldp basic-tlv management-ipv6-address

This command configures an LLDP-enabled port to advertise the management IPv6 address for this device. Use the **no** form to disable this feature.

Syntax

[no] lldp basic-tlv management-ipv6-address

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- If both the management-ip-address and the IPv4 address of a VLAN interface is configured, the primary IPv4 address of the VLAN ID will be sent in the Management Address TLV of the LLDP PDU transmitted.
- If both the management-ipv6-address and the IPv6 address of a VLAN interface is configured, the IPv6 address of the VLAN ID will be sent in the Management Address TLV of the LLDP PDU transmitted.
- Two Management Address TLVs in the LLDP PDU will be sent if both of the two conditions below are true:
  - The interface has both commands configured i.e. management-ip-address and management-ipv6-address.
  - The VLAN interface has both IPv4 and IPv6 addresses set.

  One address will be the IPv4 address and the other will be the IPv6 address.
- If either or both the management-ip-address or management-ipv6-address are configured

  - and -

  Neither the IPv4 address nor the IPv6 address of a VLAN interface is configured.

  The CPU MAC address (or device MAC address) will be sent in the Management Address TLV of the LLDP PDU transmitted.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv management-ipv6-address
Console(config-if)#
```

lldp basic-tlv port-description

This command configures an LLDP-enabled port to advertise its port description. Use the **no** form to disable this feature.

Syntax

[no] lldp basic-tlv port-description

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

The port description is taken from the ifDescr object in RFC 2863, which includes information about the manufacturer, the product name, and the version of the interface hardware/software.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv port-description
Console(config-if)#
```

lldp basic-tlv system-capabilities

This command configures an LLDP-enabled port to advertise its system capabilities. Use the **no** form to disable this feature.

Syntax

[no] lldp basic-tlv system-capabilities

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

The system capabilities identifies the primary function(s) of the system and whether or not these primary functions are enabled. The information advertised by this TLV is described in IEEE 802.1AB.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv system-capabilities
Console(config-if)#
```

lldp basic-tlv system-description

This command configures an LLDP-enabled port to advertise the system description. Use the no form to disable this feature.

Syntax

[no] lldp basic-tlv system-description

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

The system description is taken from the sysDescr object in RFC 3418, which includes the full name and version identification of the system's hardware type, software operating system, and networking software.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv system-description
Console(config-if)#
```

lldp basic-tlv system-name

This command configures an LLDP-enabled port to advertise the system name. Use the no form to disable this feature.

Syntax

[no] lldp basic-tlv system-name

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

The system name is taken from the sysName object in RFC 3418, which contains the system's administratively assigned name, and is in turn based on the hostname command.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp basic-tlv system-name
Console(config-if)#
```

lldp dot1-tlv proto-ident

This command configures an LLDP-enabled port to advertise the supported protocols. Use the **no** form to disable this feature.

Syntax

[no] lldp dot1-tlv proto-ident

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises the protocols that are accessible through this interface.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dot1-tlv proto-ident
Console(config-if)#
```

lldp dot1-tlv proto-vid

This command configures an LLDP-enabled port to advertise port-based protocol VLAN information. Use the **no** form to disable this feature.

Syntax

[no] lldp dot1-tlv proto-vid

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises the port-based protocol VLANs configured on this interface (see "Configuring Protocol-Based VLANs" on page 539).

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dot1-tlv proto-vid
Console(config-if)#
```

lldp dot1-tlv pvid

This command configures an LLDP-enabled port to advertise its default VLAN ID. Use the no form to disable this feature.

Syntax

[no] lldp dot1-tlv pvid

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

The port's default VLAN identifier (PVID) indicates the VLAN with which untagged or priority-tagged frames are associated (see the switchport native vlan command).

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dot1-tlv pvid
Console(config-if)#
```

lldp dot1-tlv vlan-name

This command configures an LLDP-enabled port to advertise its VLAN name. Use the no form to disable this feature.

Syntax

[no] lldp dot1-tlv vlan-name

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises the name of all VLANs to which this interface has been assigned. See "switchport allowed vlan" on page 515 and "protocol-vlan protocol-group (Configuring Interfaces)" on page 540.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dot1-tlv vlan-name
Console(config-if)#
```

lldp dot3-tlv link-agg

This command configures an LLDP-enabled port to advertise link aggregation capabilities. Use the **no** form to disable this feature.

Syntax

[no] lldp dot3-tlv link-agg

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises link aggregation capabilities, aggregation status of the link, and the 802.3 aggregated port identifier if this interface is currently a link aggregation member.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dot3-tlv link-agg
Console(config-if)#
```

lldp dot3-tlv mac-phy

This command configures an LLDP-enabled port to advertise its MAC and physical layer capabilities. Use the **no** form to disable this feature.

Syntax

[no] lldp dot3-tlv mac-phy

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises MAC/PHY configuration/status which includes information about auto-negotiation support/capabilities, and operational Multistation Access Unit (MAU) type.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no lldp dot3-tlv mac-phy
Console(config-if)#
```

lldp dot3-tlv max-frame

This command configures an LLDP-enabled port to advertise its maximum frame size. Use the **no** form to disable this feature.

Syntax

[no] lldp dot3-tlv max-frame

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Refer to "Frame Size" on page 85 for information on configuring the maximum frame size for this switch.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dot3-tlv max-frame
Console(config-if)#
```

lldp med-location civic-addr

This command configures an LLDP-MED-enabled port to advertise its location identification details. Use the **no** form to restore the default settings.

Syntax

lldp med-location civic-addr [[**country** *country-code*] | [**what** *device-type*] | [*ca-type ca-value*]]

no lldp med-location civic-addr [[**country**] | [**what**] | [*ca-type*]]

country-code – The two-letter ISO 3166 country code in capital ASCII letters. (Example: DK, DE or US)

device-type – The type of device to which the location applies.

0 – Location of DHCP server.

1 – Location of network element closest to client.

2 – Location of client.

ca-type – A one-octet descriptor of the data civic address value. (Range: 0-255)

ca-value – Description of a location. (Range: 1-32 characters)

Default Setting
Not advertised
No description

Command Mode
Interface Configuration (Ethernet, Port Channel)

Command Usage
- Use this command without any keywords to advertise location identification details.

- Use the *ca-type* to advertise the physical location of the device, that is the city, street number, building and room information. The address location is specified as a type and value pair, with the civic address (CA) type being defined in RFC 4776. The following table describes some of the CA type numbers and provides examples.

Table 115: LLDP MED Location CA Types

CA Type	Description	CA Value Example
0	The ISO 639 language code used for presenting the address information.	en
1	National subdivisions (state, canton, province)	California
2	County, parish	Orange
3	City, township	Irvine
4	City division, borough, city district	West Irvine
5	Neighborhood, block	Riverside
6	Group of streets below the neighborhood level	Exchange
18	Street suffix or type	Avenue
19	House number	320
20	House number suffix	A
21	Landmark or vanity address	Tech Center
26	Unit (apartment, suite)	Apt 519
27	Floor	5
28	Room	509B

  Any number of CA type and value pairs can be specified for the civic address location, as long as the total does not exceed 250 characters.

- For the location options defined for *device-type*, normally option 2 is used to specify the location of the client device. In situations where the client device location is not known, 0 and 1 can be used, providing the client device is physically close to the DHCP server or network element.

Example

The following example enables advertising location identification details.

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp med-location civic-addr
Console(config-if)#lldp med-location civic-addr 1 California
Console(config-if)#lldp med-location civic-addr 2 Orange
Console(config-if)#lldp med-location civic-addr 3 Irvine
Console(config-if)#lldp med-location civic-addr 4 West Irvine
Console(config-if)#lldp med-location civic-addr 6 Exchange
Console(config-if)#lldp med-location civic-addr 18 Avenue
Console(config-if)#lldp med-location civic-addr 19 320
Console(config-if)#lldp med-location civic-addr 27 5
Console(config-if)#lldp med-location civic-addr 28 509B
Console(config-if)#lldp med-location civic-addr country US
Console(config-if)#lldp med-location civic-addr what 2
Console(config-if)#
```

lldp med-notification

This command enables the transmission of SNMP trap notifications about LLDP-MED changes. Use the **no** form to disable LLDP-MED notifications.

Syntax

[no] lldp med-notification

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- This option sends out SNMP trap notifications to designated target stations at the interval specified by the lldp notification-interval command. Trap notifications include information about state changes in the LLDP MIB (IEEE 802.1AB), the LLDP-MED MIB (ANSI/TIA 1057), or organization-specific LLDP-EXT-DOT1 and LLDP-EXT-DOT3 MIBs.

- SNMP trap destinations are defined using the snmp-server host command.

- Information about additional changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a trap notification are included in the transmission. An SNMP agent should therefore periodically check the value of lldpStatsRemTableLastChangeTime to detect any lldpRemTablesChange notification-events missed due to throttling or transmission loss.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp med-notification
Console(config-if)#
```

lldp med-tlv inventory

This command configures an LLDP-MED-enabled port to advertise its inventory identification details. Use the **no** form to disable this feature.

Syntax

[no] lldp med-tlv inventory

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises device details useful for inventory management, such as manufacturer, model, software version and other pertinent information.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp med-tlv inventory
Console(config-if)#
```

lldp med-tlv location

This command configures an LLDP-MED-enabled port to advertise its location identification details. Use the **no** form to disable this feature.

Syntax

[no] lldp med-tlv location

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises location identification details.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp med-tlv location
Console(config-if)#
```

lldp med-tlv med-cap

This command configures an LLDP-MED-enabled port to advertise its Media Endpoint Device capabilities. Use the **no** form to disable this feature.

Syntax

[no] lldp med-tlv med-cap

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises LLDP-MED TLV capabilities, allowing Media Endpoint and Connectivity Devices to efficiently discover which LLDP-MED related TLVs are supported on the switch.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp med-tlv med-cap
Console(config-if)#
```

lldp med-tlv network-policy

This command configures an LLDP-MED-enabled port to advertise its network policy configuration. Use the **no** form to disable this feature.

Syntax

[no] lldp med-tlv network-policy

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

This option advertises network policy configuration information, aiding in the discovery and diagnosis of VLAN configuration mismatches on a port. Improper

network policy configurations frequently result in voice quality degradation or complete service disruption.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp med-tlv network-policy
Console(config-if)#
```

lldp notification

This command enables the transmission of SNMP trap notifications about LLDP changes in remote neighbors. Use the **no** form to disable LLDP notifications.

Syntax

[no] lldp notification

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- This option sends out SNMP trap notifications to designated target stations at the interval specified by the lldp notification-interval command. Trap notifications include information about state changes in the LLDP MIB (IEEE 802.1AB), or organization-specific LLDP-EXT-DOT1 and LLDP-EXT-DOT3 MIBs.
- SNMP trap destinations are defined using the snmp-server host command.
- Information about additional changes in LLDP neighbors that occur between SNMP notifications is not transmitted. Only state changes that exist at the time of a trap notification are included in the transmission. An SNMP agent should therefore periodically check the value of lldpStatsRemTableLastChangeTime to detect any lldpRemTablesChange notification-events missed due to throttling or transmission loss.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp notification
Console(config-if)#
```

show lldp config

This command shows LLDP configuration settings for all ports.

Syntax

show lldp config [detail *interface*]

detail - Shows configuration summary.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode

Privileged Exec

Example

The following example shows the basic LLDP parameters for Port 1.

```
Console#show lldp config detail ethernet 1/1

LLDP Port Configuration Detail
 Port                           : Eth 1/1
 Admin Status                   : Tx-Rx
 Notification Enabled           : True
 Basic TLVs Advertised          : port-description
                                  system-name
                                  system-description
                                  system-capabilities
                                  management-ip-address
 802.1 specific TLVs Advertised : port-vid
                                  vlan-name
                                  proto-vlan
                                  proto-ident
 802.3 specific TLVs Advertised : mac-phy
                                  link-agg
                                  max-frame
 MED Notification Status        : Disabled
 MED Enabled TLVs Advertised    : med-cap
                                  network-policy
                                  location
                                  inventory
 MED Location Identification
  Location Data Format : Civic Address LCI
  Country Name         : DK
  What                 : 2 - DHCP Client
  CA Type 1            : 12
  CA Type 13           : 13

Console#
```

show lldp info local-device

This command shows LLDP global and interface-specific configuration settings for this device.

Syntax

show lldp info local-device [**detail** *interface*]

detail - Shows configuration summary.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode

Privileged Exec

Example

```
Console#show lldp info local-device
 LLDP Local Global Information
  Chassis Type : MAC Address
  Chassis ID   : 00-01-02-03-04-05
  System Name  :
  System Description : ECS5550-54X
  System Capabilities Support : Bridge
  System Capabilities Enabled : Bridge
  Management Address : 192.168.0.101 (IPv4)

 LLDP Port Information
  Port    Port ID Type     Port ID           Port Description
 -------- ---------------- ----------------- --------------------------------
 Eth 1/1  MAC Address      00-12-CF-DA-FC-E9 Ethernet Port on unit 1, port 1
 Eth 1/2  MAC Address      00-12-CF-DA-FC-EA Ethernet Port on unit 1, port 2
 Eth 1/3  MAC Address      00-12-CF-DA-FC-EB Ethernet Port on unit 1, port 3
 Eth 1/4  MAC Address      00-12-CF-DA-FC-EC Ethernet Port on unit 1, port 4
.
.
.
Console#show lldp info local-device detail ethernet 1/1
LLDP Local Port Information Detail
 Port             : Eth 1/1
 Port ID Type     : MAC Address
 Port ID          : 00-12-CF-DA-FC-E9
 Port Description : Ethernet Port on unit 1, port 1
 MED Capability   : LLDP-MED Capabilities
                    Network Policy
                    Location Identification
                    Inventory

Console#
```

show lldp info remote-device

This command shows LLDP global and interface-specific configuration settings for remote devices attached to an LLDP-enabled port.

Syntax

show lldp info remote-device [**detail** *interface*]

detail - Shows detailed information.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode

Privileged Exec

Example

Note that an IP phone or other end-node device which advertises LLDP-MED capabilities must be connected to the switch for information to be displayed in the "LLDP-MED Capability" and other related fields.

```
Console#show lldp info remote-device
 LLDP Remote Devices Information
  Local Port Chassis ID        Port ID           System Name
  ---------- ----------------- ----------------- ----------------------------
  Eth 1/1   00-E0-0C-00-00-FD 00-E0-0C-00-01-02

Console#show lldp info remote-device detail ethernet 1/1
LLDP Remote Devices Information Detail
------------------------------------------------------------------
 Index                : 2
 Chassis Type         : MAC Address
 Chassis ID           : 70-72-CF-91-1C-B2
 Port ID Type         : MAC Address
 Port ID              : 70-72-CF-91-1C-B4
 Time To Live         : 120 seconds
 Port Description     : Ethernet Port on unit 1, port 2
 System Description   : ECS5550-54X
 System Capabilities  : Bridge
 Enabled Capabilities : Bridge

 Management Address : 192.168.0.4 (IPv4)

 Port VLAN ID : 1

 Port and Protocol VLAN ID : supported, disabled

 VLAN Name : VLAN    1 - DefaultVlan

 Protocol Identity (Hex) : 88-CC

 MAC/PHY Configuration/Status
  Port Auto-neg Supported           : Yes
  Port Auto-neg Enabled             : Yes
```

```
  Port Auto-neg Advertised Cap (Hex) : 6C00
  Port MAU Type                      : 16

 Power via MDI
  Power Class             : PSE
  Power MDI Supported     : Yes
  Power MDI Enabled       : Yes
  Power Pair Controllable : No
  Power Pairs             : Spare
  Power Classification    : Class 1

 Link Aggregation
  Link Aggregation Capable : Yes
  Link Aggregation Enable  : No
  Link Aggregation Port ID : 0

 Max Frame Size : 1522

Console#
```

The following example shows information which is displayed for end-node device which advertises LLDP-MED TLVs.

```
...
  LLDP-MED Capability :
    Device Class                  : Network Connectivity
    Supported Capabilities        : LLDP-MED Capabilities
                                    Network Policy
                                    Location Identification
                                    Extended Power via MDI - PSE
                                    Inventory
    Current Capabilities          : LLDP-MED Capabilities
                                    Location Identification
                                    Extended Power via MDI - PSE
                                    Inventory
  Location Identification :
    Location Data Format          : Civic Address LCI
    Country Name                  : TW
    What                          : 2
  Extended Power via MDI :
    Power Type                    : PSE
    Power Source                  : Unknown
    Power Priority                : Unknown
    Power Value                   : 0 Watts
  Inventory          :
    Hardware Revision             : R0A
    Firmware Revision             : 1.2.6.0
    Software Revision             : 1.2.6.0
    Serial Number                 : S123456
    Manufacture Name              : Prye
    Model Name                    : VP101
    Asset ID                      : 340937
Console#
```

show lldp info statistics

This command shows statistics based on traffic received through all attached LLDP-enabled interfaces.

Syntax

show lldp info statistics [**detail** *interface*]

detail - Shows configuration summary.

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode

Privileged Exec

Example

```
Console#show lldp info statistics
LLDP Global Statistics
 Neighbor Entries List Last Updated : 485 seconds
 New Neighbor Entries Count         : 2
 Neighbor Entries Deleted Count     : 1
 Neighbor Entries Dropped Count     : 0
 Neighbor Entries Ageout Count      : 1

LLDP Port Statistics
 Port     NumFramesRecvd NumFramesSent NumFramesDiscarded
 -------- -------------- ------------- ------------------
 Eth 1/1              12            12                  0
 Eth 1/2              17            17                  0
 Eth 1/3               0             0                  0
 Eth 1/4               0             0                  0
 Eth 1/5               0             0                  0
⋮
Console#show lldp info statistics detail ethernet 1/1
LLDP Port Statistics Detail
 Port Name         : Eth 1/1
 Frames Discarded  : 0
 Frames Invalid    : 0
 Frames Received   : 12
 Frames Sent       : 12
 TLVs Unrecognized : 0
 TLVs Discarded    : 0
 Neighbor Ageouts  : 1
Console#
```

29 CFM Commands

Connectivity Fault Management (CFM) is an OAM protocol that includes proactive connectivity monitoring using continuity check messages, fault verification through loop back messages, and fault isolation by examining end-to-end connections between provider edge devices or between customer edge devices.

CFM is implemented as a service level protocol based on service instances which encompass only that portion of the metropolitan area network supporting a specific customer. CFM can also provide controlled management access to a hierarchy of maintenance domains (such as the customer, service provider, and equipment operator).

The following list of commands support functions for defining the CFM structure, including domains, maintenance associations, and maintenance access points. It also provides commands for fault detection through continuity check messages for all known maintenance points, and cross-check messages for statically configured maintenance points located on other devices. Fault verification is supported through loop back messages, and fault isolation through link trace messages. Fault notification is also provided by SNMP alarms which are automatically generated by maintenance points when connectivity faults or configuration errors are detected in the local maintenance domain.

Table 116: CFM Commands

Command	Function	Mode
Defining CFM Structures		
ethernet cfm ais level	Configures the maintenance level at which Alarm Indication Signal information will be sent	GC
ethernet cfm ais ma	Enables the MEPs within the specified MA to send frames with AIS information	GC
ethernet cfm ais period	Configures the interval at which AIS information is sent	GC
ethernet cfm ais suppress alarm	Suppresses AIS messages following the detection of defect conditions	GC
ethernet cfm domain	Defines a CFM maintenance domain, sets the authorized maintenance level, and enters CFM configuration mode; also specifies the MIP creation method for MAs within this domain	GC
ethernet cfm enable	Enables CFM processing globally on the switch	GC
ma index name	Creates a maintenance association within the current maintenance domain, maps it to a customer service instance, and sets the manner in which MIPs are created for this service instance	CFM

Table 116: CFM Commands (Continued)

Command	Function	Mode
ma index name-format	Specifies the name format for the maintenance association as IEEE 802.1ag character based, or ITU-T SG13/SG15 Y.1731 defined ICC-based format	CFM
ethernet cfm mep	Sets an interface as a domain boundary, defines it as a maintenance end point (MEP), and sets direction of the MEP in regard to sending and receiving CFM messages	IC
ethernet cfm port-enable	Enables CFM processing on an interface	IC
clear ethernet cfm ais mpid	Clears AIS defect information for the specified MEP	PE
show ethernet cfm configuration	Displays CFM configuration settings, including global settings, SNMP traps, and interface settings	PE
show ethernet cfm md	Displays configured maintenance domains	PE
show ethernet cfm ma	Displays configured maintenance associations	PE
show ethernet cfm maintenance-points local	Displays maintenance points configured on this device	PE
show ethernet cfm maintenance-points local detail mep	Displays detailed CFM information about a specified local MEP in the continuity check database	PE
show ethernet cfm maintenance-points remote detail	Displays detailed CFM information about a specified remote MEP in the continuity check database	PE
Continuity Check Operations		
ethernet cfm cc ma interval	Sets the transmission delay between continuity check messages	GC
ethernet cfm cc enable	Enables transmission of continuity check messages within a specified maintenance association	GC
snmp-server enable traps ethernet cfm cc	Enables SNMP traps for CFM continuity check events	GC
mep archive-hold-time	Sets the time that data from a missing MEP is kept in the continuity check database before being purged	CFM
clear ethernet cfm maintenance-points remote	Clears the contents of the continuity check database	PE
clear ethernet cfm errors	Clears continuity check errors logged for the specified maintenance domain and maintenance level	PE
show ethernet cfm errors	Displays CFM continuity check errors logged on this device	PE
Cross Check Operations		
ethernet cfm mep crosscheck start-delay	Sets the maximum delay that a device waits for remote MEPs to come up before starting the cross-check operation	GC
snmp-server enable traps ethernet cfm crosscheck	Enables SNMP traps for CFM continuity check events, in relation to the cross-check operations between statically configured MEPs and those learned via continuity check messages	GC
mep crosscheck mpid	Statically defines a remote MEP in a maintenance association	CFM

Table 116: CFM Commands (Continued)

Command	Function	Mode
ethernet cfm mep crosscheck	Enables cross-checking between the list of configured remote MEPs within a maintenance association and MEPs learned through continuity check messages	PE
show ethernet cfm maintenance-points remote crosscheck	Displays information about remote maintenance points configured statically in a cross-check list	PE
Link Trace Operations		
ethernet cfm linktrace cache	Enables caching of CFM data learned through link trace messages	GC
ethernet cfm linktrace cache hold-time	Sets the hold time for CFM link trace cache entries	GC
ethernet cfm linktrace cache size	Sets the maximum size for the link trace cache	GC
ethernet cfm linktrace	Sends CFM link trace messages to the MAC address for a MEP	PE
clear ethernet cfm linktrace-cache	Clears link trace messages logged on this device	PE
show ethernet cfm linktrace-cache	Displays the contents of the link trace cache	PE
Loopback Operations		
ethernet cfm loopback	Sends CFM loopback messages to a MAC address for a MEP or MIP	PE
Fault Generator Operations		
mep fault-notify alarm-time	Sets the time a defect must exist before a fault alarm is issued	CFM
mep fault-notify lowest-priority	Sets the lowest priority defect that is allowed to generate a fault alarm	CFM
mep fault-notify reset-time	Configures the time after a fault alarm has been issued, and no defect exists, before another fault alarm can be issued	CFM
show ethernet cfm fault-notify-generator	Displays configuration settings for the fault notification generator	PE
Delay Measure Operations		
ethernet cfm delay-measure two-way	Sends periodic delay-measure requests to a specified MEP within a maintenance association	PE

Basic Configuration Steps for CFM

1. Configure the maintenance domains with the ethernet cfm domain command.
2. Configure the maintenance associations with the ma index name command.
3. Configure the local maintenance end points (MEPs) which will serve as the domain service access points for the specified maintenance association using the ethernet cfm mep command.

4. Enter a static list of MEPs assigned to other devices within the same maintenance association using the mep crosscheck mpid command. This allows CFM to automatically verify the functionality of these remote end points by cross-checking the static list configured on this device against information learned through continuity check messages.

5. Enable CFM globally on the switch with the ethernet cfm enable command.

6. Enable CFM on the local MEPs with the ethernet cfm port-enable command.

7. Enable continuity check operations with the ethernet cfm cc enable command.

8. Enable cross-check operations with the ethernet cfm mep crosscheck command.

Other configuration changes may be required for your particular environment, such as adjusting the interval at which continuity check messages are sent (page 769), or setting the start-up delay for the cross-check operation (page 774). You can also enable SNMP traps for events discovered by continuity check messages (page 771) or cross-check messages (page 775).

Defining CFM Structures

ethernet cfm ais level

This command configures the maintenance level at which Alarm Indication Signal (AIS) information will be sent within the specified MA. Use the **no** form restore the default setting.

Syntax

ethernet cfm ais level *level-id* **md** *domain-name* **ma** *ma-name*

no ethernet cfm ais level md *domain-name* **ma** *ma-name*

level-id – Maintenance level at which AIS information will be sent. (Range: 0-7)

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

Default Setting

Level 0

Command Mode

Global Configuration

Command Usage

The configured AIS level must be higher than the maintenance level of the domain containing the specified MA.

Example

This example sets the maintenance level for sending AIS messages within the specified MA.

```
Console(config)#ethernet cfm ais level 4 md voip ma rd
Console(config)#
```

ethernet cfm ais ma

This command enables the MEPs within the specified MA to send frames with AIS information following detection of defect conditions. Use the **no** form to disable this feature.

Syntax

[no] **ethernet cfm ais md** *domain-name* **ma** *ma-name*

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – Maintenance association name[13]. (Range: 1-43 alphanumeric characters)

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- Each MA name must be unique within the CFM domain.
- Frames with AIS information can be issued at the client's maintenance level by a MEP upon detecting defect conditions. For example, defect conditions may include:
  - Signal failure conditions if continuity checks are enabled.
  - AIS condition or LCK condition if continuity checks are disabled.
- A MEP continues to transmit periodic frames with AIS information until the defect condition is removed.

Example

This example enables the MEPs within the specified MA to send frames with AIS information.

```
Console(config)#ethernet cfm ais md voip ma rd
Console(config)#
```

13. The total length of the MD name and MA name cannot exceed 44 characters.

ethernet cfm ais period

This command configures the interval at which AIS information is sent. Use the **no** form to restore the default setting.

Syntax

ethernet cfm ais period *period* **md** *domain-name* **ma** *ma-name*

no ethernet cfm ais period md *domain-name* **ma** *ma-name*

period – The interval at which AIS information is sent. (Options: 1 second, 60 seconds)

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

Default Setting

1 second

Command Mode

Global Configuration

Example

This example sets the interval for sending frames with AIS information at 60 seconds.

```
Console(config)#ethernet cfm ais period 60 md voip ma rd
Console(config)#
```

ethernet cfm ais suppress alarm

This command suppresses sending frames containing AIS information following the detection of defect conditions. Use the **no** form to restore the default setting.

Syntax

[**no**] **ethernet cfm ais suppress alarm md** *domain-name* **ma** *ma-name*

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

Default Setting

Suppression is disabled

Command Mode

Global Configuration

Command Usage

- For multipoint connectivity, a MEP cannot determine the specific maintenance level entity that has encountered defect conditions upon receiving a frame with AIS information. More importantly, it cannot determine the associated subset of its peer MEPs for which it should suppress alarms since the received AIS information does not contain that information. Therefore, upon reception of a frame with AIS information, the MEP will suppress alarms for all peer MEPs whether there is still connectivity or not.

- However, for a point-to-point connection, a MEP has only a single peer MEP for which to suppress alarms when it receives frames with AIS information.

- If suppression is enabled by this command, upon receiving a frame with AIS information, a MEP detects an AIS condition and suppresses loss of continuity alarms associated with all its peer MEPs. A MEP resumes loss of continuity alarm generation upon detecting loss of continuity defect conditions in the absence of AIS messages.

Example

This example suppresses sending frames with AIS information.

```
Console(config)#ethernet cfm ais suppress alarm md voip ma rd
Console(config)#
```

ethernet cfm domain

This command defines a CFM maintenance domain, sets the authorized maintenance level, and enters CFM configuration mode. Use the **no** form to delete a CFM maintenance domain.

Syntax

ethernet cfm domain index *index* **name** *domain-name* **level** *level-id* [**mip-creation** *type*]

no ethernet cfm domain index *index*

index – Domain index. (Range: 1-65535)

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

level-id – Authorized maintenance level for this domain. (Range: 0-7)

type – Specifies the CFM protocol's creation method for maintenance intermediate points (MIPs) in this domain:

default – MIPs can be created for any maintenance association (MA) configured in this domain on any bridge port through which the MA's VID can pass.

explicit – MIPs can be created for any MA configured in this domain only on bridge ports through which the MA's VID can pass, and only if a maintenance end point (MEP) is created at some lower MA Level.

none – No MIP can be created for any MA configured in this domain.

Default Setting
No maintenance domains are configured.
No MIPs are created for any MA in the specified domain.

Command Mode
Global Configuration

Command Usage
- A domain can only be configured with one name.
- Where domains are nested, an upper-level hierarchical domain must have a higher maintenance level than the ones it encompasses. The higher to lower level domain types commonly include entities such as customer, service provider, and operator.
- More than one domain can be configured at the same maintenance level, but a single domain can only be configured with one maintenance level.
- If MEPs or MAs are configured for a domain using the ethernet cfm mep command or ma index name command, they must first be removed before you can remove the domain.
- Maintenance domains are designed to provide a transparent method of verifying and resolving connectivity problems for end-to-end connections. By default, these connections run between the domain service access points (DSAPs) within each MA defined for a domain, and are manually configured using the ethernet cfm mep command.

  In contrast, MIPs are interconnection points that make up all possible paths between the DSAPs within an MA. MIPs are automatically generated by the CFM protocol when the *mip-creation* option in this command is set to "default" or "explicit," and the MIP creation state machine is invoked (as defined in IEEE 802.1ag). The default option allows MIPs to be created for all interconnection points within an MA, regardless of the domain's level in the maintenance hierarchy (e.g., customer, provider, or operator). While the explicit option only generates MIPs within an MA if its associated domain is not at the bottom of the maintenance hierarchy. This option is used to hide the structure of network at the lowest domain level.

  The diagnostic functions provided by CFM can be used to detect connectivity failures between any pair of MEPs in an MA. Using MIPs allows these failures to be isolated to smaller segments of the network.

  Allowing the CFM to generate MIPs exposes more of the network structure to users at higher domain levels, but can speed up the process of fault detection and recovery. This trade-off should be carefully considered when designing a CFM maintenance structure.

  Also note that while MEPs are active agents which can initiate consistency check messages (CCMs), transmit loop back or link trace messages, and maintain the local CCM database. MIPs, on the other hand are passive agents which can

only validate received CFM messages, and respond to loop back and link trace messages.

The MIP creation method defined by the ma index name command takes precedence over the method defined by this command.

Example

This example creates a maintenance domain set to maintenance level 3, and enters CFM configuration mode for this domain.

```
Console(config)#ethernet cfm domain index 1 name voip level 3 mip-creation
  explicit
Console(config-ether-cfm)#
```

ethernet cfm enable

This command enables CFM processing globally on the switch. Use the **no** form to disable CFM processing globally.

Syntax

[no] **ethernet cfm enable**

Default Setting

Enabled

Command Mode

Global Configuration

Command Usage

- To avoid generating an excessive number of traps, the complete CFM maintenance structure and process parameters should be configured prior to globally enabling CFM processing with this command. Specifically, the maintenance domains, maintenance associations, and MEPs should be configured on each participating bridge.
- When CFM is enabled, hardware resources are allocated for CFM processing.

Example

This example enables CFM globally on the switch.

```
Console(config)#ethernet cfm enable
Console(config)#
```

ma index name

This command creates a maintenance association (MA) within the current maintenance domain, maps it to a customer service instance (S-VLAN), and sets the manner in which MIPs are created for this service instance. Use the **no** form with the

vlan keyword to remove the S-VLAN from the specified MA. Or use the **no** form with only the **index** keyword to remove the MA from the current domain.

Syntax

ma index *index* **name** *ma-name* [**vlan** *vlan-list* [**mip-creation** *type*]]

no ma index *index* [**vlan** *vlan-list*]

index – MA identifier. (Range: 1-2147483647)

ma-name – MA name. (Range: 1-43 alphanumeric characters)

vlan-list - Separate nonconsecutive VLAN identifiers with a comma and no spaces; use a hyphen to designate a range of IDs. (Range: 1-4094).

type – Specifies the CFM protocol's creation method for maintenance intermediate points (MIPs) in this MA:

default – MIPs can be created for this MA on any bridge port through which the MA's VID can pass.

explicit – MIPs can be created this MA only on bridge ports through which the MA's VID can pass, and only if a maintenance end point (MEP) is created at some lower MA Level.

none – No MIP can be created for this MA.

Default Setting

None

Command Mode

CFM Domain Configuration

Command Usage

- The maintenance domain used to enter CFM domain configuration mode, the MA name and VLAN identifier specified by this command, and the DSAPs configured with the mep crosscheck mpid command create a unique service instance for each customer.
- If only the MA index and name are entered for this command, the MA will be recorded in the domain database, but will not function. No MEPs can be created until the MA is associated with a service VLAN.
- Note that multiple domains at the same maintenance level (see the ethernet cfm domain command) cannot have an MA on the same VLAN. Also, each MA name must be unique within the CFM-managed network.
- The first VLAN entered in the list by this command is the primary VLAN, and is the VLAN on which all CFM functions are executed.
- Before removing an MA, first remove all the MEPs configured for it (see the mep crosscheck mpid command).

- If the MIP creation method is not defined by this command, the creation method defined by the ethernet cfm domain command is applied to this MA. For a detailed description of the MIP types, refer to the Command Usage section under the ethernet cfm domain command.

Example

This example creates a maintenance association, binds it to VLAN 1, and allows MIPs to be created within this MA using the default method.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#ma index 1 name rd vlan 1 mip-creation default
Console(config-ether-cfm)#
```

ma index name-format

This command specifies the name format for the maintenance association as IEEE 802.1ag character based, or ITU-T SG13/SG15 Y.1731 defined ICC-based format. Use the **no** form to restore the default setting.

Syntax

ma index *index* **name-format** {**character-string** | **icc-based**}

no ma index *index* **name-format**

index – MA identifier. (Range: 1-2147483647)

character-string – IEEE 802.1ag defined character string format. This is an IETF RFC 2579 DisplayString.

icc-based – ITU-T SG13/SG15 Y.1731 defined ICC based format.

Default Setting

character-string

Command Mode

CFM Domain Configuration

Example

This example specifies the name format as character string.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#ma index 1 name-format character-string
Console(config-ether-cfm)#
```

ethernet cfm mep

This command sets an interface as a domain boundary, defines it as a maintenance end point (MEP), and sets direction of the MEP in regard to sending and receiving CFM messages. Use the **no** form to delete a MEP.

Syntax

ethernet cfm mep mpid *mpid* **md** *domain-name* **ma** *ma-name* [**up**]

no ethernet cfm mep mpid *mpid* **ma** *ma-name*

mpid – Maintenance end point identifier. (Range: 1-8191)

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

up – Indicates that the MEP faces inward toward the switch cross-connect matrix, and transmits CFM messages towards, and receives them from, the direction of the internal bridge relay mechanism. If the **up** keyword is not included in this command, then the MEP is facing away from the switch, and transmits CFM messages towards, and receives them from, the direction of the physical medium.

Default Setting

No MEPs are configured.
The MEP faces outward (down).

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- CFM elements must be configured in the following order: (1) maintenance domain at the same level as the MEP to be configured (using the ethernet cfm domain command), (2) maintenance association within the domain (using the ma index name command), and (3) finally the MEP using this command.
- An interface may belong to more than one domain. This command can be used to configure an interface as a MEP for different MAs in different domains.
- To change the MEP's MA or the direction it faces, first delete the MEP, and then create a new one.

Example

This example sets port 1 as a DSAP for the specified maintenance association.

```
Console(config)#interface ethernet 1/1
Console(config-if)#ethernet cfm mep mpid 1 md voip ma rd
Console(config-if)#
```

ethernet cfm port-enable

This command enables CFM processing on an interface. Use the **no** form to disable CFM processing on an interface.

Syntax

[no] ethernet cfm port-enable

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- An interface must be enabled before a MEP can be created with the ethernet cfm mep command.
- If a MEP has been configured on an interface with the ethernet cfm mep command, it must first be deleted before CFM can be disabled on that interface.
- When CFM is disabled, hardware resources previously used for CFM processing on that interface are released, and all CFM frames entering that interface are forwarded as normal data traffic.

Example

This example enables CFM on port 1.

```
Console(config)#interface ethernet 1/1
Console(config-if)#ethernet cfm port-enable
Console(config-if)#
```

clear ethernet cfm ais mpid

This command clears AIS defect information for the specified MEP.

Syntax

clear ethernet cfm ais mpid *mpid* **md** *domain-name* **ma** *ma-name*

mpid – Maintenance end point identifier. (Range: 1-8191)

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

Default Setting

None

Command Mode

Privileged Exec

Command Usage
This command can be used to clear AIS defect entries if a MEP does not exit the AIS state when all errors are resolved.

Example
This example clears AIS defect entries on port 1.

```
Console#clear ethernet cfm ais mpid 1 md voip ma rd
Console#
```

show ethernet cfm configuration
This command displays CFM configuration settings, including global settings, SNMP traps, and interface settings.

Syntax
show ethernet cfm configuration {**global** | **traps** | **interface** *interface*}

global – Displays global settings including CFM global status, cross-check start delay, and link trace parameters.

traps – Displays the status of all continuity check and cross-check traps.

interface – Displays CFM status for the specified interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Default Setting
None

Command Mode
Privileged Exec

Example
This example shows the global settings for CFM.

```
Console#show ethernet cfm configuration global
CFM Global Status         : Enabled
Crosscheck Start Delay    : 10 seconds
Linktrace Cache Status    : Enabled
Linktrace Cache Hold Time : 100 minutes
Linktrace Cache Size      : 100 entries
Console#
```

This example shows the configuration status for continuity check and cross-check traps.

```
Console#show ethernet cfm configuration traps
CC MEP Up Trap               :Disabled
CC MEP Down Trap             :Disabled
CC Configure Trap            :Disabled
CC Loop Trap                 :Disabled
Cross Check MEP Unknown Trap :Disabled
Cross Check MEP Missing Trap :Disabled
Cross Check MA Up            :Disabled
Console#
```

This example shows the CFM status for port 1.

```
Console#show ethernet cfm configuration interface ethernet 1/1
Ethernet 1/1 CFM Status:Enabled
Console#
```

show ethernet cfm md

This command displays the configured maintenance domains.

Syntax

show ethernet cfm md [level *level*]

level – Maintenance level. (Range: 0-7)

Default Setting

None

Command Mode

Privileged Exec

Example

This example shows all configured maintenance domains.

```
Console#show ethernet cfm md
MD Index  MD Name              Level  MIP Creation  Archive Hold Time (m.)
--------  ------------------  -----  ------------  ----------------------
       1  rd                      0  default                         100
Console#
```

show ethernet cfm ma

This command displays the configured maintenance associations.

Syntax

show ethernet cfm ma [level *level*]

level – Maintenance level. (Range: 0-7)

Default Setting
None

Command Mode
Privileged Exec

Command Usage
For a description of the values displayed in the CC Interval field, refer to the ethernet cfm cc ma interval command.

Example
This example shows all configured maintenance associations.

```
Console#show ethernet cfm ma
MD Name         MA Index MA Name         Primary VID  CC Interval MIP Creation
--------------- -------- --------------- ----------- ----------- ------------
steve                1 voip                      1           4 Default
Console#
```

show ethernet cfm maintenance-points local

This command displays the maintenance points configured on this device.

Syntax

show ethernet cfm maintenance-points local
{**mep** [**domain** *domain-name* | **interface** *interface* | **level** *level-id*] | **mip** [**domain** *domain-name* | **level** *level-id*]}

mep – Displays only local maintenance end points.

mip – Displays only local maintenance intermediate points.

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

interface – Displays CFM status for the specified interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

level-id – Maintenance level for this domain. (Range: 0-7)

Default Setting
None

Command Mode
Privileged Exec

Command Usage

- Use the **mep** keyword with this command to display the MEPs configured on this device as DSAPs through the ethernet cfm mep command.
- Using the **mip** keyword with this command to display the MIPs generated on this device by the CFM protocol when the mip-creation method is set to either "default" or "explicit" by the ethernet cfm domain command or the ma index name command.

Example

This example shows all MEPs configured on this device for maintenance domain rd.

```
Console#show ethernet cfm maintenance-points local mep
MPID MD Name          Level Direct VLAN Port     CC Status MAC Address
---- ---------------- ----- ------ ---- -------- --------- -----------------
   1 rd                   0 UP        1 Eth 1/ 1 Enabled   00-12-CF-3A-A8-C0
Console#
```

show ethernet cfm maintenance-points local detail mep

This command displays detailed CFM information about a local MEP in the continuity check database.

Syntax

show ethernet cfm maintenance-points local detail mep [**domain** *domain-name* | **interface** *interface* | **level** *level-id*]

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

interface – Displays CFM status for the specified interface.

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

level-id – Maintenance level for this domain. (Range: 0-7)

Default Setting

None

Command Mode

Privileged Exec

Example

This example shows detailed information about the local MEP on port 1.

```
Console#show ethernet cfm maintenance-points local detail mep interface
  ethernet 1/1
MEP Settings:
```

```
-------------
MPID                  : 1
MD Name               : vopu
MA Name               : r&d
MA Name Format        : Character String
Level                 : 0
Direction             : Up
Interface             : Eth 1/ 1
CC Status             : Enabled
MAC Address           : 00-E0-0C-00-00-FD
Defect Condition      : No Defect
Received RDI          : False
AIS Status            : Enabled
AIS Period            : 1 seconds
AIS Transmit Level    : Default
Suppress Alarm        : Disabled
Suppressing Alarms    : Disabled

Console#
```

show ethernet cfm maintenance-points remote detail

This command displays detailed CFM information about a remote MEP in the continuity check database.

Syntax

show ethernet cfm maintenance-points remote detail
{**mac** *mac-address* | **mpid** *mpid*}
[**domain** *domain-name* | **level** *level-id*]

mac-address – MAC address of a remote maintenance point.
This address can be entered in either of the following formats: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx

mpid – Maintenance end point identifier. (Range: 1-8191)

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

level-id – Authorized maintenance level for this domain. (Range: 0-7)

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Use the **mpid** keyword with this command to display information about a specific maintenance point, or use the **mac** keyword to display information about all maintenance points that have the specified MAC address.

Example

This example shows detailed information about the remote MEP designated by MPID 2.

```
Console#show ethernet cfm maintenance-points remote detail mpid 2
MAC Address            : 00-0D-54-FC-A2-73
Domain/Level           : voip / 3
MA Name                : rd
Primary VLAN           : 1
MPID                   : 2
Incoming Port          : Eth 1/ 2
CC Lifetime            : 645 seconds
Age of Last CC Message : 2 seconds
Frame Loss             : 137
CC Packet Statistics   : 647/1
Port State             : Up
Interface State        : Up
Crosscheck Status      : Enabled

Console#
```

Continuity Check Operations

ethernet cfm cc ma interval

This command sets the transmission delay between continuity check messages (CCMs). Use the **no** form to restore the default settings.

Syntax

ethernet cfm cc md *domain-name* **ma** *ma-name* **interval** *interval-level*

no ethernet cfm cc ma *ma-name* **interval**

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

interval-level – The transmission delay between connectivity check messages. The setting for this parameter is expressed as levels 1 through 7, which in turn map to specific intervals of time. (CCM interval field options: 1 - 300Hz, 2 - 10 milliseconds, 3 - 100 milliseconds, 4 - 1 second, 5 - 10 seconds, 6 - 1 minute, 7 - 10 minutes)

Default Setting

4 (1 second)

Command Mode

Global Configuration

Command Usage

- CCMs provide a means to discover other MEPs and to detect connectivity failures in an MA. If any MEP fails to receive three consecutive CCMs from any other MEPs in its MA, a connectivity failure is registered. The interval at which

CCMs are issued should therefore be configured to detect connectivity problems in a timely manner, as dictated by the nature and size of the MA.

- The maintenance of a MIP CCM database by a MIP presents some difficulty for bridges carrying a large number of Service Instances, and for whose MEPs are issuing CCMs at a high frequency. For this reason, slower CCM transmission rates may have to be used.

Example

This example sets the transmission delay for continuity check messages to level 7 (60 seconds).

```
Console(config)#ethernet cfm cc md voip ma rd interval 7
Console(config)#
```

ethernet cfm cc enable

This command enables the transmission of continuity check messages (CCMs) within a specified maintenance association. Use the **no** form to disable the transmission of these messages.

Syntax

[no] **ethernet cfm cc enable md** *domain-name* **ma** *ma-name*

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

Default Setting

Enabled

Command Mode

Global Configuration

Command Usage

- CCMs are multicast periodically by a MEP in order to discover other MEPs in the same MA, and to assure connectivity to all other MEPs/MIPs in the MA.

- Each CCM received is checked to verify that the MEP identifier field sent in the message does not match its own MEPID, which would indicate a duplicate MEP or network loop. If these error types are not found, the CCM is stored in the MEP's local database until aged out.

- If a maintenance point fails to receive three consecutive CCMs from any other MEP in the same MA, a connectivity failure is registered.

- If a maintenance point receives a CCM with an invalid MEPID or MA level or an MA level lower than its own, a failure is registered which indicates a configuration error or cross-connect error (i.e., overlapping MAs).

Example

This example enables continuity check messages for the specified maintenance association.

```
Console(config)#ethernet cfm cc enable md voip ma rd
Console(config)#
```

snmp-server enable traps ethernet cfm cc

This command enables SNMP traps for CFM continuity check events. Use the **no** form to disable these traps.

Syntax

[no] **snmp-server enable traps ethernet cfm cc** [**config** | **loop** | **mep-down** | **mep-up**]

config – Sends a trap if this device receives a CCM with the same MPID as its own but with a different source MAC address, indicating that a CFM configuration error exists.

loop – Sends a trap if this device receives a CCM with the same source MAC address and MPID as its own, indicating that a forwarding loop exists.

mep-down – Sends a trap if this device loses connectivity with a remote MEP, or connectivity has been restored to a remote MEP which has recovered from an error condition.

mep-up – Sends a trap if a remote MEP is discovered and added to the local database, the port state of a previously discovered remote MEP changes, or a CCM is received from a remote MEP which as an expired entry in the archived database.

Default Setting

All continuity checks are disabled.

Command Mode

Global Configuration

Command Usage

All mep-up traps are suppressed when cross-checking of MEPs is enabled because cross-check traps include more detailed status information.

Example
This example enables SNMP traps for mep-up events.

```
Console(config)#snmp-server enable traps ethernet cfm cc mep-up
Console(config)#
```

mep archive-hold-time

This command sets the time that data from a missing MEP is retained in the continuity check message (CCM) database before being purged. Use the **no** form to restore the default setting.

Syntax

mep archive-hold-time *hold-time*

hold-time – The time to retain data for a missing MEP. (Range: 1-65535 minutes)

Default Setting
100 minutes

Command Mode
CFM Domain Configuration

Command Usage
A change to the hold time only applies to entries stored in the database after this command is entered.

Example
This example sets the aging time for missing MEPs in the CCM database to 30 minutes.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#mep archive-hold-time 30
Console(config-ether-cfm)#
```

clear ethernet cfm maintenance-points remote

This command clears the contents of the continuity check database.

Syntax

clear ethernet cfm maintenance-points remote [**domain** *domain-name* | **level** *level-id*]

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

level-id – Maintenance level. (Range: 0-7)

Default Setting
None

Command Mode
Privileged Exec

Command Usage
Use this command without any keywords to clear all entries in the CCM database. Use the **domain** keyword to clear the CCM database for a specific domain, or the **level** keyword to clear it for a specific maintenance level.

Example

```
Console#clear ethernet cfm maintenance-points remote domain voip
Console#
```

clear ethernet cfm errors

This command clears continuity check errors logged for the specified maintenance domain or maintenance level.

Syntax

clear ethernet cfm errors [**domain** *domain-name* | **level** *level-id*]

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

level-id – Maintenance level. (Range: 0-7)

Default Setting
None

Command Mode
Privileged Exec

Command Usage
Use this command without any keywords to clear all entries in the error database. Use the **domain** keyword to clear the error database for a specific domain, or the **level** keyword to clear it for a specific maintenance level.

Example

```
Console#clear ethernet cfm errors domain voip
Console#
```

show ethernet cfm errors

This command displays the CFM continuity check errors logged on this device.

Syntax

show ethernet cfm errors [**domain** *domain-name* | **level** *level-id*]

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

level-id – Authorized maintenance level for this domain. (Range: 0-7)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show ethernet cfm errors
Level VLAN MPID Interface Remote MAC        Reason           MA Name
----- ---- ---- --------- ----------------- ---------------- ----------------
5      2     40 Eth 1/1   ab.2f.9c.00.05.01 LEAK             provider_1_2
Console#
```

Cross Check Operations

ethernet cfm mep crosscheck start-delay

This command sets the maximum delay that a device waits for remote MEPs to come up before starting the cross-check operation. Use the **no** form to restore the default setting.

Syntax

ethernet cfm mep crosscheck start-delay *delay*

no ethernet cfm mep crosscheck start-delay

delay – The time a device waits for remote MEPs to come up before the cross-check is started. (Range: 1-65535 seconds)

Default Setting

10 seconds

Command Mode

Global Configuration

Command Usage

- This command sets the delay that a device waits for a remote MEP to come up, and it starts cross-checking the list of statically configure remote MEPs in the local maintenance domain against the MEPs learned through CCMs.

- The cross-check start delay should be configured to a value greater than or equal to the continuity check message interval to avoid generating unnecessary traps.

Example

This example sets the maximum delay before starting the cross-check process.

```
Console(config)#ethernet cfm mep crosscheck start-delay 60
Console(config)#
```

snmp-server enable traps ethernet cfm crosscheck

This command enables SNMP traps for CFM continuity check events, in relation to the cross-check operations between statically configured MEPs and those learned via continuity check messages (CCMs). Use the **no** form to restore disable these traps.

Syntax

[no] **snmp-server enable traps ethernet cfm crosscheck** [**ma-up** | **mep-missing** | **mep-unknown**]

ma-up – Sends a trap when all remote MEPs in an MA come up.

mep-missing – Sends a trap if the cross-check timer expires and no CCMs have been received from a remote MEP configured in the static list.

mep-unknown – Sends a trap if an unconfigured MEP comes up.

Default Setting

All continuity checks are enabled.

Command Mode

Global Configuration

Command Usage

- For this trap type to function, cross-checking must be enabled on the required maintenance associations using the ethernet cfm mep crosscheck command.
- A mep-missing trap is sent if cross-checking is enabled (with the ethernet cfm mep crosscheck command), and no CCM is received for a remote MEP configured in the static list (with the mep crosscheck mpid command).
- A mep-unknown trap is sent if cross-checking is enabled, and a CCM is received from a remote MEP that is not configured in the static list.
- A ma-up trap is sent if cross-checking is enabled, and a CCM is received from all remote MEPs configured in the static list for this maintenance association.

Example

This example enables SNMP traps for mep-unknown events detected in cross-check operations.

```
Console(config)#snmp-server enable traps ethernet cfm crosscheck mep-unknown
Console(config)#
```

mep crosscheck mpid

This command statically defines a remote MEP in a maintenance association. Use the **no** form to remove a remote MEP.

Syntax

[**no**] **mep crosscheck mpid** *mpid* **ma** *ma-name*

mpid – Identifier for a maintenance end point which exists on another CFM-enabled device within the same MA. (Range: 1-8191)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

Default Setting

No remote MEPs are configured.

Command Mode

CFM Domain Configuration

Command Usage

- Use this command to statically configure remote MEPs that exist inside the maintenance association. These remote MEPs are used in the cross-check operation to verify that all endpoints in the specified MA are operational.
- Remote MEPs can only be configured with this command if domain service access points (DSAPs) have already been created with the ethernet cfm mep command at the same maintenance level and in the same MA. DSAPs are MEPs that exist on the edge of the domain, and act as primary service access points for end-to-end cross-check, loop-back, and link-trace functions.

Example

This example defines a static MEP for the specified maintenance association.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#ma index 1 name rd vlan 1
Console(config-ether-cfm)#mep crosscheck mpid 2 ma rd
Console(config-ether-cfm)#
```

ethernet cfm mep crosscheck

This command enables cross-checking between the static list of MEPs assigned to other devices within the same maintenance association and the MEPs learned through continuity check messages (CCMs). Use the **disable** keyword to stop the cross-check process.

Syntax

ethernet cfm mep crosscheck {**enable** | **disable**} **md** *domain-name* **ma** *ma-name*

enable – Starts the cross-check process.

disable – Stops the cross-check process.

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – MA name. (Range: 1-43 alphanumeric characters)

Default Setting

Enabled

Command Mode

Privileged Exec

Command Usage

- Before using this command to start the cross-check process, first configure the remote MEPs that exist on other devices inside the maintenance association using the mep crosscheck mpid command. These remote MEPs are used in the cross-check operation to verify that all endpoints in the specified MA are operational.
- The cross-check process is disabled by default, and must be manually started using this command with the **enable** keyword.

Example

This example enables cross-checking within the specified maintenance association.

```
Console#ethernet cfm mep crosscheck enable md voip ma rd
Console#
```

show ethernet cfm maintenance-points remote crosscheck

This command displays information about remote MEPs statically configured in a cross-check list.

Syntax

show ethernet cfm maintenance-points remote crosscheck [**domain** *domain-name* | **mpid** *mpid*]

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

mpid – Maintenance end point identifier. (Range: 1-8191)

Default Setting
None

Command Mode
Privileged Exec

Example
This example shows all remote MEPs statically configured on this device.

```
Console#show ethernet cfm maintenance-points remote crosscheck
MPID  MA Name               Level  VLAN  MEP Up  Remote MAC
----  --------------------  -----  ----  ------  ------------------
   2  downtown                  4     2  Yes     00-0D-54-FC-A2-73
Console#
```

Link Trace Operations

ethernet cfm linktrace cache

This command enables caching of CFM data learned through link trace messages. Use the **no** form to disable caching.

Syntax

[no] ethernet cfm linktrace cache

Default Setting
Enabled

Command Mode
Global Configuration

Command Usage
- A link trace message is a multicast CFM frame initiated by a MEP, and forwarded from MIP to MIP, with each MIP generating a link trace reply, up to the point at which the link trace message reaches its destination or can no longer be forwarded.
- Use this command to enable the link trace cache to store the results of link trace operations initiated on this device. Use the ethernet cfm linktrace command to transmit a link trace message.
- Link trace responses are returned from each MIP along the path and from the target MEP. Information stored in the cache includes the maintenance domain name, MA name, MEPID, sequence number, and TTL value.

Example
This example enables link trace caching.

```
Console(config)#ethernet cfm linktrace cache
Console(config)#
```

ethernet cfm linktrace cache hold-time

This command sets the hold time for CFM link trace cache entries. Use the **no** form to restore the default setting.

Syntax

ethernet cfm linktrace cache hold-time *minutes*

no ethernet cfm linktrace cache hold-time

minutes – The aging time for entries stored in the link trace cache. (Range: 1-65535 minutes)

Default Setting
100 minutes

Command Mode
Global Configuration

Command Usage
Before setting the aging time for cache entries, the cache must first be enabled with the ethernet cfm linktrace cache command.

Example
This example sets the aging time for entries in the link trace cache to 60 minutes.

```
Console(config)#ethernet cfm linktrace cache hold-time 60
Console(config)#
```

ethernet cfm linktrace cache size

This command sets the maximum size for the link trace cache. Use the **no** form to restore the default setting.

Syntax

ethernet cfm linktrace cache size *entries*

no ethernet cfm linktrace cache size

entries – The number of link trace responses stored in the link trace cache. (Range: 1-4095 entries)

Default Setting
100 entries

Command Mode
Global Configuration

Command Usage
- Before setting the cache size, the cache must first be enabled with the ethernet cfm linktrace cache command.
- If the cache reaches the maximum number of specified entries, or the size is set to a value less than the current number of stored entries, no new entries are added. To add additional entries, the cache size must first be increased with this command, or purged with the clear ethernet cfm linktrace-cache command.

Example
This example limits the maximum size of the link trace cache to 500 entries.

```
Console(config)#ethernet cfm linktrace cache size 500
Console(config)#
```

ethernet cfm linktrace

This command sends CFM link trace messages to the MAC address of a remote MEP.

Syntax

ethernet cfm linktrace {**dest-mep** *destination-mpid* | **src-mep** *source-mpid* {**dest-mep** *destination-mpid* | *mac-address*} | *mac-address*} **md** *domain-name* **ma** *ma-name* [**ttl** *number* | **priority** *level*]

destination-mpid – The identifier of a remote MEP that is the target of the link trace message. (Range: 1-8191)

source-mpid – The identifier of a source MEP that will send the link trace message. (Range: 1-8191)

mac-address – MAC address of a remote MEP that is the target of the link trace message. This address can be entered in either of the following formats: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

number – The time to live of the linktrace message. (Range: 0-255 hops)

level - The priority level for sending the link trace messages. (Range: 0-7, 7 highest)

Default Setting
None

Command Mode
Privileged Exec

Command Usage
- Link trace messages can be targeted to MEPs, not MIPs. Before sending a link trace message, be sure you have configured the target MEP for the specified MA.
- If the MAC address of target MEP has not been learned by any local MEP, then the linktrace may fail. Use the show ethernet cfm maintenance-points remote crosscheck command to verify that a MAC address has been learned for the target MEP.
- Link trace messages (LTMs) are sent as multicast CFM frames, and forwarded from MIP to MIP, with each MIP generating a link trace reply, up to the point at which the LTM reaches its destination or can no longer be forwarded.
- Link trace messages are used to isolate faults. However, this task can be difficult in an Ethernet environment, since each node is connected through multipoint links. Fault isolation is even more challenging since the MAC address of the target node can age out in several minutes. This can cause the traced path to vary over time, or connectivity lost if faults cause the target MEP to be isolated from other MEPs in an MA.
- When using the command line or web interface, the source MEP used by to send a link trace message is chosen by the CFM protocol. However, when using SNMP, the source MEP can be specified by the user.

Example
This example sends a link trace message to the specified MEP with a maximum hop count of 25.

```
Console#linktrace ethernet dest-mep 2 md voip ma rd ttl 25
Console#
```

clear ethernet cfm linktrace-cache

This command clears link trace messages logged on this device.

Command Mode
Privileged Exec

Example

```
Console#clear ethernet cfm linktrace-cache
Console#
```

show ethernet cfm linktrace-cache

This command displays the contents of the link trace cache.

Command Mode

Privileged Exec

Example

```
Console#show ethernet cfm linktrace-cache
Hops MA             IP / Alias              Ingress MAC       Ing. Action Relay
                    Forwarded               Egress MAC        Egr. Action
---- -------------- ----------------------- ----------------- ----------- -----
   2 rd             192.168.0.6             00-12-CF-12-12-2D ingOk       Hit
                    Not Forwarded
Console#
```

Loopback Operations

ethernet cfm loopback

This command sends CFM loopback messages to a MAC address for a MEP or MIP.

Syntax

ethernet cfm loopback {**dest-mep** *destination-mpid* | **src-mep** *source-mpid* {**dest-mep** *destination-mpid* | *mac-address*} | *mac-address*} **md** *domain-name* **ma** *ma-name* [**count** *transmit-count*] [**pattern** *padding-value*] [**priority** *priority-value*] [**size** *packet-size*]

destination-mpid – The identifier of a MEP that is the target of the loopback message. (Range: 1-8191)

source-mpid – The identifier of a source MEP that will send the loopback message. (Range: 1-8191)

mac-address – MAC address of the remote maintenance point that is the target of the loopback message. This address can be entered in either of the following formats: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

transmit-count – The number of times the loopback message is sent. (Range: 1-1024)

padding-value – Padding characters used to fill the data TLV in a loopback message. (Range: Any hexadecimal characters; Default: 0x0)

priority-value – Priority assigned to the loopback message (Range:0-7; Default: 7)

packet-size – The size of the loopback message. (Range: 64-1518 bytes)

Default Setting
Loop back count: One loopback message is sent.
Loop back size: 64 bytes

Command Mode
Privileged Exec

Command Usage
- Use this command to test the connectivity between maintenance points. If the continuity check database does not have an entry for the specified maintenance point, an error message will be displayed.
- The point from which the loopback message is transmitted (i.e., the DSAP) and the target maintenance point specified in this command must be within the same MA.
- Loop back messages can be used for fault verification and isolation after automatic detection of a fault or receipt of some other error report. Loopback messages can also used to confirm the successful restoration or initiation of connectivity. The receiving maintenance point should respond to the loop back message with a loopback reply.
- When using the command line or web interface, the source MEP used by to send a loopback message is chosen by the CFM protocol. However, when using SNMP, the source MEP can be specified by the user.

Example
This example sends a loopback message to the specified remote MEP.

```
Console#ethernet cfm loopback dest-mep 2 md rd2 ma rd2
Type ESC to abort.
Source MA Name       : rd2
Destination Address  : 00-00-09-98-00-00
Transmitted LBM      : 5
Received LBR In Time : 5
Console#
```

Fault Generator Operations

mep fault-notify alarm-time

This command sets the time a defect must exist before a fault alarm is issued. Use the **no** form to restore the default setting.

Syntax

mep fault-notify alarm-time *alarm-time*

no fault-notify alarm-time

alarm-time – The time that one or more defects must be present before a fault alarm is generated. (Range: 3-10 seconds)

Default Setting
3 seconds

Command Mode
CFM Domain Configuration

Command Usage
A fault alarm is issued when the MEP fault notification generator state machine detects that a time period configured by this command has passed with one or more defects indicated, and fault alarms are enabled at or above the priority level set by the mep fault-notify lowest-priority command.

Example
This example set the delay time before generating a fault alarm.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#mep fault-notify alarm-time 10
Console(config-ether-cfm)#
```

mep fault-notify lowest-priority

This command sets the lowest priority defect that is allowed to generate a fault alarm. Use the **no** form to restore the default setting.

Syntax

mep fault-notify lowest-priority *priority*

no fault-notify lowest-priority

priority – Lowest priority default allowed to generate a fault alarm. (Range: 1-6)

Default Setting
Priority level 2

Command Mode
CFM Domain Configuration

Command Usage
- A fault alarm can generate an SNMP notification. It is issued when the MEP fault notification generator state machine detects that a configured time period (see the mep fault-notify alarm-time command) has passed with one or more defects indicated, and fault alarms are enabled at or above the priority level set by this command. The state machine transmits no further fault alarms until it is reset by the passage of a configured time period (see the mep fault-notify reset-time command) without a defect indication. The normal procedure upon receiving a fault alarm is to inspect the reporting MEP's managed objects using an appropriate SNMP software tool, diagnose the fault, correct it, re-examine

the MEP's managed objects to see whether the MEP fault notification generator state machine has been reset, and repeat those steps until the fault is resolved.

- Only the highest priority defect currently detected is reported in the fault alarm.
- Priority defects include the following items:

Table 117: Remote MEP Priority Levels

Priority Level	Level Name	Description
1	allDef	All defects.
2	macRemErrXcon	DefMACstatus, DefRemoteCCM, DefErrorCCM, or DefXconCCM.
3	remErrXcon	DefErrorCCM, DefXconCCM or DefRemoteCCM.
4	errXcon	DefErrorCCM or DefXconCCM.
5	xcon	DefXconCCM
6	noXcon	No defects DefXconCCM or lower are to be reported.

Table 118: MEP Defect Descriptions

Field	Description
DefMACstatus	Either some remote MEP is reporting its Interface Status TLV as not isUp, or all remote MEPs are reporting a Port Status TLV that contains some value other than psUp.
DefRemoteCCM	The MEP is not receiving valid CCMs from at least one of the remote MEPs.
DefErrorCCM	The MEP has received at least one invalid CCM whose CCM Interval has not yet timed out.
DefXconCCM	The MEP has received at least one CCM from either another MAID or a lower MD Level whose CCM Interval has not yet timed out.

Example

This example sets the lowest priority defect that will generate a fault alarm.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#mep fault-notify lowest-priority 1
Console(config-ether-cfm)#
```

mep fault-notify reset-time

This command configures the time after a fault alarm has been issued, and no defect exists, before another fault alarm can be issued. Use the **no** form to restore the default setting.

Syntax

mep fault-notify reset-time *reset-time*

no fault-notify reset-time

reset-time – The time that must pass without any further defects indicated before another fault alarm can be generated. (Range: 3-10 seconds)

Default Setting

10 seconds

Command Mode

CFM Domain Configuration

Example

This example sets the reset time after which another fault alarm can be generated.

```
Console(config)#ethernet cfm domain index 1 name voip level 3
Console(config-ether-cfm)#mep fault-notify reset-time 7
Console(config-ether-cfm)#
```

show ethernet cfm fault-notify-generator

This command displays configuration settings for the fault notification generator.

Syntax

show ethernet cfm fault-notify-generator mep *mpid*

mpid – Maintenance end point identifier. (Range: 1-8191)

Default Setting

None

Command Mode

Privileged Exec

Example

This example shows the fault notification settings configured for one MEP.

```
Console#show ethernet cfm fault-notify-generator mep 1
MD Name      MA Name      Highest Defect Lowest Alarm  Alarm Time Reset Time
------------ ------------ -------------- ------------- ---------- ----------
voip         rd           none           macRemErrXcon     3sec.     10sec.
Console#
```

Delay Measure Operations

ethernet cfm delay-measure two-way

This command sends periodic delay-measure requests to a specified MEP within a maintenance association.

Syntax

ethernet cfm delay-measure two-way [**src-mep** *source-mpid*] {**dest-mep** *destination-mpid* | *mac-address*} **md** *domain-name* **ma** *ma-name* [**count** *transmit-count*] [**interval** *interval*] [**size** *packet-size*] [**timeout** *timeout*]

source-mpid – The identifier of a source MEP that will send the delay-measure message. (Range: 1-8191)

destination-mpid – The identifier of a remote MEP that is the target of the delay-measure message. (Range: 1-8191)

mac-address – MAC address of a remote MEP that is the target of the delay-measure message. This address can be entered in either of the following formats: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx

domain-name – Domain name. (Range: 1-43 alphanumeric characters)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

count – The number of times to retry sending the message if no response is received before the specified timeout. (Range: 1-5)

interval – The transmission delay between delay-measure messages. (Range: 1-5 seconds)

packet-size – The size of the delay-measure message. (Range: 64-1518 bytes)

timeout - The timeout to wait for a response. (Range: 1-5 seconds)

Default Setting

Count: 5
Interval: 1 second
Size: 64 bytes
Timeout: 5 seconds

Command Mode

Privileged Exec

Command Usage

- Delay measurement can be used to measure frame delay and frame delay variation between MEPs.
- A local MEP must be configured for the same MA before you can use this command.

- If a MEP is enabled to generate frames with delay measurement (DM) information, it periodically sends DM frames to its peer MEP in the same MA., and expects to receive DM frames back from it.

- Frame delay measurement can be made only for two-way measurements, where the MEP transmits a frame with DM request information with the TxTimeStampf (Timestamp at the time of sending a frame with DM request information), and the receiving MEP responds with a frame with DM reply information with TxTimeStampf copied from the DM request information, RxTimeStampf (Timestamp at the time of receiving a frame with DM request information), and TxTimeStampb (Timestamp at the time of transmitting a frame with DM reply information):

  Frame Delay=(RxTimeStampb-TxTimeStampf)-(TxTimeStampb-RxTimeStampf)

- The MEP can also make two-way frame delay variation measurements based on its ability to calculate the difference between two subsequent two-way frame delay measurements.

Example

This example sends periodic delay-measure requests to a remote MEP.

```
Console#ethernet cfm delay-measure two-way dest-mep 1 md voip ma rd
Type ESC to abort.
Sending 5 Ethernet CFM delay measurement message, timeout is 5 sec.
Sequence  Delay Time (ms.)  Delay Variation (ms.)
--------  ----------------  ----------------------
       1              < 10                       0
       2              < 10                       0
       3              < 10                       0
       4                40                      40
       5              < 10                      40
Success rate is 100% (5/5), delay time min/avg/max=0/8/40 ms.
Average frame delay variation is 16 ms.
Console#
```

30 OAM Commands

The switch provides OAM (Operation, Administration, and Maintenance) remote management tools required to monitor and maintain the links to subscriber CPEs (Customer Premise Equipment). This section describes functions including enabling OAM for selected ports, loop back testing, and displaying device information.

Table 119: OAM Commands

Command	Function	Mode
efm oam	Enables OAM services	IC
efm oam critical-link-event	Enables reporting of critical event or dying gasp	IC
efm oam link-monitor frame	Enables reporting of errored frame link events	IC
efm oam link-monitor frame threshold	Sets the threshold for errored frame link events	IC
efm oam link-monitor frame window	Sets the monitor period for errored frame link events	IC
efm oam mode	Sets the OAM operational mode to active or passive	IC
clear efm oam counters	Clears statistical counters for various OAMPDU message types	PE
clear efm oam event-log	Clears all entries from the OAM event log for the specified port	PE
efm oam remote-loopback	Initiates or terminates remote loopback test	PE
efm oam remote-loopback test	Performs remote loopback test, sending a specified number of packets	PE
show efm oam counters interface	Displays counters for various OAM PDU message types	NE,PE
show efm oam event-log interface	Displays OAM event log	NE,PE
show efm oam remote-loopback interface	Displays results of OAM remote loopback test	NE,PE
show efm oam status interface	Displays OAM configuration settings and event counters	NE,PE
show efm oam status remote interface	Displays information about attached OAM-enabled devices	NE,PE

efm oam

This command enables OAM functions on the specified port. Use the **no** form to disable this function.

Syntax

[no] efm oam

Default Setting

Disabled

Command Mode

Interface Configuration

Command Usage

- If the remote device also supports OAM, both exchange Information OAMPDUs to establish an OAM link.
- Not all CPEs support OAM functions, and OAM is therefore disabled by default. If the CPE attached to a port supports OAM, then this functionality must first be enabled by the **efm oam** command to gain access to other remote configuration functions.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam
Console(config-if)#
```

efm oam critical-link-event

This command enables reporting of critical events. Use the **no** form to disable this function.

Syntax

[no] efm oam critical-link-event {critical-event}

critical-event - If a critical event occurs, the local OAM entity (this switch) indicates this to its peer by setting the appropriate flag in the next OAMPDU to be sent and stores this information in its OAM event log.

Default Setting

Enabled

Command Mode

Interface Configuration

Command Usage

Critical events are vendor-specific and may include various failures, such as abnormal voltage fluctuations, out-of-range temperature detected, fan failure, CRC error in flash memory, insufficient memory, or other hardware faults.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam critical-link-event critical-event
Console(config-if)#
```

efm oam link-monitor frame

This command enables reporting of errored frame link events. Use the **no** form to disable this function.

Syntax

[no] efm oam link-monitor frame

Default Setting

Enabled

Command Mode

Interface Configuration

Command Usage

- An errored frame is a frame in which one or more bits are errored.
- If this feature is enabled and an errored frame link event occurs, the local OAM entity (this switch) sends an Event Notification OAMPDU.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam link-monitor frame
Console(config-if)#
```

efm oam link-monitor frame threshold

This command sets the threshold for errored frame link events. Use the **no** form to restore the default setting.

Syntax

efm oam link-monitor frame threshold *count*

no efm oam link-monitor frame threshold

count - The threshold for errored frame link events. (Range: 1-65535)

Default Setting

1

Command Mode

Interface Configuration

Command Usage

If this feature is enabled, an event notification message is sent if the threshold is reached or exceeded within the period specified by the efm oam link-monitor frame window command. The Errored Frame Event TLV includes the number of errored frames detected during the specified period.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam link-monitor frame threshold 5
Console(config-if)#
```

efm oam link-monitor frame window

This command sets the monitor period for errored frame link events. Use the **no** form to restore the default setting.

Syntax

efm oam link-monitor frame window *size*

no efm oam link-monitor frame window

size - The period of time in which to check the reporting threshold for errored frame link events. (Range: 10-65535 units of 10 milliseconds)

Default Setting

10 (units of 100 milliseconds) = 1 second

Command Mode

Interface Configuration

Command Usage

If this feature is enabled, an event notification message is sent if the threshold specified by the efm oam link-monitor frame threshold command is reached or exceeded within the period specified by this command. The Errored Frame Event TLV includes the number of errored frames detected during the specified period.

Example

This example set the window size to 5 seconds.

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam link-monitor frame window 50
Console(config-if)#
```

efm oam mode

This command sets the OAM mode on the specified port. Use the **no** form to restore the default setting.

Syntax

efm oam mode {**active** | **passive**}

no efm oam mode

active - All OAM functions are enabled.

passive - All OAM functions are enabled, except for OAM discovery, and sending loopback control OAMPDUs.

Default Setting

Active

Command Mode

Interface Configuration

Command Usage

When set to active mode, the selected interface will initiate the OAM discovery process. When in passive mode, it can only respond to discovery messages.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#efm oam mode active
Console(config-if)#
```

clear efm oam counters

This command clears statistical counters for various OAMPDU message types.

Syntax

clear efm oam counters [*interface-list*]

interface-list - *unit/port*

unit - Unit identifier.

port - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports.

Command Mode

Privileged Exec

Example

```
Console#clear efm oam counters
Console#
```

clear efm oam event-log

This command clears all entries from the OAM event log for the specified port.

Syntax

clear efm oam event-log [*interface-list*]

unit - Unit identifier.

port - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports.

Command Mode

Privileged Exec

Example

```
Console#clear efm oam event-log
Console#
```

efm oam remote-loopback

This command starts or stops OAM loopback test mode to the attached CPE.

Syntax

efm oam remote-loopback {**start** | **stop**} *interface*

start - Starts remote loopback test mode.

stop - Stops remote loopback test mode.

interface - *unit/port*

unit - Unit identifier.

port - Port number.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- OAM remote loop back can be used for fault localization and link performance testing. Statistics from both the local and remote DTE can be queried and compared at any time during loop back testing.

- Use the **efm oam remote-loopback start** command to start OAM remote loop back test mode on the specified port. Afterwards, use the efm oam remote-loopback test command to start sending test packets. Then use the **efm oam remote loopback stop** command to terminate testing (if test packets are still being sent) and to terminate loop back test mode.

- The port that you specify to run this test must be connected to a peer OAM device capable of entering into OAM remote loopback mode.
- During a remote loopback test, the remote OAM entity loops back every frame except for OAMPDUs and pause frames.
- During loopback testing, both the switch and remote device are permitted to send OAMPDUs to the peer device and to process any OAMPDUs received from the peer.

Example

```
Console#efm oam remote-loopback start 1/1
Loopback operation is processing, please wait.
Enter loopback mode succeeded.
Console#
```

efm oam remote-loopback test

This command performs a remote loopback test, sending a specified number of packets.

Syntax

efm oam remote-loopback test *interface* [*number-of-packets* [*packet-size*]]

interface - *unit/port*

unit - Unit identifier.

port - Port number.

number-of-packets - Number of packets to send. (Range: 1-99999999)

packet-size - Size of packets to send. (Range: 64-1518 bytes)

Default Setting

Number of packets: 10,000
Packet size: 64 bytes

Command Mode

Privileged Exec

Command Usage

- You can use this command to perform an OAM remote loopback test on the specified port. The port that you specify to run this test must be connected to a peer OAM device capable of entering into OAM remote loopback mode.
- During a remote loopback test, the remote OAM entity loops back every frame except for OAMPDUs and pause frames.
- OAM remote loopback can be used for fault localization and link performance testing. Statistics from both the local and remote DTE can be queried and compared at any time during loopback testing.

- A summary of the test is displayed after it is finished.

Example

```
Console#efm oam remote-loopback test 1/2
Loopback test is processing, press ESC to suspend.
....
Port OAM loopback Tx OAM loopback Rx Loss Rate
---- --------------- --------------- ---------
1/2             1990            1016   48.94 %
Console#
```

show efm oam counters interface

This command displays counters for various OAM PDU message types.

Syntax

show efm oam counters interface [*interface-list*]

interface-list - *unit/port*

unit - Unit identifier.

port - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports.

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show efm oam counters interface 1/1
Port OAMPDU Type           TX         RX
---- --------------------- ---------- ----------
1/1  Information           1121       1444
1/1  Event Notification    0          0
1/1  Loopback Control      1          0
1/1  Organization Specific 76         0
Console#
```

show efm oam event-log interface

This command displays the OAM event log for the specified port(s) or for all ports that have logs.

show efm oam event-log interface [*interface-list*]

interface-list - *unit/port*

unit - Unit identifier.

port - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports.

Command Mode
Normal Exec, Privileged Exec

Command Usage
- When a link event occurs, no matter whether the location is local or remote, this information is entered in the OAM event log.
- When the log system becomes full, older events are automatically deleted to make room for new entries.

Example
This command can show OAM link status changes for link partner as shown in this example.

```
Console#show efm oam event-log interface 1/1
OAM event log of Eth 1/1:
 10:22:55 2013/09/13
 "Unit 1, Port 1: Connection to remote device is up at Local"
 10:22:44 2013/09/13
 "Unit 1, Port 1: Connection to remote device is down at Local"
    <--- When the link is down,this event will be written to OAM event-log
 10:20:02 2013/09/13
 "Unit 1, Port 1: Connection to remote device is up at Local"
    <--- When the link is up,this event will be written to OAM event-log,
Console#clear efm oam event-log
    <--- Use he "clear efm oam event-log" command to clear the event-log.
Console#show efm oam event-log interface 1/1
Console#
```

show efm oam remote-loopback interface

This command displays the results of an OAM remote loopback test.

Syntax

show efm oam remote-loopback interface [*interface-list*]

interface-list - *unit/port*

unit - Unit identifier.

port - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports.

Command Mode
Normal Exec, Privileged Exec

Example

```
Console#show efm oam remote-loopback interface 1/1
Port OAM loopback Tx OAM loopback Rx Loss Rate
---- --------------- --------------- ---------
1/1             2300            2250    0.01 %
Console#
```

show efm oam status interface

This command displays OAM configuration settings and event counters.

Syntax

show efm oam status interface [*interface-list*] [**brief**]

interface - *unit/port*

unit - Unit identifier.

port - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports.

brief - Displays a brief list of OAM configuration states.

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show efm oam status interface 1/1
OAM information of Eth 1/1:
 Basic Information:
  Admin State                    : Enabled
  Operation State                : Operational
  Mode                           : Active
  Remote Loopback                : Disabled
  Remote Loopback Status         : No loopback
  Dying Gasp                     : Enabled
  Critical Event                 : Enabled
  Link Monitor (Errored Frame)   : Enabled
 Link Monitor:
  Errored Frame Window (100msec) : 10
  Errored Frame Threshold        : 1
Console#show efm oam status interface 1/1 brief
$ = local OAM in loopback
* = remote OAM in loopback

Port Admin    Mode    Remote   Critical Errored
     State            Loopback Event    Frame
---- -------- ------- -------- -------- -------
1/1  Disabled Active  Disabled Enabled  Enabled
Console#
```

show efm oam status remote interface

This command displays information about attached OAM-enabled devices.

Syntax

show efm oam status remote interface [*interface-list*]

interface-list - *unit/port*

unit - Unit identifier.

port - Port number or list of ports. To enter a list, separate nonconsecutive port identifiers with a comma and no spaces; use a hyphen to designate a range of ports.

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show efm oam status remote interface 1/1
Port MAC Address       OUI    Remote   Unidirectional Link    MIB Variable
                              Loopback               Monitor Retrieval
---- ----------------- ------ -------- -------------- ------- ------------
1/1  00-12-CF-6A-07-F6 000084 Enabled  Disabled       Enabled Disabled
Console#
```

31 Domain Name Service Commands

These commands are used to configure Domain Naming System (DNS) services. Entries can be manually configured in the DNS domain name to IP address mapping table, default domain names configured, or one or more name servers specified to use for domain name to address translation.

Note that domain name services will not be enabled until at least one name server is specified with the ip name-server command and domain lookup is enabled with the ip domain-lookup command.

The switch performs both as a DNS client and a DNS server/proxy in the following manner:

PC (DNS Client) <------> Switch (DNS client[1], server/proxy[2]) <------> Server (another server/proxy)

[1] For the case that the switch performs as a DNS client and an incomplete host name is received, it will work through the domain list, appending each domain name in the list to the host name, and checking with the specified name servers for a match.

[2] Otherwise, the switch acts as a DNS server/proxy when an outside host (namely, a DNS client) intends to get an IP address for a host name through the switch. In this case, it will not add the domain suffix to query name servers). That means that the DNS client is responsible for adding the domain suffix.

Table 120: Address Table Commands

Command	Function	Mode
DNS		
ip domain-list	Defines a list of default domain names for incomplete host names	GC
ip domain-lookup	Enables DNS-based host name-to-address translation	GC
ip domain-name	Defines a default domain name for incomplete host names	GC
ip host	Creates a static IPv4 host name-to-address mapping	GC
ip name-server	Specifies the address of one or more name servers to use for host name-to-address translation	GC
ipv6 host	Creates a static IPv6 host name-to-address mapping	GC
clear dns cache	Clears all entries from the DNS cache	PE
show dns	Displays the configuration for DNS services	PE
show dns cache	Displays entries in the DNS cache	PE
show hosts	Displays the static host name-to-address mapping table	PE

DNS Commands

ip domain-list

This command defines a list of domain names that can be appended to incomplete host names (i.e., host names passed from a client that are not formatted with dotted notation). Use the **no** form to remove a name from this list.

Syntax

[no] ip domain-list *name*

name - Name of the host. Do not include the initial dot that separates the host name from the domain name. (Range: 1-127 characters)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Domain names are added to the end of the list one at a time.
- When an incomplete host name is received by the DNS service on this switch, it will work through the domain list, appending each domain name in the list to the host name, and checking with the specified name servers for a match.
- If there is no domain list, the domain name specified with the ip domain-name command is used. If there is a domain list, the default domain name is not used.

Example

This example adds two domain names to the current list and then displays the list.

```
Console(config)#ip domain-list sample.com.jp
Console(config)#ip domain-list sample.com.uk
Console(config)#end
Console#show dns
Domain Lookup Status:
    DNS Disabled
Default Domain Name:
    sample.com
Domain Name List:
    sample.com.jp
    sample.com.uk
Name Server List:
Console#
```

ip domain-lookup

This command enables DNS host name-to-address translation. Use the **no** form to disable DNS.

Syntax

[no] ip domain-lookup

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- At least one name server must be specified before DNS can be enabled.
- If one or more name servers are configured, but DNS is not yet enabled and the switch receives a DHCP packet containing a DNS field with a list of DNS servers, then the switch will automatically enable DNS host name-to-address translation.
- If all name servers are deleted, DNS will automatically be disabled.

Example

This example enables DNS and then displays the configuration.

```
Console(config)#ip domain-lookup
Console(config)#end
Console#show dns
Domain Lookup Status:
    DNS Enabled
Default Domain Name:
    sample.com
Domain Name List:
    sample.com.jp
    sample.com.uk
Name Server List:
    192.168.1.55
    10.1.0.55
Console#
```

ip domain-name

This command defines the default domain name appended to incomplete host names (i.e., host names passed from a client that are not formatted with dotted notation). Use the **no** form to remove the current domain name.

Syntax

ip domain-name *name*

no ip domain-name

name - Name of the host. Do not include the initial dot that separates the host name from the domain name. (Range: 1-127 characters)

Default Setting
None

Command Mode
Global Configuration

Example

```
Console(config)#ip domain-name sample.com
Console(config)#end
Console#show dns
Domain Lookup Status:
    DNS Disabled
Default Domain Name:
    sample.com
Domain Name List:
Name Server List:
Console#
```

ip host
This command creates a static entry in the DNS table that maps a host name to an IPv4 address. Use the **no** form to remove an entry.

Syntax
[**no**] **ip host** *name address*

name - Name of an IPv4 host. (Range: 1-127 characters)

address - Corresponding IPv4 address.

Default Setting
No static entries

Command Mode
Global Configuration

Command Usage
Use the **no ip host** command to clear static entries.

Example
This example maps an IPv4 address to a host name.

```
Console(config)#ip host rd5 192.168.1.55
Console(config)#end
Console#show hosts
No.  Flag Type    IP Address            TTL   Domain
---- ---- ------- --------------------  ----- ------------------------------
```

```
   0    2 Address 192.168.1.55                rd5
Console#
```

ip name-server

This command specifies the address of one or more domain name servers to use for name-to-address resolution. Use the **no** form to remove a name server from this list.

Syntax

[**no**] **ip name-server** *server-address1* [*server-address2* … *server-address6*]

server-address1 - IPv4 or IPv6 address of domain-name server.

server-address2 … *server-address6* - IPv4 or IPv6 address of additional domain-name servers.

Default Setting

None

Command Mode

Global Configuration

Command Usage

The listed name servers are queried in the specified sequence until a response is received, or the end of the list is reached with no response.

Example

This example adds two domain-name servers to the list and then displays the list.

```
Console(config)#ip name-server 192.168.1.55 10.1.0.55
Console(config)#end
Console#show dns
Domain Lookup Status:
    DNS disabled
Default Domain Name:
    sample.com
Domain Name List:
    sample.com.jp
    sample.com.uk
Name Server List:
    192.168.1.55
    10.1.0.55
Console#
```

ipv6 host

This command creates a static entry in the DNS table that maps a host name to an IPv6 address. Use the **no** form to remove an entry.

Syntax

[no] **ipv6 host** *name ipv6-address*

name - Name of an IPv6 host. (Range: 1-127 characters)

ipv6-address - Corresponding IPv6 address. This address must be entered according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

Default Setting

No static entries

Command Mode

Global Configuration

Example

This example maps an IPv6 address to a host name.

```
Console(config)#ipv6 host rd6 2001:0db8:1::12
Console(config)#end
Console#show hosts
No.  Flag Type    IP Address            TTL   Domain
---- ---- ------- --------------------  ----- --------------------------------
   0    2 Address 192.168.1.55                rd5
   1    2 Address 2001:DB8:1::12              rd6
Console#
```

clear dns cache

This command clears all entries in the DNS cache.

Command Mode

Privileged Exec

Example

```
Console#clear dns cache
Console#show dns cache
No.     Flag    Type    IP Address      TTL     Host
------- ------- ------- --------------- ------- --------

Console#
```

show dns

This command displays the configuration of the DNS service.

Command Mode

Privileged Exec

Example

```
Console#show dns
Domain Lookup Status:
    DNS enabled
Default Domain Name:
    sample.com
Domain Name List:
    sample.com.jp
    sample.com.uk
Name Server List:
    192.168.1.55
    10.1.0.55
Console#
```

show dns cache

This command displays entries in the DNS cache.

Command Mode

Privileged Exec

Example

```
Console#show dns cache
No.     Flag    Type    IP Address      TTL     Host
------- ------- ------- --------------- ------- --------
      0       4 Host    52.196.118.60      3501 www.accton.com
      1       4 Host    166.62.56.229     21540 www.edge-core.com
      2       4 Host    35.201.87.174      1787 ignitenet.com
      3       4 CNAME   POINTER TO:2       1787 www.ignitenet.com
Console#
```

show hosts

This command displays the static host name-to-address mapping table.

Command Mode

Privileged Exec

Example

Note that a host name will be displayed as an alias if it is mapped to the same address(es) as a previously configured entry.

```
Console#show hosts
No.  Flag Type    IP Address            TTL   Host
---- ---- ------- --------------------  ----- --------------------------------
   0    2 Address 192.168.2.1                 rdrouter
   1    4 Address 52.196.118.60          3341 www.accton.com
   2    4 Address 166.62.56.229         21381 www.edge-core.com
```

```
   3     4 Address 35.201.87.174          1627 ignitenet.com
   4     4 CNAME   POINTER TO:3           1628 www.ignitenet.com
Console#
```

32 DHCP Commands

These commands are used to configure Dynamic Host Configuration Protocol (DHCP) client and relay functions. Any VLAN interface can be configured to automatically obtain an IPv4 address through DHCP. This switch can also be configured to relay DHCP client configuration requests to a DHCP server on another network.

Table 121: DHCP Commands

Command Group	Function
DHCP Client	Allows interfaces to dynamically acquire IP address information
DHCP Relay	Relays DHCP requests from local hosts to a remote DHCP server
DHCP Server	Configures DHCP service using address pools or static bindings

DHCP Client

Use the commands in this section to allow the switch's VLAN interfaces to dynamically acquire IP address information.

Table 122: DHCP Client Commands

Command	Function	Mode
DHCP for IPv4		
ip dhcp dynamic-provision	Enables dynamic provision via DHCP	GC
ip dhcp client class-id	Specifies the DHCP client identifier for an interface	IC
ip dhcp inform	Enables DHCP Inform on a VLAN interface	IC
ip dhcp restart client	Submits a BOOTP or DHCP client request	PE
show ip dhcp dynamic-provision	Shows the status of dynamic provision via DHCP	PE
DHCP for IPv6		
ipv6 dhcp client rapid-commit vlan	Specifies the Rapid Commit option for DHCPv6 message exchange	GC
ipv6 dhcp restart client vlan	Submits a DHCPv6 client request	PE
show ipv6 dhcp duid	Shows the DHCP Unique Identifier for this switch	PE
show ipv6 dhcp vlan	Shows DHCPv6 information for specified interface	PE

DHCP for IPv4

ip dhcp dynamic-provision

This command enables dynamic provisioning via DHCP. Use the **no** form to disable this feature.

Syntax

[no] ip dhcp dynamic-provision

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

DHCPD is the daemon used by Linux to dynamically configure TCP/IP information for client systems. To support DHCP option 66/67, you have to add corresponding statements to the configuration file of DHCPD.

The following are some alternative commands which can be added to the DHCPD to complete the dynamic provisioning process.

By default, the parameters for DHCP option 66/67 are not carried by the reply sent from the DHCP server. To ask for a DHCP reply with option 66/67, the client can inform the server that it is interested in option 66/67 by sending a DHCP request that includes a 'parameter request list' option. Besides this, the client can also send a DHCP request that includes a 'vendor class identifier' option to the server so that the DHCP server can identify the device, and determine what information should be given to requesting device.

The following are two additional sample configurations of the dhcpd.conf file for the server version dhcp-3.0.4rc1, you can choose either one of them.

1. Define the conditions in subnet section:

```
shared-network Sample1 {
    subnet 192.168.1.0 netmask 255.255.255.0 {
# option 55
    option dhcp-parameter-request-list 1,66,67;
# option 66
    option tftp-server-name "192.168.1.1";
# option 67
    option bootfile-name "dhcp_config.cfg ";
   }
 }
```

2. Define the conditions in class section:

```
class "OPT66_67" { # for option 66/67
# option 124
    match if option vendor-class-identifier = "Edgecore";
```

```
# option 55
    option dhcp-parameter-request-list 1,66,67;
# option 66
    option tftp-server-name "192.168.1.1";
# option 67
    option bootfile-name "dhcp_config.cfg";
}

shared-network Sample2 {
subnet 192.168.1.0 netmask 255.255.255.0 {
    }
    pool {
        allow members of "OPT66_67";
        range 192.168.1.10 192.168.1.20;
    }
}
```

Example

In the following example enables dhcp dynamic provisioning.

```
Console(config)#ip dhcp dynamic provisioning
Console(config)#
```

ip dhcp client class-id

This command specifies the DCHP client vendor class identifier for the current interface. Use the **no** form to remove the class identifier from the DHCP packet.

Syntax

ip dhcp client class-id [**text** *text* | **hex** *hex*]

no ip dhcp client class-id

text - A text string. (Range: 1-32 characters)

hex - A hexadecimal value. (Range: 1-64 characters)

Default Setting

Class identifier option enabled, using the model number as the string

Command Mode

Interface Configuration (VLAN)

Command Usage

- Use this command without any keyword to restore the default setting.
- This command is used to identify the vendor class and configuration of the switch to the DHCP server, which then uses this information to decide on how to service the client or the type of information to return.

- The general framework for this DHCP option is set out in RFC 2132 (Option 60). This information is used to convey configuration settings or other identification information about a client, but the specific string to use should be supplied by your service provider or network administrator. Options 60, 66 and 67 statements can be added to the server daemon's configuration file.

Table 123: Options 60, 66 and 67 Statements

Option	Statement	
	Keyword	Parameter
60	vendor-class-identifier	a string indicating the vendor class identifier
66	tftp-server-name	a string indicating the tftp server name
67	bootfile-name	a string indicating the bootfile name

- By default, DHCP option 66/67 parameters are not carried in a DHCP server reply. To ask for a DHCP reply with option 66/67 information, the DHCP client request sent by this switch includes a "parameter request list" asking for this information. Besides, the client request also includes a "vendor class identifier" set by the **ip dhcp client class-id** command that allows the DHCP server to identify the device, and select the appropriate configuration file for download. This information is included in Option 55 and 124.

Table 124: Options 55 and 124 Statements

Option	Statement	
	Keyword	Parameter
55	dhcp-parameter-request-list	a list of parameters, separated by ','
124	vendor-class-identifier	a string indicating the vendor class identifier

- The server should reply with Option 66 attributes, including the TFTP server name and boot file name.

- Note that the vendor class identifier can be formatted in either text or hexadecimal using the **ip dhcp client class-id** command, but the format used by both the client and server must be the same.

Example

```
Console(config)#interface vlan 2
Console(config-if)#ip dhcp client class-id hex 0000e8666572
Console(config-if)#
```

ip dhcp inform

This command enables DHCP client information to be received on a VLAN interface that has a user-configured IP address. Use the **no** form to disable the feature.

Syntax

[no] ip dhcp inform

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- A DHCP Inform message enables a client to obtain information from a DHCP server without requesting an IP address. When a client enables DHCP Inform, it must have a static IP address configured on the specified VLAN interface. Additional parameters are requested by sending a DHCP Inform packet with a parameter request list option. Once the DHCP server receives this DHCP Inform packet, it replies with a DHCP "ack" packet with the supported option parameters.
- Only Option 3 (router) and Option 6 (domain name server) is supported for client configuration via DHCP Inform.
- If DHCP Inform is enabled when an interface's address mode is not user configured or no IP address is configured, a warning message is displayed.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip dhcp inform
Console(config-if)#
```

ip dhcp restart client

This command submits a BOOTP or DHCP client request.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- This command issues a BOOTP or DHCP client request for any IP interface that has been set to BOOTP or DHCP mode through the ip address command.
- DHCP requires the server to reassign the client's last address if available.

- If the BOOTP or DHCP server has been moved to a different domain, the network portion of the address provided to the client will be based on this new domain.

Example

In the following example, the device is reassigned the same address.

```
Console(config)#interface vlan 1
Console(config-if)#ip address dhcp
Console(config-if)#exit
Console#ip dhcp restart client
Console#show ip interface
VLAN 1 is Administrative Up - Link Up
  Address is E0-01-A6-6E-9A-14
  Index: 1001, MTU: 1500
  Address Mode is Initial
  IP Address: 192.168.2.10 Mask: 255.255.255.0
  Proxy ARP is disabled
  DHCP Client Vendor Class ID (text): ECS5550-54X
  DHCP Relay Server:
Console#
```

show ip dhcp dynamic-provision

This command shows the status of dynamic provision via DHCP.

Command Mode

Privileged Exec

Example

```
Console#show ip dhcp dynamic provisioning
Dynamic Provision via DHCP Status:   Disabled
Console#
```

DHCP for IPv6

ipv6 dhcp client rapid-commit vlan

This command specifies the Rapid Commit option for DHCPv6 message exchange for all DHCPv6 client requests submitted from the specified interface. Use the **no** form to disable this option.

Syntax

[no] **ipv6 dhcp client rapid-commit vlan** *vlan-list*

vlan-list - VLAN ID, specified as a single number, a range of consecutive numbers separated by a hyphen, or multiple numbers separated by commas. (Range: 1-4094; Maximum command length: 300 characters)

Default Setting

Disabled

Command Mode
Global Configuration

Command Usage
- DHCPv6 clients can obtain configuration parameters from a server through a normal four-message exchange (solicit, advertise, request, reply), or through a rapid two-message exchange (solicit, reply). The rapid-commit option must be enabled on both client and server for the two-message exchange to be used.
- This command allows two-message exchange method for prefix delegation. When enabled, DCHPv6 client requests submitted from the specified interface will include the rapid commit option in all solicit messages.
- If the rapid commit option has been enabled on the switch with this command, and on the DHCPv6 server, message exchange can be reduced from the normal four step process to a two-step exchange of only solicit and reply messages.

Example

```
Console(config)#ipv6 dhcp client rapid-commit vlan 2
Console(config)#
```

ipv6 dhcp restart client vlan

This command submits a DHCPv6 client request.

Syntax

ipv6 dhcp restart client vlan *vlan-id*

vlan-id - VLAN ID, specified as a single number, a range of consecutive numbers separated by a hyphen, or multiple numbers separated by commas. (Range: 1-4094; Maximum command length: 300 characters)

Default Setting
None

Command Mode
Privileged Exec

Command Usage
- This command starts the DHCPv6 client process if it is not yet running by submitting requests for configuration information through the specified interface(s). When DHCPv6 is restarted, the switch may attempt to acquire an IP address prefix through stateful address auto-configuration. If the router advertisements have the “other stateful configuration” flag set, the switch may also attempt to acquire other non-address configuration information (such as a default gateway or DNS server) when DHCPv6 is restarted.

Prior to submitting a client request to a DHCPv6 server, the switch should be configured with a link-local address using the ipv6 address autoconfig command. The state of the Managed Address Configuration flag (M flag) and Other Stateful Configuration flag (O flag) received in Router Advertisement messages will determine the information this switch should attempt to acquire from the DHCPv6 server as described below.

- Both M and O flags are set to 1:

  DHCPv6 is used for both address and other configuration settings.

  This combination is known as DHCPv6 stateful, in which a DHCPv6 server assigns stateful addresses to IPv6 hosts.

- The M flag is set to 0, and the O flag is set to 1:

  DHCPv6 is used only for other configuration settings.

  Neighboring routers are configured to advertise non-link-local address prefixes from which IPv6 hosts derive stateless addresses.

  This combination is known as DHCPv6 stateless, in which a DHCPv6 server does not assign stateful addresses to IPv6 hosts, but does assign stateless configuration settings.

- DHCPv6 clients build a list of servers by sending a solicit message and collecting advertised message replies. These servers are then ranked based on their advertised preference value. If the client needs to acquire prefixes from servers, only servers that have advertised prefixes are considered.

- If the rapid commit option has been enabled on the switch using the ipv6 dhcp client rapid-commit vlan command, and on the DHCPv6 server, message exchange can be reduced from the normal four step process to a two-step exchange of only solicit and reply messages.

Example

The following command submits a client request on VLAN 1.

```
Console#ipv6 dhcp restart client vlan 1
Console#
```

show ipv6 dhcp duid

This command shows the DHCP Unique Identifier for this switch.

Command Mode

Privileged Exec

Command Usage

DHCPv6 clients and servers are identified by a DHCP Unique Identifier (DUID) included in the client identifier and server identifier options. Static or dynamic address prefixes may be assigned by a DHCPv6 server based on the client's DUID.

Example

```
Console#show ipv6 dhcp duid
DHCPv6 Unique Identifier (DUID): 0001-0001-4A8158B4-00E00C0000FD
Console#
```

show ipv6 dhcp vlan

This command shows DHCPv6 information for the specified interface(s).

Syntax

show ipv6 dhcp vlan *vlan-list*

vlan-list - VLAN ID, specified as a single number, a range of consecutive numbers separated by a hyphen, or multiple numbers separated by commas. (Range: 1-4094; Maximum command length: 300 characters)

Command Mode

Privileged Exec

Command Usage

Each allocation in the DHCPv6 server is identified by a DUID and an IAID. IAID means Interface Association Identifier, and is a binding between the interface and one or more IP addresses.

Example

```
Console#show ipv6 dhcp vlan 1
VLAN 1 is in DHCP client mode, Rapid-Commit
  IAID:                          C0000F0
List of known servers:
  Server address : FE80::250:FCFF:FEF9:A494
  DUID           : 0001-0001-48CFB0D5-F48F2A006801

  Server address : FE80::250:FCFF:FEF9:A405
  DUID           : 0001-0001-38CF5AB0-F48F2A003917
Console#
```

DHCP Relay

This section describes commands used to configure the switch to relay DHCP requests from local hosts to a remote DHCP server.

Table 125: DHCP Relay Commands

Command	Function	Mode
Global DHCP Relay settings		
ip dhcp relay server	Specifies DHCP server or relay server addresses	IC
ip dhcp restart relay	Enables DHCP relay agent	PE

Table 125: DHCP Relay Commands

Command	Function	Mode
show ip dhcp relay	Show the switch's global DHCP Relay setting - L2 or L3	PE
L3 DHCP Relay option settings		
ip dhcp relay information option	Enables information 82 option to be inserted into the client requests when utilizing L3 DHCP relay.	GC
ip dhcp relay information option encode no-subtype	Disables the sub-type and sub-length sub-options of the information 82 option.	GC
ip dhcp relay information option remote-id	Sets the Remote ID sub-option	GC
ip dhcp relay information policy	Sets the information 82 forwarding policy for DHCP Relay.	GC
DHCP for IPv6		
ipv6 dhcp relay destination	Specifies a DHCPv6 server or VLAN to which client requests are forwarded and enables DHCPv6 relay service	IC
show ipv6 dhcp relay destination	Displays a DHCPv6 server or VLAN to which client requests are forwarded	PE

Global DHCP Relay Settings

ip dhcp relay server

This command specifies the DHCP server or relay server addresses to use. Use the **no** form to clear all addresses.

Syntax

ip dhcp relay server *address1* [*address2* [*address3* ...]]

no ip dhcp relay server

address - IP address of DHCP server. (Range: 1-5 addresses)

Default Setting

None

Command Mode

Interface Configuration (VLAN)

Usage Guidelines

- DHCP relay service applies to DHCP client requests received on the specified VLAN.
- This command is used to configure DHCP relay for host devices attached to the switch. If DHCP relay service is enabled, and this switch sees a DHCP client request, it inserts its own IP address into the request so that the DHCP server will know the subnet where the client is located. Then, the switch forwards the packet to a DHCP server on another network. When the server receives the DHCP request, it allocates a free IP address for the DHCP client from its defined scope for the DHCP client's subnet, and sends a DHCP response back

to the DHCP relay agent (i.e., this switch). This switch then passes the DHCP response received from the server to the client.

- You must specify the IP address for at least one active DHCP server. Otherwise, the switch's DHCP relay agent will not be able to forward client requests to a DHCP server. Up to five DHCP servers can be specified in order of preference.

  If any of the specified DHCP server addresses are not located in the same network segment with this switch, use the ip default-gateway or ipv6 default-gateway command to specify the default router through which this switch can reach other IP subnetworks.

- To start DHCP relay service, enter the ip dhcp restart relay command.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip dhcp relay server 192.168.10.19
Console(config-if)#
```

ip dhcp restart relay

This command enables DHCP relay for the switch. Use the no form to disable it.

Syntax

ip dhcp restart relay

Default Setting

Disabled

Command Mode

Privileged Exec

Command Usage

This command is used to configure DHCP relay functions for host devices attached to the switch. If DHCP relay service is enabled, and this switch sees a DHCP request broadcast, it inserts its own IP address into the request so the DHCP server will know the subnet where the client is located. Then, the switch forwards the packet to the DHCP server on another network. When the server receives the DHCP request, it allocates a free IP address for the DHCP client from its defined scope for the DHCP client's subnet, and sends a DHCP response back to the DHCP relay agent (i.e., this switch). This switch then broadcasts the DHCP response received from the server to the client.

Example

In the following example, the device is reassigned the same address.

```
Console#ip dhcp restart relay
Console#show ip interface
VLAN 1 is Administrative Up - Link Up
```

```
  Address is CC-37-AB-BC-4F-FA
  Index: 1001, MTU: 1500
  Address Mode is User specified
  IP Address: 192.168.2.98 Mask: 255.255.255.0
  Proxy ARP is disabled
  DHCP Client Vendor Class ID (text): ECS5550-54X
  DHCP Inform is disabled
  DHCP Relay Server: 192.168.2.1
Console#
```

show ip dhcp relay

This command displays the operational mode and parameters of the DHCP relay server.

Syntax

show ip dhcp relay

Command Mode

Privileged Exec

Example

```
Console#show ip dhcp relay
Status of DHCP relay information:
Insertion of relay information: disabled.
DHCP option policy: drop.
DHCP sub-option format: extra subtype included
DHCP remote id sub-option: mac address (hex encoded)
Console#
```

L2 DHCP Relay Option Settings

ip dhcp relay information option

Enables the option 82 information to be relayed when the switch is set as an L2 DHCP Relay agent. Use the no form of the command to disable relaying option 82 information (RFC3046).

Syntax

ip dhcp relay information option

no ip dhcp relay information option

Default Setting

Disabled

Command Mode

Global Configuration

Usage Guidelines

This command enables the insertion of relay Option 82 information in DHCP request packets.

Example

```
Console(config)#ip dhcp relay information option
Console(config)#
```

ip dhcp relay information option encode no-subtype

Use this command to disable the Option 82 packets including sub-type and sub-length in both CID and RID. Use the no form of the command to enable including the sub-type and sub-length in both CID and RID.

Syntax

ip dhcp relay information option encode no-subtype

no ip dhcp relay information option encode no-subtype

Default Setting

Sub-type and sub-length information is included.

Command Mode

Global Configuration

Usage Guidelines

Use this command when the Type and Length fields do not need to be relayed as part of the CID and RID in the Option 82 packets.

Example

```
Console(config)#ip dhcp relay information option encode no-subtype
Console(config)#
```

ip dhcp relay information option remote-id

This command sets the remote ID to the switch's IP address, MAC address, arbitrary or string. Use the **no** form to restore the default setting.

Syntax

ip dhcp relay information option remote-id
{**ip-address** [**encode** {**ascii** | **hex**}] |
mac-address [**encode** {**ascii** | **hex**}] |
string *string* }

no ip dhcp relay information option remote-id
[**ip-address encode**] | [**mac-address encode**]

ip-address - Inserts an IP address in the remote ID sub-option for the DHCP relay (that is, the IP address of the management interface).

mac-address - Inserts a MAC address in the remote ID sub-option for the DHCP relay (that is, the MAC address of the switch's CPU).

encode - Indicates encoding in ASCII or hexadecimal.

string - An arbitrary string inserted into the remote identifier field. (Range: 1-255 characters)

Default Setting
MAC address: hexadecimal

Command Mode
Global Configuration

Example
This example sets the remote ID to the switch's IP address.

```
Console(config)#ip dhcp relay information option remote-id ip-address
Console(config)#
```

ip dhcp relay information policy

This command sets the Information 82 forwarding policy of the switch's DHCP Relay service. Use the **no** form of the command to set the policy to the default setting.

Syntax

ip dhcp relay information policy {drop | keep | replace}

no ip dhcp relay information policy

drop - Do not relay the DHCP request packet.

keep - Retain the original CID and RID in the Option 82 information of the DHCP request.

replace - Replace the CID and RID of the Option 82 information with the relay agent switch address information.

Default Setting
drop

Command Mode
Global Configuration

Usage Guidelines
- If set to **drop,** the original DHCP request packet flooded to the receiving VLAN is received but not relayed to the DHCP server.
- When the **replace** policy is set, the DHCP request packet's option 82 content (RID and CID sub-option) is replaced with the relay agent switch's address information. The agent then unicasts the modified DHCP Request packet to the DHCP server.
- When set to the **keep** option the DHCP request packet's option 82 content is unmodified. However the switch address information of the relay agent is

additionally added into the DHCP request packet. The agent finally unicasts the modified DHCP Request packet including the original RID and CID to the DHCP server.

Example

```
Console(config)#ip dhcp relay information policy keep
Console(config)#
```

DHCP Relay for IPv6

ipv6 dhcp relay destination

This command specifies a DHCPv6 server or the VLAN to which client requests are forwarded, and also enables DHCPv6 relay service on this interface. Use the **no** form to disable this service.

Syntax

ipv6 dhcp relay destination {*ipv6-address* | **multicast** {**all** | **vlan** *vlan-id*}}

no ipv6 dhcp relay destination [*ipv6-address* | **multicast** {**all** | **vlan** *vlan-id*}]

ipv6-address - A full IPv6 address including the network prefix and host address bits. This address may designate another relay server or a DHCPv6 server.

multicast - All DHCP server multicast address (FF:05::1:3).

all - Specifies all local VLAN interfaces.

vlan-id - ID of configured VLAN. (Range: 1-4094)

Default Setting

None

Command Mode

Interface Configuration (VLAN)

Usage Guidelines

- You must specify the IPv6 address for at least one DHCPv6 server or another relay agent, or the VLAN to which to multicast a relay message. Otherwise, the switch's DHCPv6 relay agent will not forward client requests. This command enables DHCPv6 relay service for the VLAN from which the command is entered.
- Up to five relay destinations may be configured by repeating this command.
- This command is used to configure DHCPv6 relay functions for host devices attached to the switch. If DHCPv6 relay service is enabled (by entering this command), and this switch sees a DHCPv6 request broadcast, it inserts its own IP address into the request so the DHCPv6 server will know the subnet where

the client is located. Then, the switch forwards the packet to the next relay agent or DHCPv6 server on another network. When the server receives the DHCPv6 request, it allocates a free IP address for the DHCPv6 client from its defined scope for the DHCPv6 client's subnet, and sends a DHCPv6 response back to the DHCPv6 relay agent (i.e., this switch). This switch then broadcasts the DHCPv6 response received from the server to the client.

- When the multicast option is used, the switch multicasts the modified client request to all configured VLANs or to a specified VLAN, and enables DHCPv6 relay service for those VLANs.
- When issuing the **no ipv6 dhcp relay destination** command without any arguments, the switch will delete all configured destination addresses and disable DHCP for IPv6 relay for all VLANs.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 dhcp relay destination 2001:0DB8:3000:3000::42
Console(config-if)#
```

show ipv6 dhcp relay destination

This command shows the destination addresses or VLAN to which client messages are forwarded for DHCP relay service.

Syntax

show ipv6 dhcp relay destination interface [**vlan** *vlan-id*]

vlan-id - VLAN ID (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#show ipv6 dhcp relay destination interface vlan 1
DHCP relay destination :
VLAN 1 :
  Unicast   : 2001:DB8:3000:3000::42
Console#
```

DHCP Server

This section describes commands used to configure client address pools for the DHCP service.

Table 126: DHCP Server Commands

Command	Function	Mode
ip dhcp excluded-address	Specifies IP addresses that a DHCP server should not assign to DHCP clients	GC
ip dhcp pool	Configures a DHCP address pool on a DHCP Server	GC
service dhcp	Enables the DHCP server feature on this switch	GC
bootfile	Specifies a default boot image for a DHCP client	DC
client-identifier*	Specifies a client identifier for a DHCP client	DC
default-router	Specifies the default router list for a DHCP client	DC
dns-server	Specifies the Domain Name Server (DNS) servers available to a DHCP client	DC
domain-name	Specifies the domain name for a DHCP client	DC
hardware-address*	Specifies the hardware address of a DHCP client	DC
host*	Specifies the IP address and network mask to manually bind to a DHCP client	DC
lease	Sets the duration an IP address is assigned to a DHCP client	DC
netbios-name-server	Configures NetBIOS Windows Internet Naming Service (WINS) name servers available to Microsoft DHCP clients	DC
netbios-node-type	Configures NetBIOS node type for Microsoft DHCP clients	DC
network	Configures the subnet number and mask for a DHCP address pool	DC
next-server	Configures the next server in the boot process of a DHCP client	DC
option	Sets DHCP option details	DC
clear ip dhcp binding	Deletes an automatic address binding from the DHCP server database	PE
show ip dhcp binding	Displays address bindings on the DHCP server	PE, NE
show ip dhcp	Displays DHCP address pools	PE
show ip dhcp pool	Displays detailed information of DHCP address pools	PE

* These commands are used for manually binding an address to a client.

ip dhcp excluded-address

This command specifies IP addresses that the DHCP server should not assign to DHCP clients. Use the **no** form to remove the excluded IP addresses.

Syntax

[no] **ip dhcp excluded-address** *low-address* [*high-address*]

low-address - An excluded IP address, or the first IP address in an excluded address range.

high-address - The last IP address in an excluded address range.

Default Setting

All IP pool addresses may be assigned.

Command Mode

Global Configuration

Example

```
Console(config)#ip dhcp excluded-address 10.1.0.19
Console(config)#
```

ip dhcp pool

This command configures a DHCP address pool and enter DHCP Pool Configuration mode. Use the **no** form to remove the address pool.

Syntax

[no] **ip dhcp pool** *name*

name - A string or integer. (Range: 1-32 characters)

Default Setting

DHCP address pools are not configured.

Command Mode

Global Configuration

Usage Guidelines

- After executing this command, the switch changes to DHCP Pool Configuration mode, identified by the (config-dhcp)# prompt.
- From this mode, first configure address pools for the network interfaces (using the network command). You can also manually bind an address to a specific client (with the host command) if required. You can configure up to 8 network address pools, and up to 32 manually bound host address pools (i.e., listing one host address per pool). However, note that any address specified in a host command must fall within the range of a configured network address pool.

Example

```
Console(config)#ip dhcp pool R&D
Console(config-dhcp)#
```

service dhcp

This command enables the DHCP server on this switch. Use the **no** form to disable the DHCP server.

Syntax

[no] service dhcp

Default Setting

Enabled

Command Mode

Global Configuration

Command Usage

If the DHCP server is running, you must restart it to implement any configuration changes.

Example

```
Console(config)#service dhcp
Console(config)#
```

bootfile

This command specifies the name of the default boot image for a DHCP client. This file should placed on the Trivial File Transfer Protocol (TFTP) server specified with the next-server command. Use the **no** form to delete the boot image name.

Syntax

bootfile *filename*

no bootfile

filename - Name of the file that is used as a default boot image. (Range: 1 to 128 characters)

Default Setting

None

Command Mode

DHCP Pool Configuration

Example

```
Console(config-dhcp)#bootfile wme.bat
Console(config-dhcp)#
```

client-identifier

This command specifies the client identifier of a DHCP client. Use the **no** form to remove the client identifier.

Syntax

client-identifier {**text** *text* | **hex** *hex*}

no client-identifier

text - A text string. (Range: 1-32 characters)

hex - The hexadecimal value.

Default Setting

None

Command Mode

DHCP Pool Configuration

Command Usage

- This command identifies a DHCP client to bind to an address specified in the host command. If both a client identifier and hardware address are configured for a host address, the client identifier takes precedence over the hardware address in the search procedure.
- BOOTP clients cannot transmit a client identifier. To bind an address to a BOOTP client, you must associate a hardware address with the host entry.

Example

```
Console(config-dhcp)#client-identifier text steve
Console(config-dhcp)#
```

default-router

This command specifies default routers for a DHCP pool. Use the **no** form to remove the default routers.

Syntax

default-router { *address1* [*address2*] | **bootfile** *filename*}

no default-router

address1 - Specifies the IP address of the primary router.

address2 - Specifies the IP address of an alternate router.

bootfile *filename* - specifies the boot file name. (Range: 1-128 characters)

Default Setting
None

Command Mode
DHCP Pool Configuration

Usage Guidelines
The IP address of the router should be on the same subnet as the client. You can specify up to two routers. Routers are listed in order of preference (starting with *address1* as the most preferred router).

Example

```
Console(config-dhcp)#default-router 10.1.0.54 10.1.0.64
Console(config-dhcp)#
```

dns-server

This command specifies the Domain Name System (DNS) IP servers available to a DHCP client. Use the **no** form to remove the DNS server list.

Syntax

dns-server *address1* [*address2*]

no dns-server

address1 - Specifies the IP address of the primary DNS server.

address2 - Specifies the IP address of the alternate DNS server.

Default Setting
None

Command Mode
DHCP Pool Configuration

Usage Guidelines
- If DNS IP servers are not configured for a DHCP client, the client cannot correlate host names to IP addresses.
- Servers are listed in order of preference (starting with *address1* as the most preferred server).

Example

```
Console(config-dhcp)#dns-server 10.1.1.253 192.168.3.19
Console(config-dhcp)#
```

domain-name

This command specifies the domain name for a DHCP client. Use the **no** form to remove the domain name.

Syntax

domain-name *domain*

no domain-name

domain - Specifies the domain name of the client. (Range: 1-128 characters)

Default Setting

None

Command Mode

DHCP Pool Configuration

Example

```
Console(config-dhcp)#domain-name sample.com
Console(config-dhcp)#
```

hardware-address

This command specifies the hardware address of a DHCP client. This command is valid for manual bindings only. Use the **no** form to remove the hardware address.

Syntax

hardware-address *hardware-address type*

no hardware-address

hardware-address - Specifies the MAC address of the client device.

type - Indicates the following protocol used on the client device:

- ethernet
- ieee802

Default Setting

If no type is specified, the default protocol is Ethernet.

Command Mode

DHCP Pool Configuration

Command Usage

This command identifies a DHCP or BOOTP client to bind to an address specified in the host command. BOOTP clients cannot transmit a client identifier. To bind an address to a BOOTP client, you must associate a hardware address with the host entry.

Example

```
Console(config-dhcp)#hardware-address 00-e0-29-94-34-28 ethernet
Console(config-dhcp)#
```

host

Use this command to specify the IP address and network mask to manually bind to a DHCP client. Use the **no** form to remove the IP address for the client.

Syntax

host *address* [*mask*]

no host

address - Specifies the IP address of a client.

mask - Specifies the network mask of the client.

Default Setting

None

Command Mode

DHCP Pool Configuration

Usage Guidelines

- Host addresses must fall within the range specified for an existing network pool.
- When a client request is received, the switch first checks for a network address pool matching the gateway where the request originated (i.e., if the request was forwarded by a relay server). If there is no gateway in the client request (i.e., the request was not forwarded by a relay server), the switch searches for a network pool matching the interface through which the client request was received. It then searches for a manually configured host address that falls within the matching network pool.
- When searching for a manual binding, the switch compares the client identifier for DHCP clients, and then compares the hardware address for DHCP or BOOTP clients.
- If no manual binding has been specified for a host entry with the client-identifier or hardware-address commands, then the switch will assign an address from the matching network pool.
- If the mask is unspecified, DHCP examines its address pools. If no mask is found in the pool database, the Class A, B, or C natural mask is used (see page 832). This command is valid for manual bindings only.
- The **no host** command only clears the address from the DHCP server database. It does not cancel the IP address currently in use by the host.

Example

```
Console(config-dhcp)#host 10.1.0.21 255.255.255.0
Console(config-dhcp)#
```

lease

This command configures the duration that an IP address is assigned to a DHCP client. Use the **no** form to restore the default value.

Syntax

lease {*days* [*hours*] [*minutes*] | **infinite**}

no lease

days - Specifies the duration of the lease in numbers of days. (Range: 0-365)

hours - Specifies the number of hours in the lease. A *days* value must be supplied before you can configure *hours*. (Range: 0-23)

minutes - Specifies the number of minutes in the lease. A *days* and *hours* value must be supplied before you can configure *minutes*. (Range: 0-59)

infinite - Specifies that the lease time is unlimited. This option is normally used for addresses manually bound to a BOOTP client via the **host** command.

Default Setting

One day

Command Modes

DHCP Pool Configuration

Example

The following example leases an address to clients using this pool for 7 days.

```
Console(config-dhcp)#lease 7
Console(config-dhcp)#
```

netbios-name-server

This command configures NetBIOS Windows Internet Naming Service (WINS) name servers that are available to Microsoft DHCP clients. Use the **no** form to remove the NetBIOS name server list.

Syntax

netbios-name-server *address1* [*address2*]

no netbios-name-server

address1 - Specifies IP address of primary NetBIOS WINS name server.

address2 - Specifies IP address of alternate NetBIOS WINS name server.

Default Setting
None

Command Mode
DHCP Pool Configuration

Usage Guidelines
Servers are listed in order of preference (starting with *address1* as the most preferred server).

Example
```
Console(config-dhcp)#netbios-name-server 10.1.0.33 10.1.0.34
Console(config-dhcp)#
```

netbios-node-type
This command configures the NetBIOS node type for Microsoft DHCP clients. Use the **no** form to remove the NetBIOS node type.

Syntax
netbios-node-type *type*

no netbios-node-type

type - Specifies the NetBIOS node type:

broadcast

hybrid (recommended)

mixed

peer-to-peer

Default Setting
None

Command Mode
DHCP Pool Configuration

Example
```
Console(config-dhcp)#netbios-node-type hybrid
Console(config-dhcp)#
```

network
This command configures the subnet number and mask for a DHCP address pool. Use the **no** form to remove the subnet number and mask.

Syntax

network *network-number* [*mask*]

no network

network-number - The IP address of the DHCP address pool.

mask - The bit combination that identifies the network (or subnet) and the host portion of the DHCP address pool.

Command Mode

DHCP Pool Configuration

Usage Guidelines

- When a client request is received, the switch first checks for a network address pool matching the gateway where the request originated (i.e., if the request was forwarded by a relay server). If there is no gateway in the client request (i.e., the request was not forwarded by a relay server), the switch searches for a network pool matching the interface through which the client request was received. It then searches for a manually configured host address that falls within the matching network pool. If no manually configured host address is found, it assigns an address from the matching network address pool. However, if no matching address pool is found the request is ignored.

- This command is valid for DHCP network address pools only. If the mask is not specified, the class A, B, or C natural mask is used. Subnet addresses are interpreted as class A, B or C, based on the first field in the specified address. In other words, if a subnet address nnn.xxx.xxx.xxx is entered, the first field (nnn) determines the class:

  0 - 127 is class A, only uses the first field in the network address.
  128 - 191 is class B, uses the first two fields in the network address.
  192 - 223 is class C, uses the first three fields in the network address.

- The DHCP server assumes that all host addresses are available. You can exclude subsets of the address space by using the ip dhcp excluded-address command.

Example

```
Console(config-dhcp)#network 10.1.0.0 255.255.255.0
Console(config-dhcp)#
```

next-server

This command configures the next server in the boot process of a DHCP client. Use the **no** form to remove the boot server list.

Syntax

[**no**] **next-server** *address*

address - Specifies the IP address of the next server in the boot process, which is typically a Trivial File Transfer Protocol (TFTP) server.

Default Setting

None

Command Mode

DHCP Pool Configuration

Example

```
Console(config-dhcp)#next-server 10.1.0.21
Console(config-dhcp)#
```

option

Use this command to enable DHCP options. Use the **no** form of the command to disable DHCP options.

Syntax

option *code* {**ascii** *word* | **hex** *hex-value* | **ip-address** *address*1[address2 [address3[address 4]]]}

code - A DHCP option code (Range: 0-254).

ascii *word* - ASCII character string representing a network device (Range: 1-48 ASCII characters).

hex *hex-value* - A concatenated hex number string of up to 4 IPv4 addresses in hex format each representing a network device.

ip-address *address* - up to 4 IPv4 addresses can be entered sequentially with blank spaces between. Each address represents a device in the network.

Default:

Disabled

Command Mode:

DHCP Pool Configuration

Command Usage:

To convert IPv4 address to a hex number string, each octet of the address is individually converted to hex and then all four hex values obtained concatenated.

Take for example the address 192.168.2.1, 192=$c0_{16}$, 168=$a8_{16}$, 2=02_{16}, and 1=01_{16} resulting in $c0a80201_{16}$ as the hex value for the IPv4 address.

Example

In this example network devices 192.168.2.1 and 192.168.3.1 are entered in hex format using the **option** command.

```
Console(config-dhcp)#option 43 hex c0a802021c0a80301
Console(config-dhcp)#
```

clear ip dhcp binding

This command deletes an automatic address binding from the DHCP server database.

Syntax

clear ip dhcp binding [*address*]

address - The address of the binding to clear.

Default Setting

None

Command Mode

Privileged Exec

Usage Guidelines

- An *address* specifies the client's IP address. If no ip address is specified, the DHCP server clears all automatic bindings.
- Use the no host command to delete a manual binding.
- This command is normally used after modifying the address pool, or after moving DHCP service to another device.

Example.

```
Console#clear ip dhcp binding
Console
```

show ip dhcp binding

This command displays address bindings on the DHCP server.

Syntax

show ip dhcp binding [*address*]

address - Specifies the IP address of the DHCP client for which bindings will be displayed.

Default Setting
None

Command Mode
Normal Exec, Privileged Exec

Example

```
Console#show ip dhcp binding

     IP                MAC           Lease Time        Start
                                    (dd/hh/mm/ss)
--------------- ----------------- ------------------ -----------
     192.1.3.21 00-00-e8-98-73-21              86400 Dec 25 08:01:57 2002
Console#
```

show ip dhcp
This command displays DHCP address pools configured on the switch.

Command Mode
Privileged Exec

Example

```
Console#show ip dhcp

  Name   Type   IP Address         Mask               Active Pool
-------- ---- --------------- --------------- --------------------------------
tps      Net  192.168.1.0     255.255.255.0   192.168.1.1     - 192.168.1.254

Total entry : 1
Console#
```

show ip dhcp pool
This command displays the detailed configuration information of DHCP address pools on the switch.

Command Mode
Privileged Exec

Example

```
Console#show ip dhcp pool
Pool name : officea
Pool type : Network
    Network address        : 192.168.3.1


    Subnet mask            : 255.255.255.0

    Boot file              :
    Client identifier mode : Hex
    Client identifier      :
    Default router         : 10.2.3.4
```

```
                              0.0.0.0
    DNS server                : 192.168.4.4
                              0.0.0.0
    Domain name               : officeA
    Hardware type             : None
    Hardware address          : 00-00-00-00-00-00
    Lease time                : 1 d/ 0 h/ 0 m
    Netbios name server       : 0.0.0.0
                              0.0.0.0
    Netbios node type         : Hybrid
    Next server               : 192.168.5.1

Console#
```

33 IP Interface Commands

An IP Version 4 and Version 6 address may be used for management access to the switch over the network. Both IPv4 or IPv6 addresses can be used simultaneously to access the switch. You can manually configure a specific IPv4 or IPv6 address or direct the switch to obtain an IPv4 address from a BOOTP or DHCP server when it is powered on. An IPv6 address can either be manually configured or dynamically generated.

The IPv4 address for VLAN 1 on this switch is set to 192.168.2.10 by default. You may also need to a establish an IPv4 or IPv6 default gateway between this device and management stations that exist on another network segment.

Table 127: IP Interface Commands

Command Group	Function
IPv4 Interface	Configures an IPv4 address for the switch
IPv6 Interface	Configures an IPv6 address for the switch
ND Snooping	Maintains IPv6 prefix table and user address binding table which can be used for stateless address auto-configuration or for address filtering by IPv6 Source Guard

IPv4 Interface

An initial IPv4 address of 192.168.2.10 is assigned to VLAN 1 on this switch by default. If this address is not suitable, you can manually configure a new address to manage the switch over your network or to connect the switch to existing IP subnets. You may also need to a establish a default gateway between this device and management stations or other devices that exist on another network segment (if routing is not enabled).

This section includes commands for configuring IP interfaces, the Address Resolution Protocol (ARP) and Proxy ARP.

Table 128: IPv4 Interface Commands

Command Group	Function
Basic IPv4 Configuration	Configures the IP address for interfaces and the gateway router
ARP Configuration	Configures static, dynamic and proxy ARP service
UDP Helper Configuration	Forwards UDP broadcast packets to a specified server

Basic IPv4 Configuration

This section describes commands used to configure IP addresses for VLAN interfaces on the switch.

Table 129: Basic IP Configuration Commands

Command	Function	Mode
ip address	Sets the IP address for the current interface	IC
ip default-gateway	Defines the default gateway through which this switch can reach other subnetworks	GC
interface loopback	Configures a loopback interface and enters interface loopback configuration mode	GC
ip address (loopback)	Sets an IP address for the loopback interface	IC
show ip interface	Displays the IP settings for this device	PE
show ip route	Displays specified entries in the routing table	PE
show ip traffic	Displays statistics for IP, ICMP, UDP, TCP and ARP protocols	PE
traceroute	Shows the route packets take to the specified host	PE
ping	Sends ICMP echo request packets to another node on the network	NE, PE

ip address

This command sets the IPv4 address for the currently selected VLAN interface. Use the **no** form to remove an IP address.

Syntax

ip address {*ip-address netmask* [**secondary**]
[**default-gateway** *ip-address*] | **bootp** | **dhcp**}

no ip address [*ip-address netmask* [**secondary**] | **dhcp**]

ip-address - IP address

netmask - Network mask for the associated IP subnet. This mask identifies the host address bits used for routing to specific subnets. The network mask can use either the traditional format xxx.xxx.xxx.xxx or classless format with the range /5 to /32. For example the subnet 255.255.224.0 would be / 19.

secondary - Specifies a secondary IP address.

default-gateway - The default gateway. (Refer to the ip default-gateway command which provides the same function.)

bootp - Obtains IP address from BOOTP.

dhcp - Obtains IP address from DHCP.

Default Setting

192.168.2.10/24

Command Mode

Interface Configuration (VLAN)

Command Usage

- Before any network interfaces are configured on the router, first create a VLAN for each unique user group, or for each network application and its associated users. Then assign the ports associated with each of these VLANs.

- An IP address must be assigned to this device to gain management access over the network or to connect the router to existing IP subnets. A specific IP address can be manually configured, or the router can be directed to obtain an address from a BOOTP or DHCP server. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. Anything other than this format will not be accepted by the configuration program.

- An interface can have only one primary IP address, but can have many secondary IP addresses. In other words, secondary addresses need to be specified if more than one IP subnet can be accessed through this interface. Note that a secondary address cannot be configured prior to setting the primary IP address, and the primary address cannot be removed if a secondary address is still present. Also, if any router/switch in a network segment uses a secondary address, all other routers/switches in that segment must also use a secondary address from the same network or subnet address space.

- If **bootp** or **dhcp** options are selected, the system will immediately start broadcasting service requests for all VLANs configured to obtain address assignments through BOOTP or DHCP. IP is enabled but will not function until a BOOTP or DHCP reply has been received. Requests are broadcast periodically by the router in an effort to learn its IP address. (BOOTP and DHCP values can include the IP address, default gateway, and subnet mask). If the DHCP/ BOOTP server is slow to respond, you may need to use the ip dhcp restart client command to re-start broadcasting service requests, or reboot the switch.

Note: Each VLAN group can be assigned its own IP interface address. You can manage the switch via any of these IP addresses.

Example

In the following example, the device is assigned an address in VLAN 1.

```
Console(config)#interface vlan 1
Console(config-if)#ip address 192.168.1.5 255.255.255.0
Console(config-if)#
```

This example assigns an IP address to VLAN 2 using a classless network mask.

```
Console(config)#interface vlan 2
Console(config-if)#ip address 10.2.2.1/24
Console(config-if)#
```

ip default-gateway

This command specifies the default gateway for destinations not found in local routing tables. Use the **no** form to remove a default gateway.

Syntax

ip default-gateway *gateway*

no ip default-gateway

gateway - IP address of the default gateway

Default Setting

No default gateway is established.

Command Mode

Global Configuration

Command Usage

- The default gateway can also be defined using the following Global configuration command: **ip route 0.0.0.0 0.0.0.0** *gateway-address*.
- Static routes can also be defined using the ip route command to ensure that traffic to the designated address or subnet passes through a preferred gateway.
- A default gateway can only be successfully set when a network interface that directly connects to the gateway has been configured on the router.
- The same link-local address may be used by different interfaces/nodes in different zones (RFC 4007). Therefore, when specifying a link-local address for a default gateway, include zone-id information indicating the VLAN identifier after the % delimiter. For example, FE80::7272%1 identifies VLAN 1 as the interface.

Example

The following example defines a default gateway for this device:

```
Console(config)#ip default-gateway 192.168.2.1
Console(config)#end
Console#show ip route
Codes: C - connected, S - static, R - RIP, B - BGP
       O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
       i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
       * - candidate default

S*      0.0.0.0/0 [1/0] via 192.168.2.1, VLAN1
C       192.168.2.0/24 is directly connected, VLAN1
Console(config)#
```

interface loopback

This command configures a loopback interface and enters interface loopback configuration mode. Use the **no** form to remove a loopback interface.

Syntax

[no] interface loopback *interface-number*

interface-number - The interface number (always 0).

Default Setting

None

Command Mode

Global Configuration

Command Usage

Configure a loopback interface to create an interface that is always up.

Example

```
Console#interface loopback 0
Console(config-if)#
```

ip address (loopback)

This command sets the IPv4 address for the loopback interface. Use the **no** form to remove the IP address.

Syntax

[no] ip address {*ip-address netmask* | *ip-address/prefix-length*}

ip-address - IP address

netmask - Network mask for the associated IP subnet. This mask identifies the host address bits used for routing to specific subnets.

prefix-length - The network mask specified in classless format with the range /5 to /32.

Default Setting

None

Command Mode

Interface Configuration (Loopback)

Example

```
Console#interface loopback 0
Console(config-if)#ip address 192.168.1.1 255.255.255.0
Console(config-if)#
```

show ip interface

This command displays the settings of an IPv4 interface.

Syntax

show ip interface [**vlan** *vlan-id*]

vlan-id - VLAN ID (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#show ip interface
VLAN 1 is Administrative Up - Link Up
  Address is CC-37-AB-BC-4F-FA
  Index: 1001, MTU: 1500
  Address Mode is User specified
  IP Address: 192.168.2.98 Mask: 255.255.255.0
  Proxy ARP is disabled
  DHCP Relay Server:
Console#
```

show ip traffic

This command displays statistics for IP, ICMP, UDP, TCP and ARP protocols.

Command Mode

Privileged Exec

Example

```
Console#show ip traffic
IP Statistics:
IP received
                7845 total received
                     header errors
                     unknown protocols
                     address errors
                     discards
                7845 delivers
                     reassembly request datagrams
                     reassembly succeeded
                     reassembly failed
IP sent
                     forwards datagrams
                9903 requests
                     discards
                     no routes
                     generated fragments
                     fragment succeeded
                     fragment failed
ICMP Statistics:
ICMP received
                     input
                     errors
                     destination unreachable messages
                     time exceeded messages
                     parameter problem message
```

```
                    echo request messages
                    echo reply messages
                    redirect messages
                    timestamp request messages
                    timestamp reply messages
                    source quench messages
                    address mask request messages
                    address mask reply messages
ICMP sent
                    output
                    errors
                    destination unreachable messages
                    time exceeded messages
                    parameter problem message
                    echo request messages
                    echo reply messages
                    redirect messages
                    timestamp request messages
                    timestamp reply messages
                    source quench messages
                    address mask request messages
                    address mask reply messages
UDP Statistics:
                    input
                    no port errors
                    other errors
                    output
TCP Statistics:
                7841 input
                     input errors
                9897 output
Console#
```

traceroute

This command shows the route packets take to the specified destination.

Syntax

traceroute *host*

host - IP address or alias of the host.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- Use the **traceroute** command to determine the path taken to reach a specified destination.
- A trace terminates when the destination responds, when the maximum timeout (TTL) is exceeded, or the maximum number of hops is exceeded.

- The traceroute command first sends probe datagrams with the TTL value set at one. This causes the first router to discard the datagram and return an error message. The trace function then sends several probe messages at each subsequent TTL level and displays the round-trip time for each message. Not all devices respond correctly to probes by returning an "ICMP port unreachable" message. If the timer goes off before a response is returned, the trace function prints a series of asterisks and the "Request Timed Out" message. A long sequence of these messages, terminating only when the maximum timeout has been reached, may indicate this problem with the target device.

- If the target device does not respond or other errors are detected, the switch will indicate this by one of the following messages:
  - * - No Response
  - H - Host Unreachable
  - N - Network Unreachable
  - P - Protocol Unreachable
  - O -Other

Example

```
Console#traceroute 192.168.0.99
Press "ESC" to abort.
Traceroute to 192.168.0.99, 30 hops max, timeout is 3 seconds
Hop Packet 1 Packet 2 Packet 3 IP Address
--- -------- -------- -------- ---------------
  1    20 ms   <10 ms   <10 ms 192.168.0.99

Trace completed.
Console#
```

ping

This command sends (IPv4) ICMP echo request packets to another node on the network.

Syntax

ping *host* [**count** *count*] [**size** *size*]

host - IP address or alias of the host.

count - Number of packets to send. (Range: 1-1000000)

size - Number of bytes in a packet. (Range: 32-1472)
The actual packet size will be eight bytes larger than the size specified because the switch adds header information.

Default Setting

count: 5
size: 32 bytes

Command Mode

Normal Exec, Privileged Exec

Command Usage

- Use the ping command to see if another site on the network can be reached.
- The following are some results of the **ping** command:
  - *Normal response* - The normal response occurs in one to ten seconds, depending on network traffic.
  - *Destination does not respond* - If the host does not respond, a "timeout" appears in ten seconds.
  - *Destination unreachable* - The gateway for this destination indicates that the destination is unreachable.
  - *Network or host unreachable* - The gateway found no corresponding entry in the route table.
- When pinging a host name, be sure the DNS server has been defined (page 804) and host name-to-address translation enabled (page 802). If necessary, local devices can also be specified in the DNS static host table (page 803).

Example

```
Console#ping 10.1.0.9
Press ESC to abort.
PING to 10.1.0.9, by 5 32-byte payload ICMP packets, timeout is 5 seconds
response time: 3.101 ms
response time: 1.855 ms
response time: 1.251 ms
response time: 1.577 ms
response time: 1.231 ms
Ping statistics for 10.1.0.9:
 5 packets transmitted, 5 packets received (100%), 0 packets lost (0%)
Approximate round trip times:
 Minimum = 1.231 ms, Maximum = 3.101 ms, Average = 1.803 ms
Console#
```

ARP Configuration

This section describes commands used to configure the Address Resolution Protocol (ARP) on the switch.

Table 130: Address Resolution Protocol Commands

Command	Function	Mode
arp	Adds a static entry in the ARP cache	GC
arp timeout	Sets the time a dynamic entry remains in the ARP cache	GC
ip proxy-arp	Enables proxy ARP service	IC
clear arp-cache	Deletes all dynamic entries from the ARP cache	PE
show arp	Displays entries in the ARP cache	PE

arp

This command adds a static entry in the Address Resolution Protocol (ARP) cache. Use the **no** form to remove an entry from the cache.

Syntax

arp *ip-address hardware-address*

no arp *ip-address*

ip-address - IP address to map to a specified hardware address.

hardware-address - Hardware address to map to a specified IP address. (The format for this address is xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx.)

Default Setting

No default entries

Command Mode

Global Configuration

Command Usage

- The ARP cache is used to map 32-bit IP addresses into 48-bit hardware (i.e., Media Access Control) addresses. This cache includes entries for hosts and other routers on local network interfaces defined on this router.
- The maximum number of static entries allowed in the ARP cache is 128.
- You may need to put a static entry in the cache if there is no response to an ARP broadcast message. For example, some applications may not respond to ARP requests or the response arrives too late, causing network operations to time out.
- Static entries will not be aged out nor deleted when power is reset. A static entry can only be removed through the configuration interface.

Example

```
Console(config)#arp 10.1.0.19 01-02-03-04-05-06
Console(config)#
```

arp timeout

This command sets the aging time for dynamic entries in the Address Resolution Protocol (ARP) cache. Use the **no** form to restore the default timeout.

Syntax

arp timeout *seconds*

no arp timeout

seconds - The time a dynamic entry remains in the ARP cache. (Range: 300-86400; 86400 seconds is one day)

Default Setting
1200 seconds (20 minutes)

Command Mode
Global Configuration

Command Usage
- When a ARP entry expires, it is deleted from the cache and an ARP request packet is sent to re-establish the MAC address.
- The aging time determines how long dynamic entries remain in the cache. If the timeout is too short, the router may tie up resources by repeating ARP requests for addresses recently flushed from the table.

Example
This example sets the ARP cache timeout for 15 minutes (i.e., 900 seconds).

```
Console(config)#arp timeout 900
Console(config)#
```

ip proxy-arp
This command enables proxy Address Resolution Protocol (ARP). Use the **no** form to disable proxy ARP.

Syntax
[no] ip proxy-arp

Default Setting
Disabled

Command Mode
Interface Configuration (VLAN)

Command Usage
- Proxy ARP allows a non-routing device to determine the MAC address of a host on another subnet or network.
- End stations that require Proxy ARP must view the entire network as a single network. These nodes must therefore use a smaller subnet mask than that used by the router or other relevant network devices.
- Extensive use of Proxy ARP can degrade router performance because it may lead to increased ARP traffic and increased search time for larger ARP address tables.

Example

```
Console(config)#interface vlan 3
Console(config-if)#ip proxy-arp
Console(config-if)#
```

clear arp-cache

This command deletes all dynamic entries from the Address Resolution Protocol (ARP) cache.

Command Mode

Privileged Exec

Example

This example clears all dynamic entries in the ARP cache.

```
Console#clear arp-cache
This operation will delete all the dynamic entries in ARP Cache.
Do you want to continue this operation (y/n)?
Console#
```

show arp

This command displays entries in the Address Resolution Protocol (ARP) cache.

Command Mode

Privileged Exec

Command Usage

- This command displays information about the ARP cache. The first line shows the cache timeout. It also shows each cache entry, including the IP address, MAC address, type (static, dynamic, other), and VLAN interface. Note that entry type "other" indicates local addresses for this router.

- Static entries are only displayed for VLANs that are up. In other words, static entries are only displayed when configured for the IP subnet of a existing VLAN, and that VLAN is linked up.

Example

This example displays all entries in the ARP cache.

```
Console#show arp
ARP Cache Timeout: 1200 (seconds)

IP Address      MAC Address       Type      Interface
--------------- ----------------- --------- -----------
10.1.0.0        FF-FF-FF-FF-FF-FF other     VLAN1
10.1.0.254      00-00-AB-CD-00-00 other     VLAN1
10.1.0.255      FF-FF-FF-FF-FF-FF other     VLAN1
145.30.20.23    09-50-40-30-20-10 dynamic   VLAN3
```

```
Total entry : 4
Console#
```

UDP Helper Configuration

User Datagram Protocol (UDP) Helper allows host applications to forward UDP broadcast packets from this switch to another part of the network. This section describes the commands used to configure UDP Helper.

Table 131: UDP Helper Commands

Command	Function	Mode
ip forward-protocol udp	Specifies the UDP destination ports for which broadcast traffic will be forwarded	GC
ip helper	Enables UDP helper globally on the switch	GC
ip helper-address	Specifies the servers to which designated UDP protocol packets are forwarded	IC
show ip helper	Displays configuration settings for UDP helper	PE

ip forward-protocol udp

This command specifies the UDP destination ports for which broadcast traffic will be forwarded when the UDP helper is enabled. Use the **no** form to remove a UDP port from the forwarding list.

Syntax

[no] **ip forward-protocol udp** *destination-port*

destination-port - UDP application port for which UDP service requests are forwarded. (Range: 1-65535)

Default Setting

The following UDP ports are included in the forwarding list when UDP helper is enabled with the ip helper command and a remote server address is configured with the ip helper-address command:

BOOTP client	port 67
BOOTP server	port 68
Domain Name Service	port 53
IEN-116 Name Service	port 42
NetBIOS Datagram Server	port 138
NetBIOS Name Server	port 137
NTP	port 37
TACACS service	port 49
TFTP	port 69

Command Mode

Global Configuration

Command Usage
Up to 100 UDP ports can be specified with this command for forwarding to one or more remote servers.

Example
This example enables forwarding for DHCPv6 UDP packets.

```
Console(config)#ip forward-protocol udp 547
Console(config)#
```

ip helper
This command enables UDP helper globally on the switch. Use the **no** form to disable this feature.

Syntax
[no] ip helper

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
- Network hosts occasionally use UDP broadcasts to determine information such as address configuration, and domain name mapping. These broadcasts are confined to the local subnet, either as an all hosts broadcast (all ones broadcast - 255.255.255.255), or a directed subnet broadcast (such as 10.10.10.255). To reduce the number of application servers deployed in a multi-segment network, UDP helper can be used to forward broadcast packets for specified UDP application ports to remote servers located in another network segment.

- To configure UDP helper, it must be enabled globally with the **ip helper** command. The UDP destination ports for which broadcast traffic will be forwarded must be specified with the ip forward-protocol udp command. And the remote servers which are configured to service UDP clients on another network segment specified with the ip helper-address command.

Example
This example enables UDP helper globally on the switch.

```
Console(config)#ip helper
Console(config)#
```

ip helper-address

This command specifies the application server or subnet (indicated by a directed broadcast address) to which designated UDP broadcast packets are forwarded. Use the **no** form to remove a UDP helper address.

Syntax

[no] **ip helper-address** *ip-address*

ip-address - Host address or directed broadcast address to which UDP broadcast packets are forwarded. (Range: 1-65535)

Default Setting

None

Command Mode

Interface Configuration (VLAN)

Command Usage

- Up to 20 helper addresses can be specified with this command.
- To forward UDP packets with the UDP helper, the clients must be connected to the selected interface, and the interface configured with an IP address.
- The UDP packets to be forwarded must be specified by the ip forward-protocol udp command, and the packets meet the following criteria:
  - The MAC address of the received frame must be all-ones broadcast address (ffff.ffff.ffff).
  - The IP destination address must be one of the following:
    - all-ones broadcast (255.255.255.255)
    - subnet broadcast for the receiving interface
  - The IP time-to-live (TTL) value must be at least 2.
  - The IP protocol must be UDP (17).
  - The UDP destination port must be TFTP, Domain Name System (DNS), Time, NetBIOS, BOOTP or DHCP packet, or a UDP port specified by the ip forward-protocol udp command.
- If a helper address is specified with this command, but no UDP ports have been specified with the ip forward-protocol udp command, broadcast traffic for several UDP protocol types will be forwarded by default as described under the ip forward-protocol udp command.

Example

This example indicates that designated UDP broadcast packets are to be forwarded to the directed broadcast address of 192.168.2.255.

```
Console(config)#interface vlan 1
Console(config-if)#ip helper-address 192.168.2.255
Console(config-if)#
```

show ip helper

This command displays configuration settings for UDP helper.

Command Mode

Privileged Exec

Command Usage

This command displays all configuration settings for UDP helper, including its functional status, the UDP ports for which broadcast traffic will be forwarded, and the remote servers or subnets to which the traffic will be forwarded.

Example

```
Console#show ip helper
Helper mechanism is enabled
Forward port list(maximum count: 100)
  547
Total port number now is: 1
Helper address list(maximum count: 1024)
Interface VLAN 1:
  192.168.2.255
Total helper number now is: 1
Console#
```

IPv6 Interface

This switch supports the following IPv6 interface commands.

Table 132: IPv6 Configuration Commands

Command	Function	Mode
Interface Address Configuration and Utilities		
ipv6 default-gateway	Sets an IPv6 default gateway for traffic with no known next hop	GC
ipv6 address	Configures an IPv6 global unicast address, and enables IPv6 on an interface	IC
ipv6 address autoconfig	Enables automatic configuration of IPv6 addresses on an interface and enables IPv6 on the interface	IC
ipv6 address dhcp	Enables IPv6 DHCP client functionality on an interface	IC

Table 132: IPv6 Configuration Commands (Continued)

Command	Function	Mode
ipv6 address eui-64	Configures an IPv6 global unicast address for an interface using an EUI-64 interface ID in the low order 64 bits, and enables IPv6 on the interface	IC
ipv6 address link-local	Configures an IPv6 link-local address for an interface and enables IPv6 on the interface	IC
ipv6 enable	Enables IPv6 on an interface that has not been configured with an explicit IPv6 address	IC
ipv6 mtu	Sets the size of the maximum transmission unit (MTU) for IPv6 packets sent on an interface	IC
show ipv6 interface	Displays the usability and configured settings for IPv6 interfaces	PE
show ipv6 mtu	Displays maximum transmission unit (MTU) information for IPv6 interfaces	PE
show ipv6 traffic	Displays statistics about IPv6 traffic	PE
clear ipv6 traffic	Resets IPv6 traffic counters	PE
ping6	Sends IPv6 ICMP echo request packets to another node on the network	NE, PE
traceroute6	Shows the route packets take to the specified host	PE
Neighbor Discovery		
ipv6 hop-limit	Configures the maximum number of hops used in router advertisements that are originated by this router	GC
ipv6 neighbor	Configures a static entry in the IPv6 neighbor discovery cache	GC
ipv6 nd dad attempts	Configures the number of consecutive neighbor solicitation messages sent on an interface during duplicate address detection	IC
ipv6 nd managed-config-flag	Configures router advertisements to indicate that attached hosts can use stateful autoconfiguration to obtain addresses	IC
ipv6 nd other-config-flag	Configures router advertisements to indicate that attached hosts can obtain autoconfiguration information other than addresses	IC
ipv6 nd ns-interval	Configures the interval between IPv6 neighbor solicitation retransmissions on an interface	IC
ipv6 nd raguard	Blocks incoming Router Advertisement and Router Redirect packets	IC
ipv6 nd reachable-time	Configures the amount of time that a remote IPv6 node is considered reachable after some reachability confirmation event has occurred	IC
ipv6 nd prefix	Configures the IPv6 prefixes to include in router advertisements	IC
ipv6 nd ra interval minimum-interval [maximum-interval]	Configures the interval between the transmission of router advertisements on an interface	IC
ipv6 nd ra lifetime	Configures the router lifetime value used in router advertisements sent from an interface	IC

Table 132: IPv6 Configuration Commands (Continued)

Command	Function	Mode
ipv6 nd ra router-preference	Configures the default router preference for the router on an interface	IC
ipv6 nd ra suppress	Suppresses router advertisement transmissions on an interface	IC
show ipv6 nd raguard	Displays the configuration setting for RA Guard	PE
clear ipv6 neighbors	Deletes all dynamic entries in the IPv6 neighbor discovery cache	PE
show ipv6 neighbors	Displays information in the IPv6 neighbor discovery cache	PE
show ipv6 nd prefix	Displays IPv6 neighbor discovery prefixes for a VLAN	PE

Interface Address Configuration and Utilities

ipv6 default-gateway

This command sets an IPv6 default gateway to use for destinations with no known next hop. Use the **no** form to remove a previously configured default gateway.

Syntax

ipv6 default-gateway *ipv6-address*

no ipv6 default-gateway

ipv6-address - The IPv6 address of the default next hop router to use for destinations with no known next hop.

Default Setting

No default gateway is defined

Command Mode

Global Configuration

Command Usage

- All IPv6 addresses must be according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.
- The same link-local address may be used by different interfaces/nodes in different zones (RFC 4007). Therefore, when specifying a link-local address, include zone-id information indicating the VLAN identifier after the % delimiter. For example, FE80::7272%1 identifies VLAN 1 as the interface from which the ping is sent.
- An IPv6 default gateway should be defined if the destination has been assigned an IPv6 address that is located in a different IP segment.

- An IPv6 default gateway can only be successfully set when a network interface that directly connects to the gateway has been configured on the switch.

Example

The following example defines a default gateway for this device:

```
Console(config)#ipv6 default-gateway FE80::269:3EF9:FE19:6780%1
Console(config)#
```

ipv6 address

This command configures an IPv6 global unicast address and enables IPv6 on an interface. Use the **no** form without any arguments to remove all IPv6 addresses from the interface, or use the **no** form with a specific IPv6 address to remove that address from the interface.

Syntax

[no] **ipv6 address** *ipv6-address*[*/prefix-length*]

ipv6-address - A full IPv6 address including the network prefix and host address bits.

prefix-length - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

Default Setting

No IPv6 addresses are defined

Command Mode

Interface Configuration (VLAN)

Command Usage

- All IPv6 addresses must be according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

- To connect to a larger network with multiple subnets, you must configure a global unicast address. This address can be manually configured with this command, or it can be automatically configured using the ipv6 address autoconfig command.

- If a link-local address has not yet been assigned to this interface, this command will assign the specified static global unicast address and also dynamically generate a link-local unicast address for the interface. (The link-local address is made with an address prefix of FE80 and a host portion based the switch's MAC address in modified EUI-64 format.)

- If a duplicate address is detected, a warning message is sent to the console.

Example

This example specifies a full IPv6 address and prefix length.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 address 2001:DB8:2222:7272::72/96
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled
Link-local address:
  fe80::7272:cfff:fe83:3466%1/64
Global unicast address(es):
  2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
ff02::1:ff00:72
ff02::1:ff83:3466
ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

ipv6 address autoconfig

This command enables stateless autoconfiguration of IPv6 addresses on an interface and enables IPv6 on the interface. The network portion of the address is based on prefixes received in IPv6 router advertisement messages; the host portion is based on the modified EUI-64 form of the interface identifier (i.e., the switch's MAC address). Use the **no** form to remove the address generated by this command.

Syntax

[no] ipv6 address autoconfig

Default Setting

No IPv6 addresses are defined

Command Mode

Interface Configuration (VLAN)

Command Usage

- If a link local address has not yet been assigned to this interface, this command will dynamically generate a global unicast address (if a global prefix is included in received router advertisements) and a link local address for the interface. (The link-local address is made with an address prefix of FE80 and a host portion based the switch's MAC address in modified EUI-64 format.)

- If a duplicate address is detected, a warning message is sent to the console.
- When DHCPv6 is restarted, the switch may attempt to acquire an IP address prefix through stateful address autoconfiguration. If the router advertisements have the "other stateful configuration" flag set, the switch may also attempt to acquire other non-address configuration information (such as a default gateway) from a DHCPv6 server when DHCPv6 is restarted.

Example

This example assigns a dynamic global unicast address of to the switch.

```
Console(config-if)#ipv6 address autoconfig
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is stale
Link-local address:
  fe80::7272:cfff:fe83:3466%1/64
Global unicast address(es):
(None)
Joined group address(es):
ff02::1:ffbc:4ffa
ff02::1:2
ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

ipv6 address dhcp

This command enables IPv6 DHCP client functionality on an interface so that it can acquire a stateful IPv6 address. Use the **no** form of the command to disabled the IPv6 DHCP client.

Syntax

ipv6 address dhcp

no ipv6 address dhcp

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- The switch can function as either a DHCPv6 server or an IPv6 client. Using the **ipv6 address dhcp** command configures the switch to act as an IPv6 client on a VLAN interface. Once enabled, the VLAN interface will have the ability for a stateful IPv6 address to be assigned to it dynamically using the DHCPv6 protocol.

- By default, the switch acts as a DHCPv6 server and sends Router Advertisements (RAs) for Stateless Address Autoconfiguration (SLAAC). However, when you want the switch to function as an IPv6 client, it should not send RAs. Therefore, you should first use the ipv6 nd ra suppress command to disable RAs before using the **ipv6 address dhcp** command. This ensures that the switch operates solely as an IPv6 client. If the switch continues to send RAs while **ipv6 address dhcp** is enabled, it would act as both a server and a client simultaneously, which is not a proper configuration in a network environment.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 nd ra suppress
Console(config-if)#ipv6 address dhcp
Console(config-if)#
```

ipv6 address eui-64

This command configures an IPv6 address for an interface using an EUI-64 interface ID in the low order 64 bits and enables IPv6 on the interface. Use the **no** form without any arguments to remove all manually configured IPv6 addresses from the interface. Use the **no** form with a specific address to remove it from the interface.

Syntax

ipv6 address *ipv6-prefix/prefix-length* **eui-64**

no ipv6 address [*ipv6-prefix/prefix-length* **eui-64**]

ipv6-prefix - The IPv6 network portion of the address assigned to the interface.

prefix-length - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

Default Setting

No IPv6 addresses are defined

Command Mode

Interface Configuration (VLAN)

Command Usage

- The prefix must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double

colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

- If a link local address has not yet been assigned to this interface, this command will dynamically generate a global unicast address and a link-local address for this interface. (The link-local address is made with an address prefix of FE80 and a host portion based the switch's MAC address in modified EUI-64 format.)
- Note that the value specified in the ipv6-prefix may include some of the high-order host bits if the specified prefix length is less than 64 bits. If the specified prefix length exceeds 64 bits, then the network portion of the address will take precedence over the interface identifier.
- If a duplicate address is detected, a warning message is sent to the console.
- IPv6 addresses are 16 bytes long, of which the bottom 8 bytes typically form a unique host identifier based on the device's MAC address. The EUI-64 specification is designed for devices that use an extended 8-byte MAC address. For devices that still use a 6-byte MAC address (also known as EUI-48 format), it must be converted into EUI-64 format by inverting the universal/local bit in the address and inserting the hexadecimal number FFFE between the upper and lower three bytes of the MAC address.
- For example, if a device had an EUI-48 address of 28-9F-18-1C-82-35, the global/local bit must first be inverted to meet EUI-64 requirements (i.e., 1 for globally defined addresses and 0 for locally defined addresses), changing 28 to 2A. Then the two bytes FFFE are inserted between the OUI (i.e., company id) and the rest of the address, resulting in a modified EUI-64 interface identifier of 2A-9F-18-FF-FE-1C-82-35.
- This host addressing method allows the same interface identifier to be used on multiple IP interfaces of a single device, as long as those interfaces are attached to different subnets.

Example

This example uses the network prefix of 2001:0DB8:0:1::/64, and specifies that the EUI-64 interface identifier be used in the lower 64 bits of the address.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 address 2001:0DB8:0:1::/64 eui-64
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled
Link-local address:
  fe80::7272:cfff:fe83:3466%1/64
Global unicast address(es):
  2001:db8:0:1:7272:cfff:fe83:3466/64, subnet is 2001:db8:0:1::/64[EUI]
  2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
ff02::1:ff00:72
ff02::1:ff83:3466
```

```
ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

ipv6 address link-local

This command configures an IPv6 link-local address for an interface and enables IPv6 on the interface. Use the **no** form without any arguments to remove all manually configured IPv6 addresses from the interface. Use the **no** form with a specific address to remove it from the interface.

Syntax

ipv6 address *ipv6-address* **link-local**

no ipv6 address [*ipv6-address* **link-local**]

ipv6-address - The IPv6 address assigned to the interface.

Default Setting

No IPv6 addresses are defined

Command Mode

Interface Configuration (VLAN)

Command Usage

- The specified address must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields. And the address prefix must be in the range of FE80~FEBF.
- The address specified with this command replaces a link-local address that was automatically generated for the interface.
- You can configure multiple IPv6 global unicast addresses per interface, but only one link-local address per interface.
- If a duplicate address is detected, a warning message is sent to the console.

Example

This example assigns a link-local address of FE80::269:3EF9:FE19:6779 to VLAN 1. Note that a prefix in the range of FE80~FEBF is required for link-local

addresses, and the first 16-bit group in the host address is padded with a zero in the form 0269.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 address FE80::269:3EF9:FE19:6779 link-local
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled
Link-local address:
  fe80::269:3ef9:fe19:6779%1/64
Global unicast address(es):
  2001:db8:0:1:7272:cfff:fe83:3466/64, subnet is 2001:db8:0:1::/64[EUI]
  2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
ff02::1:ff19:6779
ff02::1:ff00:72
ff02::1:ff83:3466
ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

ipv6 enable

This command enables IPv6 on an interface that has not been configured with an explicit IPv6 address. Use the **no** form to disable IPv6 on an interface that has not been configured with an explicit IPv6 address.

Syntax

[no] ipv6 enable

Default Setting

IPv6 is disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- This command enables IPv6 on the current VLAN interface and automatically generates a link-local unicast address. The address prefix uses FE80, and the host portion of the address is generated by converting the switch's MAC address to modified EUI-64 format (see page 859). This address type makes the switch accessible over IPv6 for all devices attached to the same local subnet.

- If a duplicate address is detected on the local segment, this interface will be disabled and a warning message displayed on the console.

- The **no ipv6 enable** command does not disable IPv6 for an interface that has been explicitly configured with an IPv6 address.

Example

In this example, IPv6 is enabled on VLAN 1, and the link-local address FE80::2E0:CFF:FE00:FD/64 is automatically generated by the switch.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 enable
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled
Link-local address:
  fe80::269:3ef9:fe19:6779%1/64
Global unicast address(es):
  2001:db8:0:1:7272:cfff:fe83:3466/64, subnet is 2001:db8:0:1::/64[EUI]
  2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
ff02::1:ff19:6779
ff02::1:ff00:72
ff02::1:ff83:3466
ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 3.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

ipv6 mtu

This command sets the size of the maximum transmission unit (MTU) for IPv6 packets sent on an interface. Use the **no** form to restore the default setting.

Syntax

ipv6 mtu *size*

no ipv6 mtu

size - Specifies the MTU size. (Range: 1280-65535 bytes)

Default Setting

1500 bytes

Command Mode

Interface Configuration (VLAN)

Command Usage

- If a non-default value is configured, an MTU option is included in the router advertisements sent from this device.

- The maximum value set by this command cannot exceed the MTU of the physical interface, which is currently fixed at 1500 bytes.
- IPv6 routers do not fragment IPv6 packets forwarded from other routers. However, traffic originating from an end-station connected to an IPv6 router may be fragmented.
- All devices on the same physical medium must use the same MTU in order to operate correctly.
- IPv6 must be enabled on an interface before the MTU can be set.

Example

The following example sets the MTU for VLAN 1 to 1280 bytes:

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 mtu 1280
Console(config-if)#
```

show ipv6 interface

This command displays the usability and configured settings for IPv6 interfaces.

Syntax

show ipv6 interface [**brief** [**vlan** *vlan-id* [*ipv6-prefix/prefix-length*]]]

brief - Displays a brief summary of IPv6 operational status and the addresses configured for each interface.

vlan-id - VLAN ID (Range: 1-4094)

ipv6-prefix - The IPv6 network portion of the address assigned to the interface. The prefix must be formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

prefix-length - A decimal value indicating how many of the contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

Command Mode

Privileged Exec

Example

This example displays all the IPv6 addresses configured for the switch.

```
Console#show ipv6 interface
VLAN 2 is down.
IPv6 is stale.
Link-local address:
```

```
  FE80::260:3EFF:FE11:6770/64[TEN]
Global unicast address(es):
  3FFE::1, subnet is 3FFE:0:0:0::/64[TEN]
  3FFE::212:CFFF:FE32:2120, subnet is 3FFE:0:0:0::/64[TEN]
Joined group address(es):
  FF01::1/16
  FF02::1/16
  FF02::1:FF00:1/104
  FF02::1:FF11:6770/104
  FF02::1:FF32:2120/104

IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 1.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND managed-config-flag: disabled
ND other-config-flag : disabled
ND ra suppress: disabled
Console#
```

This example displays a brief summary of IPv6 addresses configured on the switch.

```
Console#show ipv6 interface brief
Interface       Status     IPv6       IPv6 Address
--------------- ---------- ---------- ---------------------------------------
VLAN 1          Up         Up         FE80::768E:F8FF:FE68:870
VLAN 1          Up         Up         2001:1DB8:1111:2F3B:12AA:11FF:FE28:9C5A
VLAN 2          Up         Down       Unassigned
Craft           Up         Up         FE80::768E:F8FF:FE68:870

Console#
```

show ipv6 mtu

This command displays the maximum transmission unit (MTU) cache for destinations that have returned an ICMP packet-too-big message along with an acceptable MTU to this switch.

Command Mode

Normal Exec, Privileged Exec

Example

The following example shows the MTU cache for this device:

```
Console#show ipv6 mtu
MTU     Since   Destination Address
1400    00:04:21  5000:1::3
1280    00:04:50  FE80::203:A0FF:FED6:141D
Console#
```

show ipv6 traffic

This command displays statistics about IPv6 traffic passing through this switch.

Command Mode

Privileged Exec

Example

The following example shows statistics for all IPv6 unicast and multicast traffic, as well as ICMP, UDP and TCP statistics:

```
Console#show ipv6 traffic
IPv6 Statistics:
IPv6 received
                    3 total received
                      header errors
                      too big errors
                      no routes
                      address errors
                      unknown protocols
                      truncated packets
                      discards
                      delivers
                      reassembly request datagrams
                      reassembly succeeded
                      reassembly failed
IPv6 sent
                      forwards datagrams
                    6 requests
                      discards
                      no routes
                      generated fragments
                      fragment succeeded
                      fragment failed
ICMPv6 Statistics:
ICMPv6 received
                      input
                      errors
                      destination unreachable messages
                      packet too big messages
                      time exceeded messages
                      parameter problem message
                      echo request messages
                      echo reply messages
                      router solicit messages
                      router advertisement messages
                      neighbor solicit messages
                      neighbor advertisement messages
                      redirect messages
                      group membership query messages
                      group membership response messages
                      group membership reduction messages
ICMPv6 sent
                    6 output
                      destination unreachable messages
                      packet too big messages
                      time exceeded messages
                      parameter problem message
                      echo request messages
                      echo reply messages
                    3 router solicit messages
                      router advertisement messages
```

```
                    3 neighbor solicit messages
                      neighbor advertisement messages
                      redirect messages
                      group membership query messages
                      group membership response messages
                      group membership reduction messages
UDP Statistics:
                      input
                      no port errors
                      other errors
                      output
Console#
```

clear ipv6 traffic

This command resets IPv6 traffic counters.

Command Mode

Privileged Exec

Command Usage

This command resets all of the counters displayed by the show ipv6 traffic command.

Example

```
Console#clear ipv6 traffic
Console#
```

ping6

This command sends (IPv6) ICMP echo request packets to another node on the network.

Syntax

ping6 {*ipv6-address* | *host-name*} [**count** *count*] [**size** *size*]

ipv6-address - The IPv6 address of a neighbor device. You can specify either a link-local or global unicast address formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

host-name - A host name string which can be resolved into an IPv6 address through a domain name server.

count - Number of packets to send. (Range: 1-1000000)

size - Number of bytes in a packet. (Range: 0-1500 bytes)
The actual packet size will be eight bytes larger than the size specified because the router adds header information.

Default Setting
count: 5
size: 32 bytes

Command Mode
Normal Exec, Privileged Exec

Command Usage
- Use the **ping6** command to see if another site on the network can be reached, or to evaluate delays over the path.
- The same link-local address may be used by different interfaces/nodes in different zones (RFC 4007). Therefore, when specifying a link-local address, include zone-id information indicating the VLAN identifier after the % delimiter. For example, FE80::7272%1 identifies VLAN 1 as the interface from which the ping is sent.
- When pinging a host name, be sure the DNS server has been enabled (see page 802). If necessary, local devices can also be specified in the DNS static host table (see page 803).
- When using ping6 with a host name, the switch first attempts to resolve the alias into an IPv6 address before trying to resolve it into an IPv4 address.

Example

```
Console#ping6 FE80::2E0:CFF:FE00:FC%1
Press ESC to abort.
PING to FE80::2E0:CFF:FE00:FC%1/64, by 5 32-byte payload ICMP packets,
  timeout is 3 seconds
response time: 20 ms    [FE80::2E0:CFF:FE00:FC] seq_no: 1
response time: 0 ms     [FE80::2E0:CFF:FE00:FC] seq_no: 2
response time: 0 ms     [FE80::2E0:CFF:FE00:FC] seq_no: 3
response time: 0 ms     [FE80::2E0:CFF:FE00:FC] seq_no: 4
response time: 0 ms     [FE80::2E0:CFF:FE00:FC] seq_no: 5
Ping statistics for FE80::2E0:CFF:FE00:FC%1/64:
 5 packets transmitted, 5 packets received (100%), 0 packets lost (0%)
Approximate round trip times:
 Minimum = 0 ms, Maximum = 20 ms, Average = 4 ms
Console#
```

traceroute6

This command shows the route packets take to the specified destination.

Syntax

traceroute6 {*ipv6-address* | *host-name*} [**max-failures** *failure-count*]

ipv6-address - The IPv6 address of a neighbor device. You can specify either a link-local or global unicast address formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to

indicate the appropriate number of zeros required to fill the undefined fields.

host-name - A host name string which can be resolved into an IPv6 address through a domain name server.

failure-count - The maximum number of failures before which the trace route is terminated. (Range: 1-255)

Default Setting

Maximum failures: 5

Command Mode

Privileged Exec

Command Usage

- Use the **traceroute6** command to determine the path taken to reach a specified destination.
- The same link-local address may be used by different interfaces/nodes in different zones (RFC 4007). Therefore, when specifying a link-local address, include zone-id information indicating the VLAN identifier after the % delimiter. For example, FE80::7272%1 identifies VLAN 1 as the interface from which the ping is sent.
- A trace terminates when the destination responds, when the maximum timeout (TTL) is exceeded, or the maximum number of hops is exceeded.
- The traceroute command first sends probe datagrams with the TTL value set at one. This causes the first router to discard the datagram and return an error message. The trace function then sends several probe messages at each subsequent TTL level and displays the round-trip time for each message. Not all devices respond correctly to probes by returning an "ICMP port unreachable" message. If the timer goes off before a response is returned, the trace function prints a series of asterisks and the "Request Timed Out" message. A long sequence of these messages, terminating only when the maximum timeout has been reached, may indicate this problem with the target device.

Example

```
Console#traceroute6 FE80::2E0:CFF:FE9C:CA10%1
Press "ESC" to abort.

Traceroute to FE80::2E0:CFF:FE9C:CA10%1/64, 30 hops max, timeout is 3
  seconds, 5 max failure(s) before termination.

Hop Packet 1 Packet 2 Packet 3 IPv6 Address
--- -------- -------- -------- ----------------------------------------
  1   <10 ms   <10 ms   <10 ms FE80::2E0:CFF:FE9C:CA10%1/64

Trace completed.
Console#
```

Neighbor Discovery

ipv6 hop-limit

This command configures the maximum number of hops used in router advertisements that are originated by this router. Use the **no** form to restore the default setting.

Syntax

ipv6 hop-limit *hops*

no ipv6 hop-limit

hops - The maximum number of hops in router advertisements and all IPv6 packets. (Range: 1-255)

Default Setting

1

Command Mode

Global Configuration

Example

The following sets the hop limit for router advertisements to 64:

```
Console(config)#ipv6 hop-limit 64
Console(config)#
```

ipv6 neighbor

This command configures a static entry in the IPv6 neighbor discovery cache. Use the **no** form to remove a static entry from the cache.

Syntax

ipv6 neighbor *ipv6-address* **vlan** *vlan-id hardware-address*

no ipv6 neighbor *ipv6-address* **vlan** *vlan-id*

ipv6-address - The IPv6 address of a neighbor device that can be reached through one of the network interfaces configured on this switch. You can specify either a link-local or global unicast address formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

vlan-id - VLAN ID (Range: 1-4094)

hardware-address - The 48-bit MAC layer address for the neighbor device. This address must be formatted as six hexadecimal pairs separated by hyphens.

Default Setting
None

Command Mode
Global Configuration

Command Usage
- Address Resolution Protocol (ARP) has been replaced in IPv6 with the Neighbor Discovery Protocol (NDP). The **ipv6 neighbor** command is similar to the mac-address-table static command that is implemented using ARP.
- Static entries can only be configured on an IPv6-enabled interface.
- The switch does not determine whether a static entry is reachable before placing it in the IPv6 neighbor discovery cache.
- If the specified entry was dynamically learned through the IPv6 neighbor discovery process, and already exists in the neighbor discovery cache, it is converted to a static entry. Static entries in the IPv6 neighbor discovery cache are not modified if subsequently detected by the neighbor discovery process.
- Disabling IPv6 on an interface with the no ipv6 enable command (see page 862) deletes all dynamically learned entries in the IPv6 neighbor discovery cache for that interface, but does not delete static entries.

Example
The following maps a static entry for global unicast address to a MAC address:

```
Console(config)#ipv6 neighbor 2009:DB9:2229::81 vlan 1 30-65-14-01-11-86
Console(config)#end
Console#show ipv6 neighbors
State: I1 - Incomplete, I2 - Invalid, R - Reachable, S - Stale, D - Delay,
       P1 - Probe, P2 - Permanent, U - Unknown
IPv6 Address               Age         Link-layer Addr    State       VLAN
2009:DB9:2229::80          956         12-34-11-11-43-21      R          1
2009:DB9:2229::81          Permanent   30-65-14-01-11-86      R          1
FE80::1034:11FF:FE11:4321  961         12-34-11-11-43-21      R          1
Console#
```

ipv6 nd dad attempts

This command configures the number of consecutive neighbor solicitation messages sent on an interface during duplicate address detection. Use the **no** form to restore the default setting.

Syntax

ipv6 nd dad attempts *count*

no ipv6 nd dad attempts

count - The number of neighbor solicitation messages sent to determine whether or not a duplicate address exists on this interface. (Range: 0-600)

Default Setting
1

Command Mode
Interface Configuration (VLAN)

Command Usage
- Configuring a value of 0 disables duplicate address detection.
- Duplicate address detection determines if a new unicast IPv6 address already exists on the network before it is assigned to an interface.
- Duplicate address detection is stopped on any interface that has been suspended (see the vlan command). While an interface is suspended, all unicast IPv6 addresses assigned to that interface are placed in a "pending" state. Duplicate address detection is automatically restarted when the interface is administratively re-activated.
- An interface that is re-activated restarts duplicate address detection for all unicast IPv6 addresses on the interface. While duplicate address detection is performed on the interface's link-local address, the other IPv6 addresses remain in a "tentative" state. If no duplicate link-local address is found, duplicate address detection is started for the remaining IPv6 addresses.
- If a duplicate address is detected, it is set to "duplicate" state, and a warning message is sent to the console. If a duplicate link-local address is detected, IPv6 processes are disabled on the interface. If a duplicate global unicast address is detected, it is not used. All configuration commands associated with a duplicate address remain configured while the address is in "duplicate" state.
- If the link-local address for an interface is changed, duplicate address detection is performed on the new link-local address, but not for any of the IPv6 global unicast addresses already associated with the interface.

Example
The following configures five neighbor solicitation attempts for addresses configured on VLAN 1. The show ipv6 interface command indicates that the duplicate address detection process is still on-going.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 nd dad attempts 5
Console(config-if)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled.
Link-local address:
  fe80::269:3ef9:fe19:6779%1/64
Global unicast address(es):
  2001:db8:0:1:2e0:cff:fe02:fd/64, subnet is 2001:db8:0:1::/64[EUI]
  2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
```

```
ff02::2
ff02::1:ff19:6779
ff02::1:ff00:0
ff02::1:ff00:72
ff02::1:ff02:fd
ff02::1:2
ff02::1
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 5.
ND retransmit interval is 1000 milliseconds
ND advertised retransmit interval is 0 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

ipv6 nd managed-config-flag

This command configures IPv6 router advertisements to indicate to attached hosts that they can use stateful autoconfiguration to obtain addresses. Use the **no** form to clear this flag from router advertisements.

Syntax

[no] ipv6 nd managed-config-flag

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- The "managed-address configuration" flag tells hosts that they should use stateful autoconfiguration to obtain addresses from a DHCPv6 server.
- The ipv6 nd other-config-flag command is used to tell hosts that they should use stateless address autoconfiguration to get IPv6 address (based on the IPv6 prefixes found in router advertisements) and stateful autoconfiguration to get other non-address parameters (such as DNS server addresses) from DHCPv6 servers.
- The absence of the "managed-address configuration" flag tells hosts to use only stateless address autoconfiguration (based on IPv6 prefixes found in router advertisements).
- The "managed address configuration" flag is only a suggestion to attached hosts. They may still use stateful and/or stateless address autoconfiguration. If hosts must be forced to use DHCPv6 for security reasons, ensure that no route prefixes are sent in router advertisements.

Example

The following tells hosts to use stateful autoconfiguration to obtain addresses:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd managed-config-flag
Console(config)#
```

ipv6 nd other-config-flag

This command configures IPv6 router advertisements to indicate to attached hosts that they can obtain stateful autoconfiguration information other than addresses. Use the **no** form to clear this flag from router advertisements.

Syntax

[no] ipv6 nd other-config-flag

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- The "other-stateful-configuration" flag tells hosts that they should use stateful autoconfiguration to obtain information other than addresses from a DHCPv6 server.

- Some hosts interpret the "other stateful configuration" flag to indicate that they should use stateless address autoconfiguration to get IPv6 address (based on the IPv6 prefixes found in router advertisements) and stateful autoconfiguration to get other non-address parameters from DHCPv6 servers. In this case, the absence of both the "managed address configuration" flag and the "other stateful configuration" flag is interpreted to mean that they should use only stateless autoconfiguration to obtain addresses.

Example

The following tells hosts to use stateful autoconfiguration to obtain other non-address information from a DHCPv6 server:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd other-config-flag
Console(config)#
```

ipv6 nd ns-interval

This command configures the interval between transmitting IPv6 neighbor solicitation messages on an interface. Use the **no** form to restore the default value.

Syntax

ipv6 nd ns-interval *milliseconds*

no ipv6 nd ns-interval

milliseconds - The interval between transmitting IPv6 neighbor solicitation messages. (Range: 1000-3600000)

Default Setting

1000 milliseconds is used for neighbor discovery operations
0 milliseconds is advertised in router advertisements

Command Mode

Interface Configuration (VLAN)

Command Usage

- When a non-default value is configured, the specified interval is used both for router advertisements and by the router itself.
- This command specifies the interval between transmitting neighbor solicitation messages when resolving an address, or when probing the reachability of a neighbor. Therefore, avoid using very short intervals for normal IPv6 operations.
- Setting the neighbor solicitation interval to 0 means that the configured time is unspecified by this router.Setting the neighbor solicitation interval to 0 means that the configured time is unspecified by this router.

Example

The following sets the interval between sending neighbor solicitation messages to 30000 milliseconds:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd ns-interval 30000
Console(config)#end
Console#show ipv6 interface
VLAN 1 is up
IPv6 is enabled.
Link-local address:
  fe80::269:3ef9:fe19:6779%1/64
Global unicast address(es):
  2001:db8:0:1:2e0:cff:fe02:fd/64, subnet is 2001:db8:0:1::/64[EUI][EIU]
  2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
ff02::2
ff02::1:ff19:6779
ff02::1:ff00:0
ff02::1:ff00:72
ff02::1:ff02:fd
ff02::1:2
ff02::1
```

```
IPv6 link MTU is 1500 bytes
ND DAD is enabled, number of DAD attempts: 5.
ND retransmit interval is 30000 milliseconds
ND advertised retransmit interval is 30000 milliseconds
ND reachable time is 30000 milliseconds
ND advertised reachable time is 0 milliseconds
ND advertised router lifetime is 1800 seconds

Console#
```

ipv6 nd raguard

This command blocks incoming Router Advertisement and Router Redirect packets. Use the no form to disable this feature.

Syntax

[no] ipv6 nd raguard

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- IPv6 Router Advertisements (RA) convey information that enables nodes to auto-configure on the network. This information may include the default router address taken from the observed source address of the RA message, as well as on-link prefix information. However, unintended mis-configurations, or possibly malicious attacks on the network, may lead to bogus RAs being sent, which in turn can cause operational problems for hosts on the network.

- This command can be used to block RAs and Router Redirect (RR) messages on the specified interface. Determine which interfaces are connected to known routers, and enable RA Guard on all other untrusted interfaces.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 nd raguard
Console(config-if)#
```

show ipv6 nd raguard

This command displays the configuration setting for RA Guard.

Syntax

show ipv6 nd raguard [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier.

port - Port number.

port-channel *channel-id*

Command Mode
Privileged Exec

Example

```
Console#show ipv6 nd raguard interface ethernet 1/1
Interface RA Guard
--------- --------
Eth 1/ 1  Yes
Console#
```

ipv6 nd reachable-time

This command configures the amount of time that a remote IPv6 node is considered reachable after some reachability confirmation event has occurred. Use the **no** form to restore the default setting.

Syntax

ipv6 nd reachable-time *milliseconds*

no ipv6 nd reachable-time

milliseconds - The time that a node can be considered reachable after receiving confirmation of reachability. (Range: 0-3600000)

Default Setting
30000 milliseconds is used for neighbor discovery operations
0 milliseconds is advertised in router advertisements

Command Mode
Interface Configuration (VLAN)

Command Usage
- The time limit configured by this parameter allows the router to detect unavailable neighbors. During the neighbor discover process, an IPv6 node will multicast neighbor solicitation messages to search for neighbor nodes. For a neighbor node to be considered reachable, it must respond to the neighbor soliciting node with a neighbor advertisement message to become a confirmed neighbor, after which the reachable timer will be considered in effect for subsequent unicast IPv6 layer communications.

- This time limit is included in all router advertisements sent out through an interface, ensuring that nodes on the same link use the same time value.

- Setting the time limit to 0 means that the configured time is unspecified by this router.

Example

The following sets the reachable time for a remote node to 1000 milliseconds:

```
Console(config)#interface vlan 1
Console(config-if)ipv6 nd reachable-time 1000
Console(config-if)#
```

ipv6 nd prefix

This command configures the IPv6 prefixes to include in router advertisements. Use the **no** form to remove a prefix.

Syntax

ipv6 nd prefix *ipv6-address/prefix-length* {**default** | [*valid-lifetime preferred-lifetime* [**no-autoconfig** | **off-link**]]}

no ipv6 nd prefix *ipv6-address/prefix-length*

ipv6-address - An IPv6 address including the network prefix and host address bits.

prefix-length - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

default - Uses default values for remaining parameters.

valid-lifetime - The amount of time that the specified IPv6 prefix is advertised as being valid. (Range: 0-4294967295 seconds)

preferred-lifetime - The amount of time that the specified IPv6 prefix is advertised as being preferred. The preferred lifetime is counted down in real time. (Range: 0-4294967295 seconds)

no-autoconfig - Indicates to hosts on the local link that the specified prefix cannot be used for IPv6 autoconfiguration.

off-link - Indicates that the specified prefix is assigned to the link. Nodes sending traffic to addresses that contain the prefix consider the destination to be locally reachable on the link.

Default Setting

valid-lifetime	2592000 seconds
preferred-lifetime	2592000 seconds
no-autoconfig	Disabled
off-link	Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- Prefixes configured as addresses on an interface using the ipv6 address command are advertised in router advertisements. If prefixes are configured for

advertisement using the **ipv6 nd prefix** command, then only these prefixes are advertised.

- The preferred lifetime and valid lifetime are counted down in real time. After the preferred lifetime expires, no new connections are made using this prefix. When the valid lifetime expires, this prefix will no longer be advertised.
- All prefixes are inserted in the routing table as Connected (i.e., on-line), unless specified with the off-link option. If the off-link option is specified, and the prefix is already present in the routing table as a Connected prefix, it will be removed.
- Do not include the link-local prefix in the list of advertised prefixes.

Example

The following configures a network prefix with a valid lifetime of 1000 seconds, and a preferred lifetime of 900 seconds:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd prefix 2011:0DBF::/35 1000 900
Console(config)#
```

ipv6 nd ra interval

This command configures the interval between the transmission of IPv6 router advertisements on an interface. Use the **no** form to restore the default interval.

Syntax

ipv6 nd ra interval *minimum-interval* [*maximum-interval*]

no ipv6 nd ra interval

minimum-interval - The maximum interval between IPv6 router advertisements. (Range: 4-1800 seconds)

maximum-interval - The minimum interval between IPv6 router advertisements. (Range: 3-1350 seconds)

Command Mode

Interface Configuration (VLAN)

Default Setting

maximum interval: 600 seconds
minimum interval: 198 seconds

Command Usage

- The interval between transmissions should be less than or equal to the IPv6 router advertisement lifetime if you configure a route as a default router by using the ipv6 nd ra lifetime command.
- To prevent synchronization with other IPv6 nodes, the actual interval used is randomly selected from a value between the minimum value set by the system

(33% of the maximum RA interval) and the maximum value set by the **ipv6 nd ra interval** command.

Example

The following sets the maximum RA interval to 1800 seconds:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd ra interval 1800
Console(config)#
```

ipv6 nd ra lifetime

This command configures the router lifetime value used in IPv6 router advertisements sent from an interface. Use the **no** form to restore the default setting.

Syntax

ipv6 nd ra lifetime *lifetime*

no ipv6 nd ra lifetime

lifetime - Router lifetime. (Range: 0-90000 seconds)

Command Mode

Interface Configuration (VLAN)

Default Setting

1800 seconds

Command Usage

- This command can be used to indicate the usefulness of this router as a default router on this interface.
- Set the router lifetime to 0 to indicate that this router should not be considered a default router. Set the lifetime to a non-zero value to indicate that it should be considered a default router. When a non-zero value is used, the lifetime should not be less than the router advertisement interval.

Example

The following sets the router lifetime to 8000 seconds:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd ra lifetime 8000
Console(config)#
```

ipv6 nd ra router-preference

This command configures the default router preference for the router on an interface. Use the **no** form to restore the default setting.

Syntax

ipv6 nd ra router-preference {**high** | **medium** | **low**}

no ipv6 nd ra router-preference

high - Preference for the router is high.

medium - Preference for the router is medium.

low - Preference for the router is low.

Command Mode

Interface Configuration (VLAN)

Default Setting

medium

Command Usage

Default router preference may be used to prioritize routers which provide equivalent, but not equal-cost, routing, and policy dictates that hosts should prefer one of the routers.

Example

The following sets the default router preference to high:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd ra router-preference high
Console(config)#
```

ipv6 nd ra suppress

This command suppresses router advertisement transmissions on an interface. Use the **no** form to re-enable router advertisements.

Syntax

[**no**] **ipv6 nd ra suppress**

Command Mode

Interface Configuration (VLAN, IPv6/v4 Tunnel)

Default Setting

Not suppressed

Command Usage

This command suppresses periodic unsolicited router advertisements. It does not suppress advertisements sent in response to a router solicitation.

Example
The following suppresses router advertisements on the current interface:

```
Console(config)#interface vlan 1
Console(config)#ipv6 nd ra suppress
Console(config)#
```

clear ipv6 neighbors
This command deletes all dynamic entries in the IPv6 neighbor discovery cache.

Command Mode
Privileged Exec

Example
The following deletes all dynamic entries in the IPv6 neighbor cache:

```
Console#clear ipv6 neighbors
Console#
```

show ipv6 neighbors
This command displays information in the IPv6 neighbor discovery cache.

Syntax
show ipv6 neighbors [**vlan** *vlan-id* | *ipv6-address*]

vlan-id - VLAN ID (Range: 1-4094)

ipv6-address - The IPv6 address of a neighbor device. You can specify either a link-local or global unicast address formatted according to RFC 2373 "IPv6 Addressing Architecture," using 8 colon-separated 16-bit hexadecimal values. One double colon may be used in the address to indicate the appropriate number of zeros required to fill the undefined fields.

Default Setting
All IPv6 neighbor discovery cache entries are displayed.

Command Mode
Privileged Exec

Example
The following shows all known IPv6 neighbors for this switch:

```
Console#show ipv6 neighbors
State: I1 - Incomplete, I2 - Invalid, R - Reachable, S - Stale, D - Delay,
       P1 - Probe, P2 - Permanent, U - Unknown
IPv6 Address                            Age  Link-layer Addr   State Interface
--------------------------------------- ---- ----------------- ----- ---------
```

```
FE80::2E0:CFF:FE9C:CA10                 4     00-E0-0C-9C-CA-10 R     1
Console#
```

show ipv6 nd prefix

This command displays IPv6 prefixes in neighbor discovery router advertisements.

Syntax

show ipv6 nd prefix vlan *vlan-id*

vlan-id - VLAN ID (Range: 1-4094)

Default Setting

All IPv6 prefixes for the specified VLAN are displayed.

Command Mode

Privileged Exec

Example

The following shows all neighbor discovery IPv6 prefixes for VLAN 1:

```
Console#show ipv6 nd prefix vlan 1
Ipv6 Neighbor Discovery Prefix Information.

VLAN Name               : DefaultVlan

  IPv6 Prefix           : 2011:dbf::/35
  Valid Lifetime        : 2592000
  Preferred Lifetime    : 604800
  On-link Flag          : On
  Autonomous Flag       : On

Console#
```

ND Snooping

Neighbor Discover (ND) Snooping maintains an IPv6 prefix table and user address binding table. These tables can be used for stateless address auto-configuration or for address filtering by IPv6 Source Guard.

ND snooping maintains a binding table in the process of neighbor discovery. When it receives an Neighbor Solicitation (NS) packet from a host, it creates a new binding. If it subsequently receives a Neighbor Advertisement (NA) packet, this means that the address is already being used by another host, and the binding is therefore deleted. If it does not receive an NA packet after a timeout period, the binding will be bound to the original host. ND snooping can also maintain a prefix table used for stateless address auto-configuration by monitoring Router Advertisement (RA) packets sent from neighboring routers.

ND snooping can also detect if an IPv6 address binding is no longer valid. When a binding has been timed out, it checks to see if the host still exists by sending an NS packet to the target host. If it receives an NA packet in response, it knows that the target still exists and updates the lifetime of the binding; otherwise, it deletes the binding.

This section describes commands used to configure ND Snooping.

Table 133: ND Snooping Commands

Command	Function	Mode
ipv6 nd snooping	Enables ND snooping globally or on a specified VLAN or range of VLANs	GC
ipv6 nd snooping auto-detect	Enables automatic validation of binding table entries by periodically sending NS messages and awaiting NA replies	GC
ipv6 nd snooping auto-detect retransmit count	Sets the number of times to send an NS message to determine if a binding is still valid	GC
ipv6 nd snooping auto-detect retransmit interval	Sets the interval between sending NS messages to determine if a binding is still valid	GC
ipv6 nd snooping prefix timeout	Sets the time to wait for an RA message before deleting an entry in the prefix table	GC
ipv6 nd snooping max-binding	Sets the maximum number of address entries which can be bound to a port	IC
ipv6 nd snooping trust	Configures a port as a trusted interface from which prefix information in RA messages can be added to the prefix table, or NS messages can be forwarded without validation	IC
clear ipv6 nd snooping binding	Clears all entries in the address binding table	PE
clear ipv6 nd snooping prefix	Clears all entries in the prefix table	PE
show ipv6 nd snooping	Shows configuration settings for ND snooping	PE
show ipv6 nd snooping binding	Shows entries in the binding table	PE
show ipv6 nd snooping prefix	Show entries in the prefix table	PE

ipv6 nd snooping

This command enables ND snooping globally or on a specified VLAN or range of VLANs. Use the **no** form to disable this feature.

Syntax

[**no**] **ipv6 nd snooping** [**vlan** {*vlan-id* | *vlan-range*}]

vlan-id - VLAN ID. (Range: 1-4094)

vlan-range - A consecutive range of VLANs indicated by the use a hyphen, or a random group of VLANs with each entry separated by a comma.

Default Setting
Disabled

Command Mode
Global Configuration

Command Usage
- Use this command without any keywords to enable ND snooping globally on the switch. Use the VLAN keyword to enable ND snooping on a specific VLAN or a range of VLANs.

- Once ND snooping is enabled both globally and on the required VLANs, the switch will start monitoring RA messages to build an address prefix table as described below:
  - If an RA message is received on an untrusted interface, it is dropped. If received on a trusted interface, the switch adds an entry in the prefix table according to the Prefix Information option in the RA message. The prefix table records prefix, prefix length, valid lifetime, as well as the VLAN and port interface which received the message.
  - If an RA message is not received updating a table entry with the same prefix for a specified timeout period, the entry is deleted.

- Once ND snooping is enabled both globally and on the required VLANs, the switch will start monitoring NS messages to build a dynamic user binding table for use in Duplicate Address Detection (DAD) or for use by other security filtering protocols (e.g., IPv6 Source Guard) as described below:
  - If an NS message is received on an trusted interface, it is forwarded without further processing.
  - If an NS message is received on an untrusted interface, and the address prefix does not match any entry in the prefix table, it drops the packet.
  - If the message does match an entry in the prefix table, it adds an entry to the dynamic user binding table after a fixed delay, and forwards the packet. Each entry in the dynamic binding table includes the link-layer address, IPv6 address, lifetime, as well as the VLAN and port interface which received the message.
  - If an RA message is received in response to the original NS message (indicating a duplicate address) before the dynamic binding timeout period expires, the entry is deleted. Otherwise, when the timeout expires, the entry is dropped if the auto-detection process is not enabled.
  - If the auto-detection process is enabled, the switch periodically sends an NS message to determine is the client still exists. If it does not receive an RA message in response after the configured timeout, the entry is dropped. If the switch receives an RA message before the timeout expires, it resets the lifetime for the dynamic binding, and the auto-detection process resumes.

Example

This example enables ND snooping globally and on VLAN 1.

```
Console(config)#ipv6 nd snooping
Console(config)#ipv6 nd snooping vlan 1
Console(config)#
```

ipv6 nd snooping auto-detect

This command enables automatic validation of dynamic user binding table entries by periodically sending NS messages and awaiting NA replies. Use the **no** form to disable this feature.

Syntax

[no] ipv6 nd snooping auto-detect

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

If auto-detection is enabled, the switch periodically sends an NS message to determine is a client listed in the dynamic binding table still exists. If it does not receive an RA message in response after the configured timeout, the entry is dropped. If the switch receives an RA message before the timeout expires, it resets the lifetime for the dynamic binding, and the auto-detection process resumes.

Example

```
Console(config)#ipv6 nd snooping auto-detect
Console(config)#
```

ipv6 nd snooping auto-detect retransmit count

This command sets the number of times the auto-detection process sends an NS message to determine if a dynamic user binding is still valid. Use the **no** form to restore the default setting.

Syntax

ipv6 nd snooping auto-detect retransmit count *retransmit-times*

no ipv6 nd snooping auto-detect retransmit count

retransmit-times – The number of times to send an NS message to determine if a client still exists. (Range: 1-5)

Default Setting
3

Command Mode
Global Configuration

Command Usage
The timeout after which the switch will delete a dynamic user binding if no RA message is received is set to the retransmit count x the retransmit interval (see the ipv6 nd snooping auto-detect retransmit interval command). Based on the default settings, this is 3 seconds.

Example

```
Console(config)#ipv6 nd snooping auto-detect retransmit count 5
Console(config)#
```

ipv6 nd snooping auto-detect retransmit interval

This command sets the interval between which the auto-detection process sends NS messages to determine if a dynamic user binding is still valid. Use the **no** form to restore the default setting.

Syntax

ipv6 nd snooping auto-detect retransmit interval *retransmit-interval*

no ipv6 nd snooping auto-detect retransmit interval

retransmit-interval – The interval between which the switch sends an NS message to determine if a client still exists. (Range: 1-10 seconds)

Default Setting
1 second

Command Mode
Global Configuration

Command Usage
The timeout after which the switch will delete a dynamic user binding if no RA message is received is set to the retransmit count (see the ipv6 nd snooping auto-detect retransmit count command) x the retransmit interval. Based on the default settings, this is 3 seconds.

Example

```
Console(config)#ipv6 nd snooping auto-detect retransmit interval 5
Console(config)#
```

ipv6 nd snooping prefix timeout

This command sets the time to wait for an RA message before deleting an entry in the prefix table. Use the **no** form to restore the default setting.

Syntax

ipv6 nd snooping prefix timeout *timeout*

no ipv6 nd snooping prefix timeout

timeout – The time to wait for an RA message to confirm that a prefix entry is still valid. (Range: 3-1800 seconds)

Default Setting

None set

Command Mode

Global Configuration

Command Usage

If ND snooping is enabled and an RA message is received on a trusted interface, the switch will add an entry in the prefix table based upon the Prefix Information contained in the message. If an RA message is not received for a table entry with the same prefix for the specified timeout period, the entry is deleted.

Example

```
Console(config)#ipv6 nd snooping prefix timeout 200
Console(config)#
```

ipv6 nd snooping max-binding

This command sets the maximum number of address entries in the dynamic user binding table which can be bound to a port. Use the **no** form to restore the default setting.

Syntax

ipv6 nd snooping max-binding *max-bindings*

no ipv6 nd snooping max-binding

max-bindings – The maximum number of address entries in the dynamic user binding table which can be bound to a port. (Range: 1-5)

Default Setting

5

Command Mode

Interface Configuration (Ethernet, Port Channel)

Example

```
Console(config)#interface ethernet 1/12
Console(config-if)#ipv6 nd snooping max-binding 5
Console(config-if)#
```

ipv6 nd snooping trust

This command configures a port as a trusted interface from which prefix information in RA messages can be added to the prefix table, or NS messages can be forwarded without validation. Use the **no** form to restore the default setting.

Syntax

[no] ipv6 nd snooping trust

Default Setting

Not trusted

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- In general, interfaces facing toward to the network core, or toward routers supporting the Network Discovery protocol, are configured as trusted interfaces.
- RA messages received from a trusted interface are added to the prefix table and forwarded toward their destination.
- NS messages received from a trusted interface are forwarded toward their destination. Nothing is added to the dynamic user binding table.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#ipv6 nd snooping trust
Console(config-if)#
```

clear ipv6 nd snooping binding

This command clears all entries in the dynamic user address binding table.

Syntax

clear ipv6 nd snooping binding

Command Mode

Privileged Exec

Example

```
Console#clear ipv6 nd snooping binding
Console#show ipv6 nd snooping binding
MAC Address    IPv6 Address                          Lifetime   VLAN Interface
-------------- ------------------------------------- ---------- ---- ---------
Console#
```

clear ipv6 nd snooping prefix

This command clears all entries in the address prefix table.

Syntax

clear ipv6 nd snooping prefix [interface vlan *vlan-id*]

vlan-id - VLAN ID. (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#clear ipv6 nd snooping prefix
Console#show ipv6 nd snooping prefix
Prefix entry timeout: (seconds)
Prefix                                Len Valid-Time Expire     VLAN Interface
------------------------------------- --- ---------- ---------- ---- ---------

Console#
```

show ipv6 nd snooping

This command shows the configuration settings for ND snooping.

Syntax

show ipv6 nd snooping

Command Mode

Privileged Exec

Example

```
Console#show ipv6 nd snooping
Global ND Snooping status: enabled
ND Snooping auto-detection: disabled
ND Snooping auto-detection retransmit count: 3
ND Snooping auto-detection retransmit interval: 1 (second)
ND Snooping is configured on the following VLANs:
VLAN   1,
Interface           Trusted       Max-binding
---------           ---------     -----------
Eth 1/1             Yes                     1
Eth 1/2             No                      5
Eth 1/3             No                      5
Eth 1/4             No                      5
Eth 1/5             No                      5
```

```
:
```

show ipv6 nd snooping binding

This command shows all entries in the dynamic user binding table.

Syntax

show ipv6 nd snooping binding

Command Mode

Privileged Exec

Example

```
Console#show ipv6 nd snooping binding
MAC Address    IPv6 Address                              Lifetime   VLAN Interface
-------------- ----------------------------------------- ---------- ---- ---------
0013-49aa-3926 2001:b001::211:95ff:fe84:cb9e                   100    1 Eth 1/1
0012-cf01-0203 2001::1                                        3400    2 Eth 1/2
Console#
```

show ipv6 nd snooping prefix

This command shows all entries in the address prefix table.

Syntax

show ipv6 nd snooping prefix [interface vlan *vlan-id*]

vlan-id - VLAN ID. (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#show ipv6 nd snooping prefix
Prefix entry timeout: 100 (second)
Prefix                                Len Valid-Time Expire     VLAN Interface
------------------------------------- --- ---------- ---------- ---- ---------
2001:b000::                            64    2592000        100    1 Eth 1/1
2001::                                 64        600         34    2 Eth 1/2
Console#
```

34 VRRP Commands

Virtual Router Redundancy Protocol (VRRP) use a virtual IP address to support a primary router and multiple backup routers. The backup routers can be configured to take over the workload if the master router fails, or can also be configured to share the traffic load. The primary goal of router redundancy is to allow a host device which has been configured with a fixed gateway to maintain network connectivity in case the primary gateway goes down.

To configure VRRP, select an interface on each router in the group that will participate in the protocol as the master router or a backup router. To select a specific device as the master router, set the address of this interface as the virtual router address for the group. Now set the same virtual address and a priority on the backup routers, and configure an authentication string. You can also enable the preempt feature which allows a router to take over as the master router when it comes on line if it has a higher priority than the currently active master router.

Table 134: VRRP Commands

Command	Function	Mode
vrrp authentication	Configures a key used to authenticate VRRP packets received from other routers	IC
vrrp ip	Enables VRRP and sets the IP address of the virtual router	IC
vrrp preempt	Configures the router to take over as master virtual router for a VRRP group if it has a higher priority than the current master virtual router	IC
vrrp priority	Sets the priority of this router in the VRRP group	IC
vrrp timers advertise	Sets the interval between successive advertisements by the master virtual router	IC
show vrrp	Displays VRRP status information	PE
show vrrp interface	Displays VRRP status information for the specified interface	PE
show vrrp interface counters	Displays VRRP statistics for the specified interface	PE
show vrrp router counters	Displays VRRP statistics	PE

vrrp authentication

This command specifies the key used to authenticate VRRP packets received from other routers. Use the **no** form to prevent authentication.

Syntax

vrrp *group* **authentication** *key*

no vrrp *group* **authentication**

group - Identifies the virtual router group. (Range: 1-255)

key - Authentication string. (Range: 1-8 alphanumeric characters)

Default Setting

No key is defined.

Command Mode

Interface (VLAN)

Command Usage

- All routers in the same VRRP group must be configured with the same authentication key.
- When a VRRP packet is received from another router in the group, its authentication key is compared to the string configured on this router. If the keys match, the message is accepted. Otherwise, the packet is discarded.
- Plain text authentication does not provide any real security. It is supported only to prevent a misconfigured router from participating in VRRP.

Example

```
Console(config-if)#vrrp 1 authentication bluebird
Console(config-if)#
```

vrrp ip

This command enables the Virtual Router Redundancy Protocol (VRRP) on an interface and specifies the IP address of the virtual router. Use the **no** form to disable VRRP on an interface and remove the IP address from the virtual router.

Syntax

[**no**] **vrrp** *group* **ip** *ip-address*

group - Identifies the virtual router group. (Range: 1-255)

ip-address - The IP address of the virtual router. This is the IP address that end-hosts set as their default gateway.

Default Setting

No virtual router groups are configured.

Command Mode
Interface (VLAN)

Command Usage
- The interfaces of all routers participating in a virtual router group must be within the same IP subnet.
- If the IP address assigned to the virtual router with this command is already configured as the primary address on this interface, this router is considered the Owner, and will assume the role of the Master virtual router in the group.
- This interface is used for two purposes - to send/receive advertisement messages and to forward on behalf of the virtual router when operating as the Master VRRP router.
- VRRP is enabled as soon as this command is entered. If you need to customize any of the other parameters for VRRP such as authentication, priority, or advertisement interval, then first configure these parameters before enabling VRRP.

Example
This example creates VRRP group 1 using the primary interface for VLAN 1 as the VRRP group Owner.

```
Console(config)#interface vlan 1
Console(config-if)#vrrp 1 ip 192.168.1.6
Console(config-if)#
```

vrrp preempt
This command configures the router to take over as the master virtual router for a VRRP group if it has a higher priority than the current acting master router. Use the **no** form to disable preemption.

Syntax
vrrp *group* **preempt** [**delay** *seconds*]

no vrrp *group* **preempt**

group - Identifies the VRRP group. (Range: 1-255)

seconds - The time to wait before issuing a claim to become the master. (Range: 0-120 seconds)

Default Setting
Preempt: Enabled
Delay: 0 seconds

Command Mode
Interface (VLAN)

Command Usage

- If preempt is enabled, and this backup router has a priority higher than the current acting master, it will take over as the new master. However, note that if the original master (i.e., the owner of the VRRP IP address) comes back on line, it will always resume control as the master.

- The delay can give additional time to receive an advertisement message from the current master before taking control. If the router attempting to become the master has just come on line, this delay also gives it time to gather information for its routing table before actually preempting the currently active router.

Example

```
Console(config-if)#vrrp 1 preempt delay 10
Console(config-if)#
```

vrrp priority

This command sets the priority of this router in a VRRP group. Use the **no** form to restore the default setting.

Syntax

vrrp *group* **priority** *level*

no vrrp *group* **priority**

group - Identifies the VRRP group. (Range: 1-255)

level - Priority of this router in the VRRP group. (Range: 1-254)

Default Setting

Master: 255
Backup: 100

Command Mode

Interface (VLAN)

Command Usage

- A router that has a physical interface with the same IP address as that used for the virtual router (that is, the owner of the VRRP IP address) will become the master virtual router. The backup router with the highest priority will become the master router if the current master fails. When the original master router recovers, it will take over as the active master router again.

- If two or more routers are configured with the same VRRP priority, the router with the highest IP address is elected as the new master router if the current master fails.

- If the backup preempt function is enabled with the vrrp preempt command, and a backup router with a priority higher than the current acting master comes on line, this backup router will take over as the new acting master. However, note

that if the original master (i.e., the owner of the VRRP IP address) comes back on line, it will always resume control as the master.

- If the virtual IP address for the VRRP group is the same as that of the configured device, the priority will automatically be set to 255 prior to using this command.

Example

```
Console(config-if)#vrrp 1 priority 1
Console(config-if)#
```

vrrp timers advertise

This command sets the interval at which the master virtual router sends advertisements communicating its state as the master. Use the **no** form to restore the default interval.

Syntax

vrrp *group* **timers advertise** *interval*

no vrrp *group* **timers advertise**

group - Identifies the VRRP group. (Range: 1-255)

interval - Advertisement interval for the master virtual router. (Range: 1-255 seconds)

Default Setting

1 second

Command Mode

Interface (VLAN)

Command Usage

- VRRP advertisements from the current master virtual router include information about its priority and current state as the master.
- VRRP advertisements are sent to the multicast address 224.0.0.18. Using a multicast address reduces the amount of traffic that has to processed by network devices that are not part of the designated VRRP group.
- If the master router stops sending advertisements, backup routers will bid to become the master router based on priority. The dead interval before attempting to take over as the master is three times the hello interval plus half a second

Example

```
Console(config-if)#vrrp 1 timers advertise 5
Console(config-if)#
```

show vrrp

This command displays status information for VRRP.

Syntax

show vrrp [brief | *group*]

brief - Displays summary information for all VRRP groups on this router.

group - Identifies a VRRP group. (Range: 1-255)

Defaults

None

Command Mode

Privileged Exec

Command Usage

- Use this command without any keywords to display the full listing of status information for all VRRP groups configured on this router.
- Use this command with the brief keyword to display a summary of status information for all VRRP groups configured on this router.
- Specify a group number to display status information for a specific group

Example

This example displays the full listing of status information for all groups.

```
Console#show vrrp
 VLAN 1 - Group 1,
 State                          Master
 Virtual IP Address             192.168.1.6
 Virtual MAC Address            00-00-5E-00-01-01
 Advertisement Interval         5 sec
 Preemption                     Enabled
 Min Delay                      10 sec
 Priority                       255
 Authentication                 SimpleText
 Authentication Key             bluebird
 Master Router                  192.168.1.6
 Master Priority                255
 Master Advertisement Interval  5 sec
 Master Down Interval           15
Console#
```

This example displays the brief listing of status information for all groups.

```
Console#show vrrp brief
Interface   Grp    State    Virtual Addr     Interval   Preempt  Priority
---------- ----- -------- ---------------- ----------- --------- --------
VLAN 1         1  Master       192.168.0.3           1  E            255
Console#
```

show vrrp interface

This command displays status information for the specified VRRP interface.

Syntax

show vrrp interface vlan *vlan-id* [**brief**]

vlan-id - Identifier of configured VLAN interface. (Range: 1-4094)

brief - Displays summary information for all VRRP groups on this router.

Defaults

None

Command Mode

Privileged Exec

Example

This example displays the full listing of status information for VLAN 1.

```
Console#show vrrp interface vlan 1
 Vlan 1 - Group 1,
 State                          Master
 Virtual IP Address             192.168.1.6
 Virtual MAC Address            00-00-5E-00-01-01
 Advertisement Interval         5 sec
 Preemption                     Enabled
 Min Delay                      10 sec
 Priority                       1
 Authentication                 SimpleText
 Authentication Key             bluebird
 Master Router                  192.168.1.6
 Master Priority                1
 Master Advertisement Interval  5 sec
 Master Down Interval           15
Console#
```

show vrrp interface counters

This command displays counters for VRRP protocol events and errors that have occurred for the specified group and interface.

show vrrp *group* **interface vlan** *interface* **counters**

group - Identifies a VRRP group. (Range: 1-255)

interface - Identifier of configured VLAN interface. (Range: 1-4094)

Defaults

None

Command Mode

Privileged Exec

Example

```
Console#show vrrp 1 interface vlan 1 counters
 Total Number of Times Transitioned to MASTER                      : 6
 Total Number of Received Advertisements Packets                   : 0
 Total Number of Received Error Advertisement Interval Packets     : 0
 Total Number of Received Authentication Failures Packets          : 0
 Total Number of Received Error IP TTL VRRP Packets                : 0
 Total Number of Received Priority 0 VRRP Packets                  : 0
 Total Number of Sent Priority 0 VRRP Packets                      : 5
 Total Number of Received Invalid Type VRRP Packets                : 0
 Total Number of Received Error Address List VRRP Packets          : 0
 Total Number of Received Invalid Authentication Type VRRP Packets  : 0
 Total Number of Received Mismatch Authentication Type VRRP Packets : 0
 Total Number of Received Error Packet Length VRRP Packets         : 0
Console#
```

show vrrp router counters

This command displays counters for errors found in VRRP protocol packets.

Command Mode

Privileged Exec

Example

Note that unknown errors indicate VRRP packets received with an unknown or unsupported version number.

```
Console#show vrrp router counters
 Total Number of VRRP Packets with Invalid Checksum : 0
 Total Number of VRRP Packets with Unknown Error    : 0
 Total Number of VRRP Packets with Invalid VRID     : 0
Console#
```

35 IP Routing Commands

After network interfaces are configured for the switch, the paths used to send traffic between different interfaces must be set. To forward traffic to devices on other subnetworks, configure fixed paths with static routing commands. This section includes commands for static routing. These commands are used to connect between different local subnetworks or to connect the router to the enterprise network.

Table 188: IP Routing Commands

Command Group	Function
Global Routing Configuration	Configures global parameters for static routing, displays the routing table

Global Routing Configuration

Table 189: Global Routing Configuration Commands

Command	Function	Mode
IPv4 Commands		
ip route	Configures static routes	GC
show ip route	Displays entries in the routing table	PE
show ip host-route	Displays the interface associated with known routes	PE
show ip route database	Displays static or dynamically learned entries in the routing table	PE
show ip route summary	Displays summary information for the routing table	PE
show ip traffic	Displays statistics for IP, ICMP, UDP, TCP and ARP protocols	PE
IPv6 Commands		
ipv6 route	Configures static routes	GC
show ipv6 route	Displays specified entries in the routing table	PE
ECMP Commands		
maximum-paths	Sets the maximum number of paths allowed	GC

IPv4 Commands

ip route

This command configures static routes. Use the **no** form to remove static routes.

Syntax

ip route *destination-ip netmask* {*next-hop* [*distance*] | **null0**}

no ip route {*destination-ip netmask* [*next-hop* | **null0**] | ***}

destination-ip – IP address of the destination network, subnetwork, or host.

netmask - Network mask for the associated IP subnet. This mask identifies the host address bits used for routing to specific subnets.

next-hop – IP address of the next hop router used for this route.

distance – An administrative distance indicating that this route can be overridden by dynamic routing information if the distance of the dynamic route is less than that configured for the static route. Note that the default administrative distances used by the dynamic unicast routing protocols is 110 for OSPF, 120 for RIP, 20 for eBGP, and 200 for iBGP. (Range: 1-255, Default: 1)

null0 – Keyword for specifying a null interface.

* – Removes all static routing table entries.

Default Setting

No static routes are configured.

Command Mode

Global Configuration

Command Usage

- Up to 1024 static routes can be configured.
- If an administrative distance is defined for a static route, and the same destination can be reached through a dynamic route at a lower administration distance, then the dynamic route will be used.
- A null interface never forwards or receives traffic. Packets routed to a null interface are dropped.
- Up to eight equal-cost multipaths (ECMP) can be configured for static routing using the maximum-paths command.

Example

This example forwards all traffic for subnet 192.168.1.0 to the gateway router 192.168.5.254, using the default metric of 1.

```
Console(config)#ip route 192.168.1.0 255.255.255.0 192.168.5.254
Console(config)#
```

show ip route

This command displays information in the Forwarding Information Base (FIB).

Syntax

show ip route [connected | database | static | summary]

connected – Displays all currently connected entries.

database – All known routes, including inactive routes. See show ip route database.

static – Displays all static entries.

summary – Displays a brief list of summary information about entries in the routing table, including the maximum number of entries supported, the number of connected routes, the total number of routes currently stored in the routing table, and the number of entries in the FIB. See show ip route summary.

Command Mode

Privileged Exec

Command Usage

- The FIB contains information required to forward IP traffic. It contains the interface identifier and next hop information for each reachable destination network prefix based on the IP routing table. When routing or topology changes occur in the network, the routing table is updated, and those changes are immediately reflected in the FIB.

  The FIB is distinct from the routing table (or, Routing Information Base), which holds all routing information received from routing peers. The forwarding information base contains unique paths only. It does not contain any secondary paths. A FIB entry consists of the minimum amount of information necessary to make a forwarding decision on a particular packet. The typical components within a forwarding information base entry are a network prefix, a router port identifier, and next hop information.

- This command only displays routes which are currently accessible for forwarding. The router must be able to directly reach the next hop, so the VLAN interface associated with any static route entry must be up. Note that routes currently not accessible for forwarding, may still be displayed by using the show ip route database command.

Example

```
Console#show ip route
Codes: K - kernel route, C - connected, S - static, T - Table,
       > - selected route, * - FIB route, q - queued, r - rejected, b - backup
```

```
       t - trapped, o - offload failure

S*      0.0.0.0/0 [1/0] via 192.168.2.1, VLAN1
C       192.168.2.0/24 is directly connected, VLAN1
Console#
```

The RIB contains all available routes learned through directly attached networks, and any additionally configured routes such as static routes. The RIB contains the set of all available routes from which optimal entries are selected for use by the Forwarding Information Base (see Command Usage under the show ip route command).

```
Console#show ip route database
Codes: K - kernel route, C - connected, S - static, T - Table,
       > - selected route, * - FIB route, q - queued, r - rejected, b - backup
       t - trapped, o - offload failure

S    *> 0.0.0.0/0 [1/0] via 192.168.2.1, VLAN1
C    *> 192.168.2.0/24 is directly connected, VLAN1
Console#
```

In the following example, the numeric identifier following the routing table name (0) indicates the Forwarding Information Base identifier.

```
Console#show ip route summary
Route Source         Routes               FIB   (vrf default)
connected            1                    1
static               1                    1
------
Totals               2                    2
Console#
```

show ip host-route

This command displays the interface associated with known routes.

Syntax

show ip host-route

Command Mode

Privileged Exec

Example

```
Console#show ip host-route
 IP Address      MAC Address       VLAN Port
 --------------- ----------------- ---- -------
 192.168.0.99    00-E0-29-94-34-64    1 1/1
 192.168.1.250   00-00-30-01-01-01    3 1/ 1
 10.2.48.2       00-00-30-01-01-02    1 1/ 1
 10.2.5.6        00-00-30-01-01-03    1 1/ 2
 10.3.9.1        00-00-30-01-01-04    2 1/ 3
```

```
Console#
```

show ip route database

This command displays entries in the Routing Information Base (RIB).

Command Mode

Privileged Exec

Command Usage

The RIB contains all available routes learned through dynamic routing protocols, directly attached networks, and any additionally configured routes such as static routes. The RIB contains the set of all available routes from which optimal entries are selected for use by the Forwarding Information Base (see Command Usage under the show ip route command).

Example

```
Console#show ip route database
Codes: K - kernel route, C - connected, S - static, T - Table,
       > - selected route, * - FIB route, q - queued, r - rejected, b - backup
       t - trapped, o - offload failure

C    *> 127.0.0.0/8 is directly connected, lo0
C    *> 192.168.1.0/24 is directly connected, VLAN1

Console#
```

show ip route summary

This command displays summary information for the routing table.

Command Mode

Privileged Exec

Example

In the following example, the numeric identifier following the routing table name (0) indicates the Forwarding Information Base (FIB) identifier.

```
Console#show ip route summary
Route Source         Routes               FIB   (vrf default)
connected            1                    1
static               1                    1
------
Totals               2                    2
Console#
```

show ip traffic This command displays statistics for IP, ICMP, UDP, TCP and ARP protocols.

Command Mode
Privileged Exec

Example

```
Console#show ip traffic
IP Statistics:
IP received
                4877 total received
                     header errors
                     unknown protocols
                     address errors
                     discards
                4763 delivers
                     reassembly request datagrams
                     reassembled succeeded
                     reassembled failed
IP sent
                     forwards datagrams
                5927 requests
                     discards
                     no routes
                     generated fragments
                     fragment succeeded
                     fragment failed
ICMP Statistics:
ICMP received
                     input
                     errors
                     destination unreachable messages
                     time exceeded messages
                     parameter problem message
                     echo request messages
                     echo reply messages
                     redirect messages
                     timestamp request messages
                     timestamp reply messages
                     source quench messages
                     address mask request messages
                     address mask reply messages
ICMP sent
                     output
                     errors
                     destination unreachable messages
                     time exceeded messages
                     parameter problem message
                     echo request messages
                     echo reply messages
                     redirect messages
                     timestamp request messages
                     timestamp reply messages
                     source quench messages
                     address mask request messages
                     address mask reply messages
UDP Statistics:
                   2 input
                     no port errors
                     other errors
                     output
TCP Statistics:
                4698 input
```

```
                    input errors
                5867 output

Console#
```

IPv6 Commands

ipv6 route

This command configures static IPv6 routes. Use the **no** form to remove static routes.

Syntax

[**no**] **ipv6 route** *destination-ipv6-address/prefix-length* {*gateway-address* [*distance*] | *link-local-address***%***zone-id* [*distance*]}

destination-ipv6-address – The IPv6 address of a destination network, subnetwork, or host. This must be a full IPv6 address including the network prefix and host address bits.

prefix-length - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

gateway-address – IP address of the next hop router used for this route.

*link-local-address***%***zone-id* – a link-local address, including a zone-id indicating the VLAN identifier after the % delimiter.

distance – An administrative distance indicating that this route can be overridden by dynamic routing information if the distance of the dynamic route is less than that configured for the static route. Note that the default administrative distances used by the dynamic unicast routing protocols is 110 for OSPF, 120 for RIP, 20 for eBGP, and 200 for iBGP. (Range: 1-255, Default: 1)

Default Setting

No static routes are configured.

Command Mode

Global Configuration

Command Usage

- Up to 1024 static routes can be configured.
- If an administrative distance is defined for a static route, and the same destination can be reached through a dynamic route at a lower administration distance, then the dynamic route will be used.
- The default distance of 1 will take precedence over any other type of route, except for local routes.

- If both static and dynamic paths have the same lowest cost, the first route stored in the routing table, either statically configured or dynamically learned via a routing protocol, will be used.

Example

This example forwards all traffic for subnet 2001::/64 to the next hop router 2001:DB8:2222:7272::254, using the default metric of 1.

```
Console(config)#ipv6 route 2001::/64 2001:DB8:2222:7272::254
Console(config)#
```

show ipv6 route

This command displays information in the Forwarding Information Base (FIB).

Syntax

show ipv6 route [*ipv6-address*[/*prefix-length*] | **database** | **interface** [**vlan** *vlan-id*] | **local** | **static**]

ipv6-address - A full IPv6 address including the network prefix and host address bits.

prefix-length - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the network portion of the address).

database – All known routes, including inactive routes.

interface – Displays all routes that be accessed through this interface.

local – Displays all entries for destinations attached directly to this router.

static – Displays all static entries.

vlan-id - VLAN ID. (Range: 1-4093)

Command Mode

Privileged Exec

Command Usage

- The FIB contains information required to forward IP traffic. It contains the interface identifier and next hop information for each reachable destination network prefix based on the IP routing table. When routing or topology changes occur in the network, the routing table is updated, and those changes are immediately reflected in the FIB.

  The FIB is distinct from the routing table (or, Routing Information Base), which holds all routing information received from routing peers. The forwarding information base contains unique paths only. It does not contain any secondary paths. A FIB entry consists of the minimum amount of information necessary to make a forwarding decision on a particular packet. The typical components within a forwarding information base entry are a network prefix, a router port identifier, and next hop information.

- This command only displays routes which are currently accessible for forwarding. The router must be able to directly reach the next hop, so the VLAN interface associated with any dynamic or static route entry must be up.

Example

In the following example, note that the last entry displays both the distance and metric for this route.

```
Console#show ipv6 route
Codes: K - kernel route, C - connected, S - static, B - BGP,
       T - Table, v - VNC, V - VNC-Direct,
       > - selected route, * - FIB route, q - queued, r - rejected, b - backup
       t - trapped, o - offload failure

C * fe80::/64 is directly connected, VLAN1, 02:17:31
C>* fe80::/64 is directly connected, VLAN10, 02:18:47
K>* ff00::/8 [0/256] is directly connected, VLAN1, 02:17:33

Console#
```

ECMP Commands

maximum-paths

This command sets the maximum number of paths allowed. Use the **no** form to restore the default settings.

Syntax

maximum-paths *path-count*

no maximum-paths

path-count - The maximum number of equal-cost paths to the same destination that can be installed in the routing table. (Range: 1-8)

Command Mode

Global Configuration

Example

```
Console(config)#maximum-paths 8
Console(config)#
```

36 RIP Commands

This section includes commands for Routing Information Protocol (RIP) dynamic routing. These commands are used to connect between different local subnetworks.

The RIP protocol is the most widely used routing protocol. The RIP protocol uses a distance-vector-based approach to routing. Routes are determined on the basis of minimizing the distance vector, or hop count, which serves as a rough estimate of transmission cost. Each router broadcasts its advertisement every 30 seconds, together with any updates to its routing table. This allows all routers on the network to learn consistent tables of next hop links which lead to relevant subnets.

Table 188: RIP Commands

Command Group	Function
Routing Information Protocol (RIP)	Configures global and interface specific parameters for RIP
IPv6 Routing Information Protocol (RIPng)	Configures global and interface specific parameters for RIPng

Routing Information Protocol (RIP)

Table 189: Routing Information Protocol Commands

Command	Function	Mode
router rip	Enables the RIP routing protocol	GC
default-information originate	Generates a default external route into an autonomous system	RC
default-metric	Sets the default metric assigned to external routes imported from other protocols	RC
distance	Defines an administrative distance for external routes learned from other routing protocols	RC
neighbor	Defines a neighboring router with which to exchange information	RC
network	Specifies the network interfaces that are to use RIP routing	RC
passive-interface	Stops RIP from sending routing updates on the specified interface	RC
redistribute	Redistribute routes from one routing domain to another	RC
timers basic	Sets basic timers, including update, timeout, garbage collection	RC

Table 189: Routing Information Protocol Commands (Continued)

Command	Function	Mode
version	Specifies the RIP version to use on all network interfaces (if not already specified with a receive version or send version command)	RC
ip rip authentication mode	Specifies the type of authentication used for RIP2 packets	IC
ip rip authentication string	Enables authentication for RIP2 packets and specifies keys	IC
ip rip receive version	Sets the RIP receive version to use on a network interface	IC
ip rip send version	Sets the RIP send version to use on a network interface	IC
ip rip split-horizon	Enables split-horizon or poison-reverse loop prevention	IC
clear ip rip route	Clears specified data from the RIP routing table	PE
show ip protocols rip	Displays RIP process parameters	PE
show ip rip	Displays information about RIP routes and configuration settings	PE

router rip

This command enables Routing Information Protocol (RIP) routing for all IP interfaces on the router. Use the no form to disable it.

Syntax

[no] router rip

Command Mode

Global Configuration

Default Setting

Disabled

Command Usage

- RIP is used to specify how routers exchange routing table information.
- This command is also used to enter router configuration mode.

Example

```
Console(config)#router rip
Console(config-router)#
```

default-information originate

This command generates a default external route into the local RIP autonomous system. Use the **no** form to disable this feature.

Syntax

[no] **default-information originate**

Default Setting

Disabled

Command Mode

Router Configuration

Command Usage

This command sets a default route for every Layer 3 interface where RIP is enabled. The response packet to external queries marks each active RIP interface as a default router with the IP address 0.0.0.0.

Example

```
Console(config-router)#default-information originate
Console(config-router)#
```

default-metric

This command sets the default metric assigned to external routes imported from other protocols. Use the **no** form to restore the default value.

Syntax

default-metric *metric-value*

no default-metric

metric-value – Metric assigned to external routes. (Range: 1-15)

Default Setting

1

Command Mode

Router Configuration

Command Usage

- This command does not override the metric value set by the redistribute command. When a metric value has not been configured by the redistribute command, the **default-metric** command sets the metric value to be used for all imported external routes.
- The default metric must be used to resolve the problem of redistributing external routes with incompatible metrics.

- It is advisable to use a low metric when redistributing routes from another protocol into RIP. Using a high metric limits the usefulness of external routes redistributed into RIP. For example, if a metric of 10 is defined for redistributed routes, these routes can only be advertised to routers up to 5 hops away, at which point the metric exceeds the maximum hop count of 15. By defining a low metric of 1, traffic can follow a imported route the maximum number of hops allowed within a RIP domain. However, note that using a low metric can increase the possibility of routing loops For example, this can occur if there are multiple redistribution points and the router learns about the same external network with a better metric from a redistribution point other than that derived from the original source.

Example

This example sets the default metric to 5.

```
Console(config-router)#default-metric 5
Console(config-router)#
```

distance

This command defines an administrative distance for external routes learned from other routing protocols. Use the **no** form to restore the default setting.

Syntax

[**no**] **distance** *distance*

distance - Administrative distance for external routes. External routes are routes for which the best path is learned from a neighbor external to the local RIP autonomous system. Routes with a distance of 255 are not installed in the routing table. (Range: 1-255)

Default Setting

None

Command Mode

Router Configuration

Command Usage

- Administrative distance is used by the routers to select the preferred path when there are two or more different routes to the same destination from two different routing protocols. A smaller administrative distance indicates a more reliable protocol.

- The administrative distance is applied to all routes learned for the specified network.

Example

```
Console(config-router)#distance 2
Console(config-router)#
```

neighbor

This command defines a neighboring router with which this router will exchange routing information. Use the **no** form to remove an entry.

Syntax

[**no**] **neighbor** *ip-address*

ip-address - IP address of a neighboring router.

Default Setting

No neighbors are defined.

Command Mode

Router Configuration

Command Usage

- This command can be used to configure a static neighbor (specifically for point-to-point links) with which this router will exchange routing information, rather than relying on broadcast or multicast messages generated by the RIP protocol.
- Use this command in conjunction with the passive-interface command to control the routing updates sent to specific neighbors.

Example

```
Console(config-router)#neighbor 10.2.0.254
Console(config-router)#
```

network

This command specifies the network interfaces that will be included in the RIP routing process. Use the **no** form to remove an entry.

Syntax

[**no**] **network** {*ip-address netmask* | **vlan** *vlan-id*}

ip-address – IP address of a network directly connected to this router.

netmask - Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

vlan-id - VLAN ID. (Range: 1-4094)

Default Setting
No networks are specified.

Command Mode
Router Configuration

Command Usage
- RIP only sends and receives updates on interfaces specified by this command. If a network is not specified, the interfaces in that network will not be advertised in any RIP updates.

- Subnet addresses are interpreted as class A, B or C, based on the first field in the specified address. In other words, if a subnet address nnn.xxx.xxx.xxx is entered, the first field (nnn) determines the class:

  0 - 127 is class A, and only the first field in the network address is used.

  128 - 191 is class B, and the first two fields in the network address are used.

  192 - 223 is class C, and the first three fields in the network address are used.

Example
This example includes network interface 10.1.0.0 in the RIP routing process.

```
Console(config-router)#network 10.1.0.0
Console(config-router)#
```

passive-interface

This command stops RIP from sending routing updates on the specified interface. Use the **no** form to disable this feature.

Syntax

[no] **passive-interface vlan** *vlan-id*

vlan-id - VLAN ID. (Range: 1-4094)

Default Setting
Disabled

Command Mode
Router Configuration

Command Usage
- If this command is used to stop sending routing updates on an interface, the attached subnet will still continue to be advertised to other interfaces, and updates from other routers on that interface will continue to be received and processed.

- Use this command in conjunction with the neighbor command to control the routing updates sent to specific neighbors.

Example

```
Console(config-router)#passive-interface vlan1
Console(config-router)#
```

redistribute

This command imports external routing information from other routing domains (that is, directly connected routes, protocols, or static routes) into the autonomous system. Use the **no** form to disable this feature.

Syntax

[**no**] **redistribute** (**bgp** | **connected** | **ospf** | **static**} [**metric** *metric-value*]

bgp - External routes will be imported from the Border Gateway Protocol (BGP) into this routing domain.

connected - Imports routes that are established automatically just by enabling IP on an interface.

ospf - External routes will be imported from the Open Shortest Path First (OSPF) protocol into this routing domain.

static - Static routes will be imported into this routing domain.

metric-value - Metric value assigned to all external routes for the specified protocol. (Range: 1-16)

Default Setting

redistribution - none
metric-value - set by the default-metric command

Command Mode

Router Configuration

Command Usage

- When a metric value has not been configured by the **redistribute** command, the default-metric command sets the metric value to be used for all imported external routes.

- A route metric must be used to resolve the problem of redistributing external routes with incompatible metrics.

- It is advisable to use a low metric when redistributing routes from another protocol into RIP. Using a high metric limits the usefulness of external routes redistributed into RIP. For example, if a metric of 10 is defined for redistributed routes, these routes can only be advertised to routers up to 5 hops away, at which point the metric exceeds the maximum hop count of 15. By defining a low metric of 1, traffic can follow a imported route the maximum number of hops allowed within a RIP domain. However, using a low metric can increase the possibility of routing loops For example, this can occur if there are multiple redistribution points and the router learns about the same external network with

a better metric from a redistribution point other than that derived from the original source.

Example

This example redistributes routes learned from OSPF and sets the metric for all external routes imported from OSPF to a value of 3.

```
Console(config-router)#redistribute ospf metric 3
Console(config-router)#
```

This example redistributes static routes and sets the metric for all of these routes to a value of 3.

```
Console(config-router)#redistribute static metric 3
Console(config-router)#
```

timers basic

This command configures the RIP update timer, timeout timer, and garbage-collection timer. Use the **no** form to restore the defaults.

Syntax

timers basic *update timeout garbage*

no timers basic

update – Sets the update timer to the specified value. (Range: 5-2147483647 seconds)

timeout – Sets the timeout timer to the specified value. (Range: 90-360 seconds)

garbage – Sets the garbage collection timer to the specified value. (Range: 60-240 seconds)

Default Setting

Update: 30 seconds
Timeout: 180 seconds
Garbage collection: 120 seconds

Command Mode

Router Configuration

Command Usage

- The *update* timer sets the rate at which updates are sent. This is the fundamental timer used to control all basic RIP processes.

- The *timeout* timer is the time after which there have been no update messages that a route is declared dead. The route is marked inaccessible (i.e., the metric

set to infinite) and advertised as unreachable. However, packets are still forwarded on this route.

- After the *timeout* interval expires, the router waits for an interval specified by the *garbage-collection* timer before removing this entry from the routing table. This timer allows neighbors to become aware of an invalid route prior to it being purged by this device.
- Setting the update timer to a short interval can cause the router to spend an excessive amount of time processing updates.
- These timers must be set to the same values for all routers in the network.

Example

This example sets the update timer to 40 seconds. The timeout timer is subsequently set to 240 seconds, and the garbage-collection timer to 160 seconds.

```
Console(config-router)#timers basic 15
Console(config-router)#
```

version

This command specifies a RIP version used globally by the router. Use the **no** form to restore the default value.

Syntax

version {1 | 2}

no version

1 - RIP Version 1

2 - RIP Version 2

Default Setting

Receive: Accepts RIPv1 or RIPv2 packets
Send: Route information is broadcast to other routers with RIPv2.

Command Mode

Router Configuration

Command Usage

- When this command is used to specify a global RIP version, any VLAN interface not previously set by the ip rip receive version or ip rip send version command will use the global RIP version setting.
- When the **no** form of this command is used to restore the default value, any VLAN interface not previously set by the ip rip receive version or ip rip send version command will be set to the default send or receive version.

- Any configured interface settings take precedence over the global settings.

Example

This example sets the global version for RIP to send and receive version 2 packets.

```
Console(config-router)#version 2
Console(config-router)#
```

ip rip authentication mode

This command specifies the type of authentication that can be used for RIPv2 packets. Use the **no** form to restore the default value.

Syntax

ip rip authentication mode {**md5** | **text**}

no ip rip authentication mode

md5 - Message Digest 5 (MD5) authentication

text - Indicates that a simple password will be used.

Default Setting

Text authentication

Command Mode

Interface Configuration (VLAN)

Command Usage

- The password to be used for authentication is specified in the ip rip authentication string command.
- This command requires the interface to exchange routing information with other routers based on an authorized password. (Note that this command only applies to RIPv2.)
- For authentication to function properly, both the sending and receiving interface must be configured with the same password or authentication key.
- MD5 is a one-way hash algorithm is that takes the authentication key and produces a 128 bit message digest or "fingerprint." This makes it computationally infeasible to produce two messages having the same message digest, or to produce any message having a given pre-specified target message digest.

Example

This example sets the authentication mode to plain text.

```
Console(config)#interface vlan 1
Console(config-if)#ip rip authentication mode text
Console(config-if)#
```

ip rip authentication string

This command specifies an authentication key for RIPv2 packets. Use the **no** form to delete the authentication key.

Syntax

ip rip authentication string *key-string*

no ip rip authentication string

key-string - A password used for authentication. (Range: 1-16 characters, case sensitive)

Default Setting

No authentication key

Command Mode

Interface Configuration (VLAN)

Command Usage

- This command can be used to restrict the interfaces that can exchange RIPv2 routing information. (Note that this command does not apply to RIPv1.)
- For authentication to function properly, both the sending and receiving interface must be configured with the same password, and authentication enabled by the ip rip authentication mode command.

Example

This example sets an authentication password of "small" to verify incoming routing messages and to tag outgoing routing messages.

```
Console(config)#interface vlan 1
Console(config-if)#ip rip authentication string small
Console(config-if)#
```

ip rip receive version

This command specifies a RIP version to receive on an interface. Use the **no** form to restore the default value.

Syntax

ip rip receive version {**1** | **2** | **none**}

no ip rip receive version

1 - Accepts only RIPv1 packets.

2 - Accepts only RIPv2 packets.

none - Disables receiving packets through the specified interface.

Default Setting
RIPv1 and RIPv2 packets

Command Mode
Interface Configuration (VLAN)

Command Usage
- Use this command to override the global setting specified by the RIP version command.
- You can specify the receive version based on these options:
  - Use version 1 or version 2 if all routers in the local network are based on RIPv1 or RIPv2, respectively.
  - Use the default of version 1 or 2 if some routers in the local network are using RIPv2, but there are still some older routers using RIPv1.

Example
This example sets the interface version for VLAN 1 to receive RIPv1 packets.

```
Console(config)#interface vlan 1
Console(config-if)#ip rip receive version 1
Console(config-if)#
```

ip rip send version

This command specifies a RIP version to send on an interface. Use the no form to restore the default value.

Syntax

ip rip send version {1 | 2 | 1-compatible | none}

no ip rip send version

1 - Sends only RIPv1 packets.

2 - Sends only RIPv2 packets.

1-compatible - Route information is broadcast to other routers with RIPv2

none - Disables sending packets through the specified interface.

Default Setting
1-compatible (Route information is broadcast to other routers with RIPv2)

Command Mode
Interface Configuration (VLAN)

Command Usage
- Use this command to override the global setting specified by the RIP version command.
- You can specify the send version based on these options:
  - Use version 1 or version 2 if all routers in the local network are based on RIPv1 or RIPv2, respectively.
  - Use "1-compatible" to propagate route information by broadcasting to other routers on the network using RIPv2, instead of multicasting as normally required by RIPv2. (Using this mode allows older RIPv2 routers which only receive RIP broadcast messages to receive all of the information provided by RIPv2, including subnet mask, next hop and authentication information.)

Example
This example sets the interface version for VLAN 1 to send RIPv1 packets.

```
Console(config)#interface vlan 1
Console(config-if)#ip rip send version 1
Console(config-if)#
```

ip rip split-horizon

This command enables split-horizon or poison-reverse (a variation) on an interface. Use the **no** form to disable this function.

Syntax

ip rip split-horizon [**poisoned**]

no rip ip split-horizon

poisoned - Enables poison-reverse on the current interface.

Command Mode
Interface Configuration (VLAN)

Default Setting
split-horizon poisoned

Command Usage
- Split horizon never propagates routes back to an interface from which they have been acquired.

- Poison reverse propagates routes back to an interface port from which they have been acquired, but sets the distance-vector metrics to infinity. (This provides faster convergence.)
- If split-horizon is disabled with the **no rip ip split-horizon** command, and a loop occurs, the hop count for a route may be gradually incremented to infinity (that is, 16) before the route is deemed unreachable.

Example

This example propagates routes back to the source using poison-reverse.

```
Console(config)#interface vlan 1
Console(config-if)#ip split-horizon poison-reverse
Console(config-if)#
```

clear ip rip route

This command clears specified data from the RIP routing table.

Syntax

clear ip rip route {**all** }

all - Deletes all entries from the routing table.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Using this command with the "all" parameter clears the RIP table of all routes. To avoid deleting the entire RIP network, use the redistribute connected command to make the RIP network a connected route.

Example

```
Console#clear ip rip route all
Console#
```

show ip protocols rip

This command displays RIP process parameters.

Command Mode

Privileged Exec

Example

```
Console#show ip protocols rip
Routing Protocol is "rip"
```

```
  Sending updates every 30 seconds with +/-50%, next due in 23 seconds
  Timeout after 180 seconds, garbage collect after 120 seconds
  Outgoing update filter list for all interface is not set
  Incoming update filter list for all interface is not set
  Default redistribution metric is 1
  Redistributing:
  Default version control: send version 2, receive any version
    Interface        Send  Recv   Key-chain
    VLAN1            2     1 2
  Routing for Networks:
    192.168.1.0/24
  Routing Information Sources:
    Gateway          BadPackets BadRoutes  Distance Last Update
  Distance: (default is 120)
Console#
```

show ip rip

This command displays information about RIP routes and configuration settings. Use this command without any keywords to display all RIP routes.

Syntax

show ip rip [interface [vlan *vlan-id*]]

interface - Shows RIP configuration settings for all interfaces or for a specified interface.

vlan-id - VLAN ID. (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#show ip rip

Codes: R - RIP, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface

     Network            Next Hop         Metric From            Tag Time
C(i) 192.168.1.0/24     0.0.0.0               1 self              0

Console#
```

IPv6 Routing Information Protocol (RIPng)

Table 190: IPv6 Routing Information Protocol Commands

Command	Function	Mode
router ipv6 rip	Enables the RIP routing protocol	GC
ipv6 rip default-information originate	Generates a default external route into an autonomous system	RC
default-metric (RIPng)	Sets the default metric assigned to external routes imported from other protocols	RC
network (RIPng)	Specifies network interfaces that are to use RIPng routing	RC
passive-interface (RIPng)	Stops RIP from sending routing updates on the specified interface	RC
redistribute (RIPng)	Redistribute routes from one routing domain to another	RC
timers basic (RIPng)	Sets basic timers, including update, timeout, garbage collection	RC
ipv6 rip split-horizon	Enables split-horizon or poison-reverse loop prevention	IC
clear ipv6 rip route	Clears specified data from the RIP routing table	PE
show ipv6 protocols rip	Displays RIP process parameters	PE
show ipv6 rip	Displays information about RIP routes and configuration settings	PE

router ipv6 rip

This command enables IPv6 Routing Information Protocol (RIPng) routing for all IP interfaces on the router. Use the no form to disable it.

Syntax

[no] router ipv6 rip

Command Mode

Global Configuration

Default Setting

Disabled

Command Usage

- RIPng is used to specify how routers exchange IPv6 routing table information.
- This command is also used to enter router configuration mode.

Example

```
Console(config)#router ipv6 rip
Console(config-router)#
```

ipv6 rip default-information originate

This command generates a default external route into the local IPv6 RIPng domain. Use the **no** form to disable this feature.

Syntax

[no] **ipv6 rip default-information originate**

Default Setting

Disabled

Command Mode

Router Configuration

Command Usage

This command sets a default route for every Layer 3 interface where RIPng is enabled.

Example

```
Console(config-router)#ipv6 rip default-information originate
Console(config-router)#
```

default-metric (RIPng)

This command sets the default metric assigned to external routes imported from other protocols. Use the **no** form to restore the default value.

Syntax

default-metric *metric-value*

no default-metric

metric-value – Metric assigned to external routes. (Range: 1-15)

Default Setting

1

Command Mode

Router Configuration

Command Usage

- This command does not override the metric value set by the redistribute (RIPng) command. When a metric value has not been configured by the redistribute (RIPng) command, the **default-metric** command sets the metric value to be used for all imported external routes.
- The default metric must be used to resolve the problem of redistributing external routes with incompatible metrics.

- It is advisable to use a low metric when redistributing routes from another protocol into RIPng. Using a high metric limits the usefulness of external routes redistributed into RIPng. For example, if a metric of 10 is defined for redistributed routes, these routes can only be advertised to routers up to 5 hops away, at which point the metric exceeds the maximum hop count of 15. By defining a low metric of 1, traffic can follow a imported route the maximum number of hops allowed within a RIPng domain. However, note that using a low metric can increase the possibility of routing loops For example, this can occur if there are multiple redistribution points and the router learns about the same external network with a better metric from a redistribution point other than that derived from the original source.

Example

This example sets the default metric to 5.

```
Console(config-router)#default-metric 5
Console(config-router)#
```

network (RIPng)

This command specifies the network interfaces that will be included in the RIPng routing process. Use the **no** form to remove an entry.

Syntax

[**no**] **network** {*network-address* | **vlan** *vlan-id*}

network-address – IPv6 address of a network directly connected to this router.

vlan-id - VLAN ID. (Range: 1-4094)

Default Setting

No networks are specified.

Command Mode

Router Configuration

Command Usage

Use this command to specify networks to which routing updates will be sent and received. If a network is not specified, the interfaces in that network will not be advertised in any RIPng update.

Example

```
Console(config-router)#network 2001::/64
Console(config-router)#network vlan 20
Console(config-router)#
```

passive-interface (RIPng)

This command stops RIPng from sending routing updates on the specified interface. Use the **no** form to disable this feature.

Syntax

[no] **passive-interface vlan** *vlan-id*

vlan-id - VLAN ID. (Range: 1-4094)

Default Setting

Disabled

Command Mode

Router Configuration

Command Usage

If this command is used to stop sending routing updates on an interface, the attached subnet will still continue to be advertised to other interfaces, and updates from other routers on that interface will continue to be received and processed.

Example

```
Console(config-router)#passive-interface vlan1
Console(config-router)#
```

redistribute (RIPng)

This command imports external routing information from other routing domains (that is, directly connected routes, protocols, or static routes) into the autonomous system. Use the **no** form to disable this feature.

Syntax

[no] **redistribute** {**connected** | **ospf** | **static**} [**metric** *metric-value*]

connected - Imports routes that are established automatically just by enabling IPv6 on an interface.

ospf - External routes will be imported from the Open Shortest Path First (OSPF) protocol into this routing domain.

static - Static routes will be imported into this routing domain.

metric-value - Metric value assigned to all external routes for the specified protocol. (Range: 1-15)

Default Setting

redistribution - none
metric-value - set by the default-metric (RIPng) command

Command Mode

Router Configuration

Command Usage

- When a metric value has not been configured by the **redistribute** command, the default-metric (RIPng) command sets the metric value to be used for all imported external routes.
- A route metric must be used to resolve the problem of redistributing external routes with incompatible metrics.
- It is advisable to use a low metric when redistributing routes from another protocol into RIPng. Using a high metric limits the usefulness of external routes redistributed into RIPng. For example, if a metric of 10 is defined for redistributed routes, these routes can only be advertised to routers up to 5 hops away, at which point the metric exceeds the maximum hop count of 15. By defining a low metric of 1, traffic can follow a imported route the maximum number of hops allowed within a RIPng domain. However, using a low metric can increase the possibility of routing loops. For example, this can occur if there are multiple redistribution points and the router learns about the same external network with a better metric from a redistribution point other than that derived from the original source.

Example

This example redistributes routes learned from OSPF and sets the metric for all external routes imported from OSPF to a value of 3.

```
Console(config-router)#redistribute ospf metric 3
Console(config-router)#
```

This example redistributes static routes and sets the metric for all of these routes to a value of 3.

```
Console(config-router)#redistribute static metric 3
Console(config-router)#
```

timers basic (RIPng)

This command configures the RIPng update timer, timeout timer, and garbage-collection timer. Use the **no** form to restore the defaults.

Syntax

timers basic *update timeout garbage*

no timers basic

update – Sets the update timer to the specified value. (Range: 5-2147483647 seconds)

timeout – Sets the timeout timer to the specified value. (Range: 90-360 seconds)

garbage – Sets the garbage collection timer to the specified value. (Range: 60-240 seconds)

Default Setting
Update: 30 seconds
Timeout: 180 seconds
Garbage collection: 120 seconds

Command Mode
Router Configuration

Command Usage
- The *update* timer sets the rate at which updates are sent. This is the fundamental timer used to control all basic RIPng processes.
- The *timeout* timer is the time after which there have been no update messages that a route is declared dead. The route is marked inaccessible (i.e., the metric set to infinite) and advertised as unreachable. However, packets are still forwarded on this route.
- After the *timeout* interval expires, the router waits for an interval specified by the *garbage-collection* timer before removing this entry from the routing table. This timer allows neighbors to become aware of an invalid route prior to it being purged by this device.
- Setting the update timer to a short interval can cause the router to spend an excessive amount of time processing updates.
- These timers must be set to the same values for all routers in the network.

Example
This example sets the update timer to 40 seconds. The timeout timer is set to 240 seconds, and the garbage-collection timer to 160 seconds.

```
Console(config-router)#timers basic 40 240 160
Console(config-router)#
```

ipv6 rip split-horizon

This command enables split-horizon or poison-reverse (a variation) on an interface. Use the no form to disable this function.

Syntax
ipv6 rip split-horizon [poisoned]

no ipv6 rip split-horizon

poisoned - Enables poison-reverse on the current interface.

Command Mode
Interface Configuration (VLAN)

Default Setting
split-horizon poisoned

Command Usage
- Split horizon never propagates routes back to an interface from which they have been acquired.
- Poison reverse propagates routes back to an interface port from which they have been acquired, but sets the distance-vector metrics to infinity. (This provides faster convergence.)
- If split-horizon is disabled with the **no ipv6 rip split-horizon** command, and a loop occurs, the hop count for a route may be gradually incremented to infinity (that is, 16) before the route is deemed unreachable.

Example
This example propagates routes back to the source using poison-reverse.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 rip split-horizon poison-reverse
Console(config-if)#
```

clear ipv6 rip route
This command clears specified data from the RIPng routing table.

Syntax
clear ipv6 rip route {**all**}

all - Deletes all entries from the routing table.

Default Setting
None

Command Mode
Privileged Exec

Command Usage
Using this command with the "all" parameter clears the RIPng table of all routes.

Example

```
Console#clear ipv6 rip route all
Console#
```

show ipv6 protocols rip

This command displays RIPng process parameters.

Command Mode

Privileged Exec

Example

```
Console#show ipv6 protocols rip
Routing Protocol is "RIPng"
  Sending updates every 30 seconds with +/-50%, next due in 22 seconds
  Timeout after 180 seconds, garbage collect after 120 seconds
  Outgoing update filter list for all interface is not set
  Incoming update filter list for all interface is not set
  Default redistribution metric is 1
  Redistributing:    connected
  Default version control: send version 1, receive version 1
    Interface        Send  Recv
  Routing for Networks:
    VLAN20
    VLAN30
  Routing Information Sources:
Gateway          BadPackets BadRoutes  Distance Last Update
Console#
```

show ipv6 rip

This command displays information about RIPng routes and configuration settings. Use this command without any keywords to display all RIPng routes.

Syntax

show ipv6 rip [interface [vlan *vlan-id*]]

interface - Shows RIPng configuration settings for all interfaces or for a specified interface.

vlan-id - VLAN ID. (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#show ipv6 rip

Codes: R - RIPng, C - connected, S - Static, O - OSPF, B - BGP
Sub-codes:
      (n) - normal, (s) - static, (d) - default, (r) - redistribute,
      (i) - interface, (a/S) - aggregated/Suppressed

   Network      Next Hop                      Via     Metric Tag Time
C(i) 2002::/64
                  ::                         self       1    0
C(i) 2003::/64
                  ::                         self       1    0
R(n) 2013::/64
                  fe80::aa27:c8ff:feef:7c3c   VLAN20    10    0  02:58
```

```
Console#
```

37 OSPF Commands

This section includes commands for Open Shortest Path First (OSPF) dynamic routing. These commands are used to connect between different local subnetworks.

OSPF is more suited for large area networks which experience frequent changes in the links. It also handles subnets much better than RIP. OSPF protocol actively tests the status of each link to its neighbors to generate a shortest path tree, and builds a routing table based on this information. OSPF then utilizes IP multicast to propagate routing information. A separate routing area scheme is also used to further reduce the amount of routing traffic.

Note that the OSPF protocol implemented in this device is based on RFC 2328 (Version 2). It also supports RFC 1583 (early Version 2) compatibility mode to ensure that the same method is used to calculate summary route costs throughout the network when older OSPF routers exist; as well as the not-so-stubby area option (RFC 3101).

Table 188: OSPF Commands

Command Group	Function
Open Shortest Path First (OSPFv2)	Configures global and interface specific parameters for OSPFv2
Open Shortest Path First (OSPFv3)	Configures global and interface specific parameters for OSPFv3

Open Shortest Path First (OSPFv2)

Table 189: Open Shortest Path First Commands

Command	Function	Mode
General Configuration		
router ospf	Enables or disables OSPFv2	GC
compatible rfc1583	Calculates summary route costs using RFC 1583 (early OSPFv2)	RC
default-information originate	Generates a default external route into an autonomous system	RC
router-id	Sets the router ID for this device	RC
timers spf	Configures the delay after a topology change and the hold time between consecutive SPF calculations	RC
clear ip ospf process	Clears and restarts the OSPF routing process	PE

Table 189: Open Shortest Path First Commands (Continued)

Command	Function	Mode
Route Metrics and Summaries		
area default-cost	Sets the cost for a default summary route sent into a stub or NSSA	RC
area range	Summarizes routes advertised by an ABR	RC
auto-cost reference-bandwidth	Calculates default metrics for an interface based on bandwidth	RC
default-metric	Sets the default metric for external routes imported from other protocols	RC
redistribute	Redistribute routes from one routing domain to another	RC
summary-address	Summarizes routes advertised by an ASBR	RC
Area Configuration		
area authentication	Enables authentication for an OSPF area	RC
area nssa	Defines a not-so-stubby that can import external routes	RC
area stub	Defines a stubby area that cannot send or receive LSAs	RC
area virtual-link	Defines a virtual link from an area border routers to the backbone	RC
Interface Configuration		
ip ospf area	Assigns a process ID and area ID to an interface	IC
ip ospf authentication	Specifies the authentication type for an interface	IC
ip ospf authentication-key	Assigns a simple password to be used by neighboring routers	IC
ip ospf cost	Specifies the cost of sending a packet on an interface	IC
ip ospf dead-interval	Sets the interval at which hello packets are not seen before neighbors declare the router down	IC
ip ospf hello-interval	Specifies the interval between sending hello packets	IC
ip ospf message-digest-key	Enables MD5 authentication and sets the key for an interface	IC
ip ospf network	Sets the network type connected to the interface	IC
ip ospf passive	Suppresses OSPF routing traffic on the specified interface	IC
ip ospf priority	Sets the router priority used to determine the designated router	IC
ip ospf retransmit-interval	Specifies the time between resending a link-state advertisement	IC
ip ospf transmit-delay	Estimates time to send a link-state update packet over an interface	IC
Display Information		
show ip ospf	Displays general information about the routing processes	PE
show ip ospf border-routers	Displays routing table entries for Area Border Routers (ABR) and Autonomous System Boundary Routers (ASBR)	PE
show ip ospf database	Shows information about different LSAs in the database	PE

Table 189: Open Shortest Path First Commands (Continued)

Command	Function	Mode
show ip ospf database asbr-summary	Shows information about ASBR summary LSAs	PE
show ip ospf database external	Shows information about external LSAs	PE
show ip ospf database network	Shows information about network LSAs in the database	PE
show ip ospf database nssa-external	Shows information about NSSA external LSAs in the database	PE
show ip ospf database router	Shows information about LSAs in the router's database	PE
show ip ospf database self-originate	Shows information originated by this router	PE
show ip ospf database summary	Shows information about summary LSAs in the router's database	PE
show ip ospf interface	Displays interface information	PE
show ip ospf neighbor	Displays neighbor information	PE
show ip ospf route	Displays the OSPF routing table	PE

General Configuration

router ospf

This command enables Open Shortest Path First (OSPFv2) routing for all IP interfaces on the router and enters router configuration mode. Use the **no** form to disable OSPF for all processes or for a specified process.

Syntax

[no] router ospf [*process-id*]

process-id - Process ID must be entered when configuring multiple routing instances. (Range: 1-65535; Default: 1)

Command Mode

Global Configuration

Default Setting

No routing process is defined.

Command Usage

- OSPF is used to specify how routers exchange routing table information.
- This command is also used to enter router configuration mode.
- If the process ID is not defined, the default is instance 1.

Example

```
Console(config)#router ospf
Console(config-router)#
```

compatible rfc1583

This command calculates summary route costs using RFC 1583 (early OSPFv2). Use the **no** form to calculate costs using RFC 2328 (OSPFv2).

Syntax

[no] **compatible rfc1583**

Command Mode

Router Configuration

Default Setting

RFC 1583 compatible

Command Usage

- When RFC 1583 compatibility is enabled, only cost is used when choosing among multiple AS-external LSAs advertising the same destination. When disabled, preference is based on type of path (where type 1 external paths are preferred over type 2 external paths, using cost only to break ties (RFC 2328).
- All routers in an OSPF routing domain should use the same RFC for calculating summary routes.
- If there are any OSPF routers in an area exchanging summary information (specifically, ABRs) which have not been upgraded to OSPFv2, this command should be used on the newly upgraded OSPFv2 routers to ensure compatibility with routers still running older OSPFv2 code. Once all systems have been upgraded to newer OSPFv2 code, use the no form of this command to restore compatibility for all systems with RFC 2328.

Example

```
Console(config-router)#compatible rfc1583
Console(config-router)#
```

default-information originate

This command generates a default external route into an autonomous system. Use the **no** form to disable this feature.

Syntax

default-information originate [**always**] [**metric** *interface-metric*] [**metric-type** *metric-type*]

no default-information originate [**always** | **metric** | **metric-type**]

always - Always advertise itself as a default external route for the local AS regardless of whether the router has a default route. (See "ip route" on page 901.)

interface-metric - Metric assigned to the default route. (Range: 0-16777214)

metric-type - External link type used to advertise the default route. (Options: Type 1, Type 2)

Command Mode

Router Configuration

Default Setting

Disabled
Metric: 20
Metric Type: 2

Command Usage

- If the **always** parameter is not selected, the router can only advertise a default external route into the AS if it has been configured to import external routes through other routing protocols or static routing, and such a route is known. (See the redistribute command.)
- The metric for the default external route is used to calculate the path cost for traffic passed from other routers within the AS out through the ASBR.
- When you use this command to redistribute routes into a routing domain (i.e., an Autonomous System, this router automatically becomes an Autonomous System Boundary Router (ASBR). However, an ASBR does not, by default, generate a default route into the routing domain.
  - If you use the **always** keyword, the router will advertise itself as a default external route into the AS, even if a default external route does not actually exist. To define a default route, use the ip route command.
  - If you do *not* use the **always** keyword, the router can only advertise a default external route into the AS if the redistribute command is used to import external routes via RIP or static routing, and such a route is known.
- Type 1 route advertisements add the internal cost to the external route metric. Type 2 routes do not add the internal cost metric. When comparing Type 2

routes, the internal cost is only used as a tie-breaker if several Type 2 routes have the same cost.

- This command should not be used to generate a default route for a stub or NSSA. To generate a default route for these area types, use the area stub or area nssa commands.

Example

This example assigns a metric of 20 to the default external route advertised into an autonomous system, sending it as a Type 2 external metric.

```
Console(config-router)#default-information originate metric 20 metric-type 2
Console(config-router)#
```

router-id

This command assigns a unique router ID for this device within the autonomous system for the current OSPF process. Use the **no** form to use the default router identification method (i.e., the highest interface address).

Syntax

router-id *ip-address*

no router-id

ip-address - Router ID formatted as an IPv4 address.

Command Mode

Router Configuration

Default Setting

Highest interface address

Command Usage

- This command sets the router ID for the OSPF process specified in the router ospf command.
- The router ID must be unique for every router in the autonomous system. Using the default setting based on the highest interface address ensures that each router ID is unique. (Note that the router ID cannot be set to 0.0.0.0.)
- If this router already has registered neighbors, the new router ID will be used when the router is rebooted, or manually restarted by entering the **no router ospf** followed by the **router ospf** command.
- If the priority values of the routers bidding to be the designated router or backup designated router for an area are equal, the router with the highest ID is elected.

Example

```
Console(config-router)#router-id 10.1.1.1
Console(config-router)#
```

timers spf

This command configures the delay after receiving a topology change and starting the shortest path first (SPF) calculation, and the hold time between making two consecutive SPF calculations. Use the **no** form to restore the default values.

Syntax

timers spf *spf-delay spf-holdtime spf-maxtime*

no timers spf

spf-delay - The delay after receiving a topology change notification and starting the SPF calculation. (Range: 0-600000 milliseconds)

spf-holdtime - Minimum time between two consecutive SPF calculations. (Range: 0-600000 milliseconds)

spf-maxtime - Minimum time between two consecutive SPF calculations. (Range: 0-600000 milliseconds)

Command Mode

Router Configuration

Default Setting

Automatically calculated

Command Usage

- Setting the SPF holdtime to 0 means that there is no delay between consecutive calculations.
- Using a low value allows the router to switch to a new path faster, but uses more CPU processing time.

Example

```
Console(config-router)#timers spf 20 20 20
Console(config-router)#
```

clear ip ospf process

This command clears and restarts the OSPF routing process. Specify the process ID to clear a particular OSPF process. When no process ID is specified, this command clears all running OSPF processes.

Syntax

clear ip ospf [*process-id*] process

process-id - Specifies the routing process ID. (Range: 1-65535)

Default Setting

Clears all routing processes.

Command Mode

Privileged Exec

Example

```
Console#clear ip ospf process
Console#
```

Route Metrics and Summaries

area default-cost

This command specifies a cost for the default summary route sent into a stub or NSSA from an Area Border Router (ABR). Use the no form to remove the assigned default cost.

Syntax

area *area-id* default-cost *cost*

no area *area-id* default-cost

area-id - Identifies the stub or NSSA. (The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.)

cost - Cost for the default summary route sent to a stub or NSSA. (Range: 0-16777215)

Command Mode

Router Configuration

Default Setting

Default cost: 1

Command Usage

- If the default cost is set to "0," the router will not advertise a default route into the attached stub or NSSA.

Example

```
Console(config-router)#area 10.3.9.0 default-cost 10
Console(config-router)#
```

area range

This command summarizes the routes advertised by an Area Border Router (ABR). Use the **no** form to disable this function.

Syntax

[**no**] **area** *area-id* **range** *ip-address* **netmask** [**advertise** | **not-advertise**]

area-id - Identifies an area for which the routes are summarized. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

ip-address - Base address for the routes to summarize.

netmask - Network mask for the summary route.

advertise - Advertises the specified address range.

not-advertise - The summary is not sent, and the routes remain hidden from the rest of the network.

Command Mode

Router Configuration

Default Setting

Disabled

Command Usage

- This command can be used to summarize intra-area routes and advertise this information to other areas through Area Border Routers (ABRs).
- If the network addresses within an area are assigned in a contiguous manner, the ABRs can advertise a summary route that covers all of the individual networks within the area that fall into the specified range using a single **area range** command.
- If routes are set to be advertised by this command, the router will issue a Type 3 summary LSA for each address range specified by this command.
- This router supports up 64 summary routes for area ranges.

Example

This example creates a summary address for all area routes in the range of 10.2.x.x.

```
Console(config-router)#area 10.2.0.0 range 10.2.0.0 255.255.0.0 advertise
Console(config-router)#
```

auto-cost reference-bandwidth

Use this command to calculate the default metrics for an interface based on bandwidth. Use the **no** form to automatically assign costs based on interface type.

Syntax

auto-cost reference-bandwidth *reference-value*

no auto-cost reference-bandwidth

reference-value - Bandwidth of interface. (Range: 1-4294967 Mbps)

Command Mode

Router Configuration

Default Setting

1 Mbps

Command Usage

- The system calculates the cost for an interface by dividing the reference bandwidth by the interface bandwidth. By default, the cost is 1 Mbps for all port types (including 100 Mbps ports, 1 Gigabit ports, and 10 Gigabit ports).
- A higher reference bandwidth can be used for aggregate links to indicate preferred use as a lower cost interface.
- The ip ospf cost command overrides the cost calculated by the **auto-cost reference-bandwidth** command.

Example

This example sets the reference value to 10000, which generates a cost of 100 for 100 Mbps ports, 10 for 1 Gbps ports and 1 for 10 Gbps ports.

```
Console(config-router)#auto-cost reference-bandwidth 10000
Console(config-router)#
```

default-metric

This command sets the default metric for external routes imported from other protocols. Use the **no** form to remove the default metric for the supported protocol types.

Syntax

default-metric *metric-value*

no default-metric

metric-value – Metric assigned to all external routes imported from other protocols. (Range: 0-16777214)

Command Mode

Router Configuration

Default Setting
20

Command Usage
- The default metric must be used to resolve the problem of redistributing external routes from other protocols that use incompatible metrics.
- This command does not override the metric value set by the redistribute command. When a metric value has not been configured by the redistribute command, the **default-metric** command sets the metric value to be used for all imported external routes.

Example
```
Console(config-router)#default-metric 100
Console(config-router)#
```

redistribute
This command redistributes external routing information from other routing protocols and static routes into an autonomous system. Use the **no** form to disable this feature or to restore the default settings.

Syntax
redistribute {**bgp** | **connected** | **rip** | **static**} [**metric** *metric-value*] [**metric-type** *type-value*] [**tag** *tag-value*]

no redistribute {**bgp** | **connected** | **rip** | **static**} [**metric**] [**metric-type**] [**tag**]

bgp – Displays external routes imported from the Border Gateway Protocol (BGP) into this routing domain.

connected - Imports all currently connected entries.

rip – Imports external routes learned through Routing Information Protocol (RIP) into this routing domain.

static - Static routes will be imported into this Autonomous System.

metric-value - Metric assigned to all external routes for the specified protocol. (Range: 0-16777214)

type-value

1 - Type 1 external route

2 - Type 2 external route (default) - Routers do not add internal route metric to external route metric.

tag-value - A tag placed in the AS-external LSA to identify a specific external routing domain, or to pass additional information between routers. (Range: 0-4294967295)

Command Mode
Router Configuration

Default Setting
redistribution - none
metric-value - 20
type-metric - 2

Command Usage
- This command is used to import routes learned from other routing protocols into the OSPF domain, and to generate AS-external-LSAs.
- When you redistribute external routes into an OSPF autonomous system (AS), the router automatically becomes an autonomous system boundary router (ASBR). If the **redistribute** command is used in conjunction with the default-information originate command to generate a "default" external route into the AS, the metric value specified in this command supersedes the metric specified in the default-information originate command.
- Metric type specifies the way to advertise routes to destinations outside the AS through External LSAs. When a Type 1 LSA is received by a router, it adds the internal cost to the external route metric. In other words, the cost of the route from any router within the AS is equal to the cost associated with reaching the advertising ASBR, plus the cost of the external route. When a Type 2 LSA is received by a router, it only uses the external route metric to determine route cost.
- A tag can be used to distinguish between routes learned from different external autonomous systems (other routing protocols). For example, if there are two ASBRs in a routing domain: A and B. ASBR A can be configured to redistribute routes learned from RIP domain 1 (identified by tag 1) and ASBR B can redistribute routes learned from RIP domain 2 (identified by tag 2).

Example
This example redistributes routes learned from RIP as Type 1 external routes.

```
Console(config-router)#redistribute rip metric-type 1
Console(config-router)#
```

summary-address

This command aggregates routes learned from other protocols. Use the **no** form to remove a summary address.

Syntax
[no] **summary-address** *summary-address netmask*

summary-address - Summary address covering a range of addresses.

netmask - Network mask for the summary route.

Command Mode
Router Configuration

Default Setting
Disabled

Command Usage
Redistributing routes from other protocols into OSPF normally requires the router to advertise each route individually in an external LSA. An Autonomous System Boundary Router (ASBR) can be configured to redistribute routes learned from other protocols by advertising an aggregate route into all attached autonomous systems. This helps both to decrease the number of external LSAs and the size of the OSPF link state database.

Example
This example creates a summary address for all routes contained in 192.168.x.x.

```
Console(config-router)#summary-address 192.168.0.0 255.255.0.0
Console(config-router)#
```

Area Configuration

area authentication
This command enables authentication for an OSPF area. Use the no form to remove authentication for an area.

Syntax
[no] **area** *area-id* **authentication** [**message-digest**]

area-id - Identifies an area for which authentication is to be configured. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

message-digest - Specifies message-digest (MD5) authentication.

Command Mode
Router Configuration

Default Setting
No authentication

Command Usage
- Use authentication to prevent routers from inadvertently joining an unauthorized area. Configure routers in the same area with the same password or key. All neighboring routers on the same network with the same password will exchange routing data.

- Specifying authentication for an area without the **message-digest** keyword sets authentication to Type 1 (simple password). Before specifying plain-text password authentication for an area, configure a password with the ip ospf authentication-key interface command. This password is inserted into the OSPF

header when routing protocol packets are originated by this device. Assign a separate password to each area for different interfaces.

- When using simple password authentication, a password is included in the packet. If it does not match the password configured on the receiving router, the packet is discarded. This method provides very little security as it is possible to learn the authentication key by snooping on routing protocol packets.
- When using Message-Digest 5 (MD5) authentication, the router uses the MD5 algorithm to verify data integrity by creating a 128-bit message digest from the authentication key. Without the proper key and key-id, it is nearly impossible to produce any message that matches the pre-specified target message digest.
- Before specifying MD5 authentication for an area, configure the message-digest key-id and key with the ip ospf message-digest-key interface command.
- The plain-text authentication-key, or the MD5 *key-id* and *key*, must be used consistently throughout the autonomous system.

Example

This example enables message-digest authentication for the specified area.

```
Console(config-router)#area 10.3.0.0 authentication
Console(config-router)#
```

area nssa

This command defines a not-so-stubby area (NSSA). To remove an NSSA, use the **no** form without any optional keywords. To remove an optional attribute, use the **no** form without the relevant keyword.

Syntax

[**no**] **area** *area-id* **nssa**
[**translator-role** [**candidate** | **never** | **always**]] | [**no-summary**]

area-id - Identifies the NSSA. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

translator-role - Indicates NSSA-ABR translator role for Type 5 external LSAs.

candidate - Router translates NSSA LSAs to Type-5 external LSAs if elected.

never - Router never translates NSSA LSAs to Type-5 external LSAs.

always - Router always translates NSSA LSAs to Type-5 external LSAs.

no-summary - Allows an area to retain standard NSSA features, but does not inject inter-area routes into this area.

Command Mode
Router Configuration

Default Setting
No NSSA is configured.

Command Usage
- All routers in a NSSA must be configured with the same area ID.
- External routes advertised into an NSSA can include network destinations outside the AS learned via OSPF, the default route, static routes, routes imported from other routing protocols such as BGP or RIP, and networks directly connected to the router that are not running OSPF.
- NSSA external LSAs (Type 7) are converted by any ABR adjacent to the NSSA into external LSAs (Type-5), and propagated into other areas within the AS.
- Also, note that unlike stub areas, all Type-3 summary LSAs are always imported into NSSAs to ensure that internal routes are always chosen over Type-7 NSSA external routes.
- This router supports up to 16 total areas (either normal transit areas, stubs, or NSSAs).

Example
This example creates a stub area 10.3.0.0, and assigns all interfaces with class B addresses 10.3.x.x to the NSSA. It also instructs the router to generate external LSAs into the NSSA when it is an NSSA ABR or NSSA ASBR.

```
Console(config-router)#area 1 nssa translator-role always no-summary
Console(config-router)#
```

area stub
This command defines a stub area. To remove a stub, use the **no** form without the optional keyword. To remove the summary attribute, use the **no** form with the summary keyword.

Syntax
[**no**] **area** *area-id* **stub** [**no-summary**]

area-id - Identifies the stub area. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

no-summary - Stops an Area Border Router (ABR) from sending summary link advertisements into the stub area.

Command Mode
Router Configuration

Default Setting
No stub is configured.

Summary advertisement are sent into the stub.

Command Usage
- All routers in a stub must be configured with the same area ID.
- Routing table space is saved in a stub by blocking Type-4 AS summary LSAs and Type 5 external LSAs. The default setting for this command completely isolates the stub by blocking Type-3 summary LSAs that advertise the default route for destinations external to the local area or the autonomous system.
- Use the **no-summary** parameter of this command on the ABR attached to the stub to define a totally stubby area. Define an area as a totally stubby area only if routers in the area do not require summary LSAs from other areas.
- Use the area default-cost command to specify the cost of a default summary route sent into a stub by an ABR attached to the stub area.

Example
This example creates a stub area 10.2.0.0, and assigns all interfaces with class B addresses 10.2.x.x to the stub.

```
Console(config-router)#area 10.2.0.0 stub
Console(config-router)#network 10.2.0.0 0.255.255.255 area 10.2.0.0
Console(config-router)#
```

area virtual-link

This command defines a virtual link. To remove a virtual link, use the **no** form with no optional keywords. To restore the default value for an attribute, use the **no** form with the required keyword.

SYNTAX

area *area-id* **virtual-link** *router-id*
[**authentication**] [**dead-interval** *seconds*] [**hello-interval** *seconds*]
[**retransmit-interval** *seconds*] [**transmit-delay** *seconds*]

no area area-id virtual-link *router-id*
[**authentication** | **dead-interval** | **hello-interval** | **retransmit-interval** | **transmit-delay**]

area *area-id* **virtual-link** *router-id*
authentication [**message-digest** | **null**]
[**authentication-key** *key* | **message-digest-key** *key-id* **md5** *key*]

no area *area-id* **virtual-link** *router-id*
authentication [**authentication-key** | **message-digest-key** *key-id*]

area *area-id* **virtual-link** *router-id*
[**authentication-key** *key* | **message-digest-key** *key-id* **md5** *key*]

no area *area-id* **virtual-link** *router-id*
[**authentication-key** | **message-digest-key** *key-id*]

area-id - Identifies the transit area for the virtual link.The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

router-id - Router ID of the virtual link neighbor. This specifies the Area Border Router (ABR) at the other end of the virtual link. To create a virtual link, enter this command for an ABR at both ends of the link. One of the ABRs must be next to the isolated area and the transit area at one end of the link, while the other ABR must be next to the transit area and backbone at the other end of the link.

dead-interval *seconds* - Specifies the time that neighbor routers will wait for a hello packet before they declare the router down. This value must be the same for all routers attached to an autonomous system.
(Range: 1-65535 seconds; Default: 4 x hello interval, or 40 seconds)

hello-interval *seconds* - Specifies the transmit delay between sending hello packets. Setting the hello interval to a smaller value can reduce the delay in detecting topological changes, but will increase the routing traffic. This value must be the same for all routers attached to an autonomous system.
(Range: 1-65535 seconds; Default: 10 seconds)

retransmit-interval *seconds* - Specifies the interval at which the ABR retransmits link-state advertisements (LSA) over the virtual link. The retransmit interval should be set to a conservative value that provides an adequate flow of routing information, but does not produce unnecessary protocol traffic. However, note that this value should be larger for virtual links. (Range: 1-3600 seconds; Default: 5 seconds)

transmit-delay *seconds* - Estimates the time required to send a link-state update packet over the virtual link, considering the transmission and propagation delays. LSAs have their age incremented by this amount before transmission. This value must be the same for all routers attached to an autonomous system. (Range: 1-65535 seconds; Default: 1 second)

authentication - Specifies the authentication mode. If no optional parameters follow this keyword, then plain text authentication is used along with the password specified by the **authentication-key**. If **message-digest** authentication is specified, then the **message-digest-key** and **md5** parameters must also be specified. If the **null** option is specified, then no authentication is performed on any OSPF routing protocol messages.

message-digest - Specifies message-digest (MD5) authentication.

null - Indicates that no authentication is used.

authentication-key *key* - Sets a plain text password (up to 8 characters) that is used by neighboring routers on a virtual link to generate or verify the authentication field in protocol message headers. A separate password can be assigned to each network interface. However, this key must be the same for all neighboring routers on the same network (i.e., autonomous system). This key is only used when authentication is enabled for the backbone.

message-digest-key *key-id* **md5** *key* - Sets the key identifier and password to be used to authenticate protocol messages passed between neighboring routers and this router when using message digest (MD5) authentication. The *key-id* is an integer from 0-255, and the *key* is an alphanumeric string up to 16 characters long. If MD5 authentication is used on a virtual link, then it must be enabled on all routers within an autonomous system; and the key identifier and key must also be the same for all routers.

Command Mode

Router Configuration

Default Setting

area-id: None
router-id: None
hello-interval: 10 seconds
retransmit-interval: 5 seconds
transmit-delay: 1 second
dead-interval: 40 seconds
authentication-key: None
message-digest-key: None

Command Usage

- All areas must be connected to a backbone area (0.0.0.0) to maintain routing connectivity throughout the autonomous system. If it not possible to physically connect an area to the backbone, you can use a virtual link. A virtual link can provide a logical path to the backbone for an isolated area, or can be configured as a backup connection that can take over if the normal connection to the backbone fails.

- A virtual link can be configured between any two backbone routers that have an interface to a common non-backbone area. The two routers joined by a virtual link are treated as if they were connected by an unnumbered point-to-point network.
- Any area disconnected from the backbone must include the transit area ID and the router ID for a virtual link neighbor that is adjacent to the backbone.

Example

This example creates a virtual link using the defaults for all optional parameters.

```
Console(config-router)#network 10.4.0.0 0.255.255.0.0 area 10.4.0.0
Console(config-router)#area 10.4.0.0 virtual-link 10.4.3.254
Console(config-router)#
```

This example creates a virtual link using MD5 authentication.

```
Console(config-router)#network 10.4.0.0 0.255.255.0.0 area 10.4.0.0
Console(config-router)#area 10.4.0.0 virtual-link 10.4.3.254 message-digest-
  key 5 md5 ld83jdpq
Console(config-router)#
```

Interface Configuration

ip ospf area

This command assigns a process ID and area ID to an interface. Use the **no** form to disable OSPF on an interface.

Syntax

[**no**] **ip ospf** [*ospf-proc-id*] **area** [*ospf-area-id* | *ip-address*]

ospf-proc-id - Assigns an OSPF process ID to an interface. (Range: 1-65535)

ospf-area-id - Assigns an area ID to an interface. (Range: 0-4294967295)

ip-address - Specifies an OSPF area ID in IPv4 address format.

Command Mode

Interface Configuration (VLAN)

Default Setting

OSPF disabled

Example

```
Console(config)#interface vlan 1
Console(config-if)# ip ospf 1 area 0

Console(config-if)#
```

ip ospf authentication

This command specifies the authentication type used for an interface. Enter this command without any optional parameters to specify plain text (or simple password) authentication. Use the **no** form to restore the default of no authentication.

Syntax

ip ospf authentication [**message-digest** | **null**]

no ip ospf authentication

message-digest - Specifies message-digest (MD5) authentication.

null - Indicates that no authentication is used.

Command Mode

Interface Configuration (VLAN)

Default Setting

No authentication

Command Usage

- Use authentication to prevent routers from inadvertently joining an unauthorized area. Configure routers in the same area with the same password or key. All neighboring routers on the same network with the same password will exchange routing data.
- This command creates a password (key) that is inserted into the OSPF header when routing protocol packets are originated by this device. Assign a separate password to each network for different interfaces.
- When using simple password authentication, a password is included in the packet. If it does not match the password configured on the receiving router, the packet is discarded. This method provides very little security as it is possible to learn the authentication key by snooping on routing protocol packets.
- When using Message-Digest 5 (MD5) authentication, the router uses the MD5 algorithm to verify data integrity by creating a 128-bit message digest from the authentication key. Without the proper key and key-id, it is nearly impossible to produce any message that matches the pre-specified target message digest.
- Before specifying plain-text password authentication for an interface, configure a password with the ip ospf authentication-key command. Before specifying MD5 authentication for an interface, configure the message-digest key-id and key with the ip ospf message-digest-key command.
- The plain-text authentication-key, or the MD5 *key-id* and *key*, must be used consistently throughout the autonomous system.

Example

This example enables message-digest authentication for the specified interface.

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf authentication message-digest
Console(config-if)#
```

ip ospf authentication-key

This command assigns a simple password to be used by neighboring routers to verify the authenticity of routing protocol messages. Use the **no** form to remove the password.

Syntax

ip ospf authentication-key *key*

no ip ospf authentication-key

key - Sets a plain text password. (Range: 1-8 characters)

Command Mode

Interface Configuration (VLAN)

Default Setting

No password

Command Usage

- Before specifying plain-text password authentication for an interface with the ip ospf authentication command, configure a password with this command.
- This command creates a password (key) that is inserted into the OSPF header when routing protocol packets are originated by this device. Assign a separate password to each network for different interfaces. All neighboring routers on the same network with the same password will exchange routing data.
- A different password can be assigned to each network interface, but the password must be used consistently on all neighboring routers throughout a network (i.e., autonomous system).

Example

This example sets a password for the specified interface.

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf authentication-key badboy
Console(config-if)#
```

ip ospf cost

This command explicitly sets the cost of sending a protocol packet on an interface, where higher values indicate slower ports. Use the **no** form to restore the default value.

Syntax

ip ospf cost *cost*

no ip ospf cost

cost - Link metric for this interface. Use higher values to indicate slower ports. (Range: 1-65535)

Command Mode

Interface Configuration (VLAN)

Default Setting

1

Command Usage

- The interface cost indicates the overhead required to send packets across a certain interface. This is advertised as the link cost in router link state advertisements.
- Routes are assigned a metric equal to the sum of all metrics for each interface link in the route.
- This router uses a default cost of 1 for all port types. Therefore, if any VLAN contains 10 Gbps ports, you may want to reset the cost for other VLANs which do not contain 10 Gbps ports to a value greater than 1.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf cost 10
Console(config-if)#
```

ip ospf dead-interval

This command sets the interval at which hello packets are not seen before neighbors declare the router down. Use the **no** form to restore the default value.

Syntax

ip ospf dead-interval *seconds*

no ip ospf dead-interval

seconds - The maximum time that neighbor routers can wait for a hello packet before declaring the transmitting router down. This interval must be set to the same value for all routers on the network. (Range: 1-65535)

Command Mode
Interface Configuration (VLAN)

Default Setting
40, or four times the interval specified by the ip ospf hello-interval command.

Command Usage
The dead-interval is advertised in the router's hello packets. It must be a multiple of the hello-interval and be the same for all routers on a specific network.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf dead-interval 50
Console(config-if)#
```

ip ospf hello-interval

This command specifies the interval between sending hello packets on an interface. Use the **no** form to restore the default value.

Syntax

ip ospf hello-interval *seconds*

no ip ospf hello-interval

seconds - Interval at which hello packets are sent from an interface. This interval must be set to the same value for all routers on the network. (Range: 1-65535)

Command Mode
Interface Configuration (VLAN)

Default Setting
10 seconds

Command Usage
Hello packets are used to inform other routers that the sending router is still active. Setting the hello interval to a smaller value can reduce the delay in detecting topological changes, but will increase routing traffic.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf hello-interval 5
Console(config-if)#
```

ip ospf message-digest-key

This command enables message-digest (MD5) authentication on the specified interface and assigns a key-id and key to be used by neighboring routers. Use the **no** form to remove an existing key.

Syntax

ip ospf message-digest-key *key-id* **md5** *key*

no ip ospf message-digest-key *key-id*

key-id - Index number of an MD5 key. (Range: 1-255)

key - Alphanumeric password used to generate a 128 bit message digest or "fingerprint." (Range: 1-16 characters)

Command Mode

Interface Configuration (VLAN)

Default Setting

MD5 authentication is disabled.

Command Usage

- Before specifying MD5 authentication for an interface with the ip ospf authentication command, configure the message-digest key-id and key with this command.
- Normally, only one key is used per interface to generate authentication information for outbound packets and to authenticate incoming packets. Neighbor routers must use the same key identifier and key value.
- When changing to a new key, the router will send multiple copies of all protocol messages, one with the old key and another with the new key. Once all the neighboring routers start sending protocol messages back to this router with the new key, the router will stop using the old key. This rollover process gives the network administrator time to update all the routers on the network without affecting the network connectivity. Once all the network routers have been updated with the new key, the old key should be removed for security reasons.

Example

This example sets a message-digest key identifier and password.

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf message-digest-key 1 md5 aiebel
Console(config-if)#
```

ip ospf network

This command configures the OSPF network type. Use the **no** form to restore the default value.

Syntax

ip ospf network {**broadcast** | **point-to-point**}

no ip ospf network

broadcast - Specifies a broadcast type network connecting more than two devices.

point-to-point - Specifies a point-to-point network connecting two routers.

Command Mode

Interface Configuration (VLAN)

Default Setting

Broadcast

Command Usage

- Broadcast networks, or broadcast multi-access networks, are capable of connecting more than two devices, and all attached devices can receive a single transmitted broadcast packet. OSPF routers on broadcast networks will elect a DR and a BDR. Hello packets are multicast with the AllSPFRouters destination address 224.0.0.5, as are all OSPF packets originated by the DR and BDR. All other routers will multicast link-state update and link-state acknowledgment packets to the reserved class D address 224.0.0.6, known as AllDRouters.

- Point-to-point networks connect a single pair of routers. Valid neighbors on point-to-point networks will always become adjacent. The destination address of OSPF packets on these networks will always be the reserved class D address 224.0.0.5, known as AllSPFRouters. The exception to this rule is retransmitted LSAs, which are always unicast on all network types.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf network point-to-point
Console(config-if)#
```

ip ospf passive

This command suppresses OSPF routing traffic on the specified interface. Use the **no** form to allow routing traffic to be sent and received on the specified interface.

Syntax

[no] ip ospf passive

Command Mode

Interface Configuration (VLAN)

Default Setting

None

Command Usage

You can configure an OSPF interface as passive to prevent OSPF routing traffic from exiting or entering that interface. No OSPF adjacency can be formed if one of the interfaces involved is set to passive mode. The specified interface will appear as a stub in the OSPF domain. Also, if you configure an OSPF interface as passive where an adjacency already exists, the adjacency will drop almost immediately.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf passive
Console(config-if)#
```

ip ospf priority

This command sets the router priority used when determining the designated router (DR) and backup designated router (BDR) for an area. Use the **no** form to restore the default value.

Syntax

ip ospf priority *priority*

no ip ospf priority

priority - Sets the interface priority for this router. (Range: 0-255)

Command Mode

Interface Configuration (VLAN)

Default Setting

1

Command Usage

- A designated router (DR) and backup designated router (BDR) are elected for each OSPF network segment based on Router Priority. The DR forms an active adjacency to all other routers in the network segment to exchange routing topology information. If for any reason the DR fails, the BDR takes over this role.

- Set the priority to zero to prevent a router from being elected as a DR or BDR. If set to any value other than zero, the router with the highest priority will become the DR and the router with the next highest priority becomes the BDR. If two or more routers are tied with the same highest priority, the router with the higher ID will be elected.
- If a DR already exists for a network segment when this interface comes up, the new router will accept the current DR regardless of its own priority. The DR will not change until the next time the election process is initiated.
- Configure router priority for multi-access networks only and not for point-to-point networks.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf priority 5
Console(config-if)#
```

ip ospf retransmit-interval

This command specifies the time between resending link-state advertisements (LSAs). Use the **no** form to restore the default value.

Syntax

ip ospf retransmit-interval *seconds*

no ip ospf retransmit-interval

seconds - Sets the interval at which LSAs are retransmitted from this interface. (Range: 1-65535)

Command Mode

Interface Configuration (VLAN)

Default Setting

5 seconds

Command Usage

- A router will resend an LSA to a neighbor if it receives no acknowledgment after the specified retransmit interval. The retransmit interval should be set to a conservative value that provides an adequate flow of routing information, but does not produce unnecessary protocol traffic. Note that this value should be larger for virtual links.
- Set this interval to a value that is greater than the round-trip delay between any two routers on the attached network to avoid unnecessary retransmissions.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf retransmit-interval 7
Console(config-if)#
```

ip ospf transmit-delay

This command sets the estimated time to send a link-state update packet over an interface. Use the **no** form to restore the default value.

Syntax

ip ospf transmit-delay *seconds*

no ip ospf transmit-delay

seconds - Sets the estimated time required to send a link-state update. (Range: 1-3600 seconds)

Command Mode

Interface Configuration (VLAN)

Default Setting

1 second

Command Usage

- LSAs have their age incremented by this delay before transmission. When estimating the transmit delay, consider both the transmission and propagation delays for an interface. Set the transmit delay according to link speed, using larger values for lower-speed links.

- If this delay is not added, the time required to transmit an LSA over the link is not taken into consideration by the routing process. On slow links, the router may send packets more quickly than devices can receive them. To avoid this problem, use the transmit delay to force the router to wait a specified interval between transmissions.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip ospf transmit-delay 6
Console(config-if)#
```

Display Information

show ip ospf

This command shows basic information about the routing configuration.

Syntax

show ip ospf [*process-id*]

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

Command Mode

Privileged Exec

Example

```
Console#show ip ospf

OSPF Instance: 1

 OSPF Routing Process, Router ID: 100.100.100.253
 Supports only single TOS (TOS0) routes
 This implementation conforms to RFC2328
 RFC1583Compatibility flag is disabled
 OpaqueCapability flag is disabled
 Initial SPF scheduling delay 0 millisec(s)
 Minimum hold time between consecutive SPFs 50 millisec(s)
 Maximum hold time between consecutive SPFs 5000 millisec(s)
 Hold time multiplier is currently 1
 SPF algorithm last executed 9m05s ago
 Last SPF duration 46 usecs
 SPF timer is inactive
 LSA minimum interval 5000 msecs
 LSA minimum arrival 1000 msecs
 Write Multiplier set to 20
 Refresh timer 10 secs
 Maximum multiple paths(ECMP) supported 8
 Administrative distance 110
 This router is an ABR, ABR type is: Alternative Cisco
 This router is an ASBR (injecting external routing information)
 Number of external LSA 1. Checksum Sum 0x0000bdc9
 Number of opaque AS LSA 0. Checksum Sum 0x00000000
 Number of areas attached to this router: 2
 Area ID: 0.0.0.0 (Backbone)
   Number of interfaces in this area: Total: 1, Active: 1
   Number of fully adjacent neighbors in this area: 1
   Area has no authentication
   SPF algorithm executed 20 times
   Number of LSA 4
   Number of router LSA 2. Checksum Sum 0x00012579
   Number of network LSA 0. Checksum Sum 0x00000000
   Number of summary LSA 2. Checksum Sum 0x00016415
   Number of ASBR summary LSA 0. Checksum Sum 0x00000000
   Number of NSSA LSA 0. Checksum Sum 0x00000000
   Number of opaque link LSA 0. Checksum Sum 0x00000000
   Number of opaque area LSA 0. Checksum Sum 0x00000000

 Area ID: 0.0.0.1
   Shortcutting mode: Default, S-bit consensus: no
   Number of interfaces in this area: Total: 1, Active: 1
```

```
   Number of fully adjacent neighbors in this area: 1
   Area has no authentication
   Number of full virtual adjacencies going through this area: 1
   SPF algorithm executed 20 times
   Number of LSA 3
   Number of router LSA 2. Checksum Sum 0x000148cb
   Number of network LSA 1. Checksum Sum 0x0000ce9d
   Number of summary LSA 0. Checksum Sum 0x00000000
   Number of ASBR summary LSA 0. Checksum Sum 0x00000000
   Number of NSSA LSA 0. Checksum Sum 0x00000000
   Number of opaque link LSA 0. Checksum Sum 0x00000000
   Number of opaque area LSA 0. Checksum Sum 0x00000000
Console#
```

show ip ospf border-routers

This command shows entries in the routing table that lead to an Area Border Router (ABR) or Autonomous System Boundary Router (ASBR).

Syntax

show ip ospf [*process-id*] **border-routers**

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

Command Mode

Privileged Exec

Example

```
Console#show ip ospf border-routers

OSPF Instance: 1

============ OSPF router routing table =============
R    100.100.100.254       [10] area: 0.0.0.1, ABR
                           via 192.168.1.254, VLAN1
                           [10] area: 0.0.0.0, ABR

Console#
```

show ip ospf database

This command shows a database summary of OSPF information.

Syntax

show ip ospf [*process-id*] **database** [**self-originate**]

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

self-originate - Shows LSAs originated by this router.

Command Mode

Privileged Exec

Examples

The following shows output for the **show ip ospf database** command.

```
Console#show ip ospf database

OSPF Instance: 1


       OSPF Router with ID (100.100.100.254)

                Router Link States (Area 0.0.0.0)

Link ID         ADV Router      Age  Seq#       CkSum  Link count
100.100.100.253100.100.100.253  612 0x80000005 0xa8ad 1
100.100.100.254100.100.100.254   62 0x8000000a 0xf808 0

                Summary Link States (Area 0.0.0.0)

Link ID         ADV Router      Age  Seq#       CkSum  Route
192.168.1.0    100.100.100.253  623 0x80000001 0xb508 192.168.1.0/24
192.168.1.0    100.100.100.254  612 0x80000001 0xaf0d 192.168.1.0/24

                ASBR-Summary Link States (Area 0.0.0.0)

Link ID         ADV Router      Age  Seq#       CkSum
100.100.100.253100.100.100.254  612 0x80000001 0x54a6

                Router Link States (Area 0.0.0.1)

Link ID         ADV Router      Age  Seq#       CkSum  Link count
100.100.100.253100.100.100.253   72 0x8000000f 0x9d74 1
100.100.100.254100.100.100.254   62 0x8000000a 0xa272 1

                Net Link States (Area 0.0.0.1)

Link ID         ADV Router      Age  Seq#       CkSum
192.168.1.254  100.100.100.254   72 0x80000002 0xce9d

                AS External Link States

Link ID         ADV Router      Age  Seq#       CkSum  Route
10.1.1.0       100.100.100.253  497 0x80000002 0x5a95 E2 10.1.1.0/24 [0x0]

Console#
```

show ip ospf database asbr-summary

This command shows information about Autonomous System Boundary Router summary LSAs.

Syntax

show ip ospf [*process-id*] **database asbr-summary** [*link-state-id* | **self-originate** | **adv-router** *ip-address*]

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

link-state-id - The network portion described by an LSA. The *link-state-id* entered should be:

- An IP network number for Type 3 Summary and External LSAs
- A Router ID for Router, Network, and Type 4 AS Summary LSAs

Also, note that when an Type 5 ASBR External LSA is describing a default route, its *link-state-id* is set to the default destination (0.0.0.0).

self-originate - Shows LSAs originated by this router.

adv-router - IP address of the advertising router. If not entered, information about all advertising routers is displayed.

ip-address - IP address of the specified router. If no address is entered, information about the local router is displayed.

Command Mode
Privileged Exec

Examples
The following shows output for the **show ip ospf database** command.

```
Console#show ip ospf database asbr-summary

OSPF Instance: 1


       OSPF Router with ID (100.100.100.254)


                ASBR-Summary Link States (Area 0.0.0.0)

  LS age: 560
  Options: 0x2  : *|-|-|-|-|-|E|-
  LS Flags: 0xb
  LS Type: summary-LSA
  Link State ID: 100.100.100.253 (AS Boundary Router address)
  Advertising Router: 100.100.100.254
  LS Seq Number: 80000001
  Checksum: 0x54a6
  Length: 28

  Network Mask: /0
        TOS: 0  Metric: 10


                ASBR-Summary Link States (Area 0.0.0.1)

Console#
```

show ip ospf database external

This command shows information about external Link State Advertisements (LSAs) stored in this router's database.

Syntax

show ip ospf [*process-id*] **database external**
[**adv-router** *ip-address* | *link-state-id* | **self-originate**]

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

link-state-id - The network portion described by an LSA. The *link-state-id* entered should be:

- An IP network number for Type 3 Summary and External LSAs
- A Router ID for Router, Network, and Type 4 AS Summary LSAs

Also, note that when an Type 5 ASBR External LSA is describing a default route, its *link-state-id* is set to the default destination (0.0.0.0).

self-originate - Shows LSAs originated by this router.

adv-router - IP address of the advertising router. If not entered, information about all advertising routers is displayed.

ip-address - IP address of the specified router. If no address is entered, information about the local router is displayed.

Command Mode

Privileged Exec

Examples

The following shows output for the **show ip ospf database** command.

```
Console#show ip ospf database external

OSPF Instance: 1


       OSPF Router with ID (100.100.100.253)

                AS External Link States

  LS age: 176
  Options: 0x2  : *|-|-|-|-|-|E|-
  LS Flags: 0xb
  LS Type: AS-external-LSA
  Link State ID: 10.1.1.0 (External Network Number)
  Advertising Router: 100.100.100.253
  LS Seq Number: 80000002
  Checksum: 0x5a95
  Length: 36

  Network Mask: /24
        Metric Type: 2 (Larger than any link state path)
        TOS: 0
```

```
        Metric: 20
        Forward Address: 192.168.1.44
        External Route Tag: 0

Console#
```

show ip ospf database network

This command shows information about network Link State Advertisements (LSAs) stored in the router's database.

Syntax

show ip ospf [*process-id*] **database network** [*link-state-id* | **self-originate** | **adv-router** *ip-address*]

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

link-state-id - The network portion described by an LSA. The *link-state-id* entered should be:

- An IP network number for Type 3 Summary and External LSAs
- A Router ID for Router, Network, and Type 4 AS Summary LSAs

Also, note that when an Type 5 ASBR External LSA is describing a default route, its *link-state-id* is set to the default destination (0.0.0.0).

self-originate - Shows LSAs originated by this router.

adv-router - IP address of the advertising router. If not entered, information about all advertising routers is displayed.

ip-address - IP address of the specified router. If no address is entered, information about the local router is displayed.

Command Mode

Privileged Exec

Examples

The following shows output for the **show ip ospf database network** command.

```
Console#show ip ospf database network

OSPF Instance: 1

       OSPF Router with ID (100.100.100.253)

                Net Link States (Area 0.0.0.0)

                Net Link States (Area 0.0.0.1 [NSSA])

  LS age: 191
```

```
  Options: 0x2  : *|-|-|-|-|-|E|-
  LS Flags: 0x6
  LS Type: network-LSA
  Link State ID: 192.168.1.254 (address of Designated Router)
  Advertising Router: 100.100.100.254
  LS Seq Number: 80000001
  Checksum: 0xd09c
  Length: 32

  Network Mask: /24
        Attached Router: 100.100.100.253

        Attached Router: 100.100.100.254

Console#
```

show ip ospf database nssa-external

This command shows information about NSSA external Link State Advertisements (LSAs) stored in this router's database.

Syntax

show ip ospf [*process-id*] **database nssa-external** [*link-state-id* | **self-originate** | **adv-router** *ip-address*]

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

link-state-id - The network portion described by an LSA. The *link-state-id* entered should be:

- An IP network number for Type 3 Summary and External LSAs
- A Router ID for Router, Network, and Type 4 AS Summary LSAs

Also, note that when an Type 5 ASBR External LSA is describing a default route, its *link-state-id* is set to the default destination (0.0.0.0).

self-originate - Shows LSAs originated by this router.

adv-router - IP address of the advertising router. If not entered, information about all advertising routers is displayed.

ip-address - IP address of the specified router. If no address is entered, information about the local router is displayed.

Command Mode

Privileged Exec

Examples

The following shows output for the **show ip ospf database nssa-external** command.

```
Console#show ip ospf database nssa-external

OSPF Instance: 1
```

```
      OSPF Router with ID (100.100.100.253)


               NSSA-external Link States (Area 0.0.0.0)


               NSSA-external Link States (Area 0.0.0.1 [NSSA])

  LS age: 3
  Options: 0xa  : *|-|-|-|N/P|-|E|-
  LS Flags: 0xb
  LS Type: NSSA-LSA
  Link State ID: 10.1.1.0 (External Network Number for NSSA)
  Advertising Router: 100.100.100.253
  LS Seq Number: 80000002
  Checksum: 0xc520
  Length: 36

  Network Mask: /24
        Metric Type: 2 (Larger than any link state path)
        TOS: 0
        Metric: 20
        NSSA: Forward Address: 192.168.1.44
        External Route Tag: 0

Console#
```

show ip ospf database router

This command shows information about the router's OSPF Link State Advertisements (LSAs) stored in its database.

Syntax

show ip ospf [*process-id*] **database router** [*link-state-id* | **self-originate** | **adv-router** *ip-address*]

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

link-state-id - The network portion described by an LSA. The *link-state-id* entered should be:

- An IP network number for Type 3 Summary and External LSAs
- A Router ID for Router, Network, and Type 4 AS Summary LSAs

Also, note that when an Type 5 ASBR External LSA is describing a default route, its *link-state-id* is set to the default destination (0.0.0.0).

self-originate - Shows LSAs originated by this router.

adv-router - IP address of the advertising router. If not entered, information about all advertising routers is displayed.

ip-address - IP address of the specified router. If no address is entered, information about the local router is displayed.

Command Mode
Privileged Exec

Examples
The following shows output for the **show ip ospf database router** command.

```
Console#show ip ospf database router

OSPF Instance: 1


       OSPF Router with ID (100.100.100.253)


                Router Link States (Area 0.0.0.0)

  LS age: 1136
  Options: 0x2  : *|-|-|-|-|-|E|-
  LS Flags: 0x3
  Flags: 0x3 : ABR ASBR
  LS Type: router-LSA
  Link State ID: 100.100.100.253
  Advertising Router: 100.100.100.253
  LS Seq Number: 80000018
  Checksum: 0x82c0
  Length: 36

   Number of Links: 1

    Link connected to: a Virtual Link
     (Link ID) Neighboring Router ID: 100.100.100.254
     (Link Data) Router Interface address: 192.168.1.253
      Number of TOS metrics: 0
       TOS 0 Metric: 10

Console#
```

show ip ospf database self-originate

This command shows information originated by this router.

Syntax

show ip ospf [*process-id*] **database self-originate**

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

Command Mode
Privileged Exec

Examples
The following shows output for the **show ip ospf database self-originate** command.

```
Console#show ip ospf database self-originate
```

```
OSPF Instance: 1


       OSPF Router with ID (100.100.100.253)

                Router Link States (Area 0.0.0.0)

Link ID         ADV Router      Age  Seq#       CkSum  Link count
100.100.100.253100.100.100.253  923 0x80000018 0x82c0 1

                Summary Link States (Area 0.0.0.0)

Link ID         ADV Router      Age  Seq#       CkSum  Route
192.168.1.0    100.100.100.253  933 0x80000001 0xb508 192.168.1.0/24

                Router Link States (Area 0.0.0.1)

Link ID         ADV Router      Age  Seq#       CkSum  Link count
100.100.100.253100.100.100.253  923 0x80000024 0x8275 1

Console#
```

show ip ospf database summary

This command shows information about OSPF summary Link State Advertisements (LSAs) stored in this router's database.

Syntax

show ip ospf [*process-id*] **database summary** [*link-state-id* | **self-originate** | **adv-router** *ip-address*]

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

link-state-id - The network portion described by an LSA. The *link-state-id* entered should be:

- An IP network number for Type 3 Summary and External LSAs
- A Router ID for Router, Network, and Type 4 AS Summary LSAs

Also, note that when an Type 5 ASBR External LSA is describing a default route, its *link-state-id* is set to the default destination (0.0.0.0).

self-originate - Shows LSAs originated by this router.

adv-router - IP address of the advertising router. If not entered, information about all advertising routers is displayed.

ip-address - IP address of the specified router. If no address is entered, information about the local router is displayed.

Command Mode

Privileged Exec

Examples

The following shows output for the **show ip ospf database summary** command.

```
Console#show ip ospf database summary

OSPF Instance: 1


       OSPF Router with ID (100.100.100.253)


                Summary Link States (Area 0.0.0.0)

  LS age: 796
  Options: 0x2  : *|-|-|-|-|-|E|-
  LS Flags: 0xb
  LS Type: summary-LSA
  Link State ID: 192.168.1.0 (summary Network Number)
  Advertising Router: 100.100.100.253
  LS Seq Number: 80000001
  Checksum: 0xb508
  Length: 28

  Network Mask: /24
        TOS: 0  Metric: 10

  LS age: 961
  Options: 0x2  : *|-|-|-|-|-|E|-
  LS Flags: 0x6
  LS Type: summary-LSA
  Link State ID: 192.168.1.0 (summary Network Number)
  Advertising Router: 100.100.100.254
  LS Seq Number: 80000002
  Checksum: 0xad0e
  Length: 28

  Network Mask: /24
        TOS: 0  Metric: 10


                Summary Link States (Area 0.0.0.1)

Console#
```

show ip ospf interface

This command displays summary information for OSPF interfaces.

Syntax

show ip ospf interface [**vlan** *vlan-id*]

vlan-id - VLAN ID (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#show ip ospf interface

OSPF Instance: 1
```

```
VLAN1 is up
  ifindex 1001, MTU 1500 bytes, BW 0 Mbit <UP,BROADCAST,RUNNING,MULTICAST>
  Internet Address 192.168.1.253/24, Broadcast 192.168.1.255, Area 0.0.0.1
  MTU mismatch detection: enabled
  Router ID 100.100.100.253, Network Type BROADCAST, Cost: 10
  Transmit Delay is 1 sec, State Backup, Priority 1
  Designated Router (ID) 100.100.100.254 Interface Address 192.168.1.254/24
  Backup Designated Router (ID) 100.100.100.253, Interface Address
  192.168.1.253
  Saved Network-LSA sequence number 0x80000003
  Multicast group memberships: OSPFAllRouters OSPFDesignatedRouters
  Timer intervals configured, Hello 10s, Dead 40s, Wait 40s, Retransmit 5
    Hello due in 0.702s
  Neighbor Count is 1, Adjacent neighbor count is 1
VLINK0 is up
  ifindex 0, MTU 1500 bytes, BW 0 Mbit <UP>
  Internet Address 192.168.1.253/24, Peer 192.168.1.254, Area 0.0.0.0
  MTU mismatch detection: enabled
  Router ID 100.100.100.253, Network Type VIRTUALLINK, Cost: 10
  Transmit Delay is 1 sec, State Point-To-Point, Priority 1
  No backup designated router on this network
  Multicast group memberships: <None>
  Timer intervals configured, Hello 10s, Dead 40s, Wait 40s, Retransmit 5
    Hello due in 4.437s
  Neighbor Count is 1, Adjacent neighbor count is 1

Console#
```

show ip ospf neighbor

This command displays information about neighboring routers on each interface within an OSPF area.

Syntax

show ip ospf [*process-id*] **neighbor**

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

Command Mode

Privileged Exec

Example

```
Console#show ip ospf neighbor

OSPF Instance: 1


Neighbor ID     Pri State           Up Time         Dead Time Address         In
terface                         RXmtL RqstL DBsmL
100.100.100.254   1 Full/DROther    6m41s             38.070s 192.168.1.254
  VL
INK0                              0     0     0
100.100.100.254   1 Full/DR         7m01s             33.022s 192.168.1.254
  VL
AN1:192.168.1.253

Console#
```

show ip ospf route

This command displays the OSPF routing table.

Syntax

show ip ospf [*process-id*] **route**

process-id - The ID of the router process for which information will be displayed. (Range: 1-65535)

Command Mode

Privileged Exec

Example

```
Console#show ip ospf route

OSPF Instance: 1

============ OSPF network routing table ============
N    192.168.1.0/24         [10] area: 0.0.0.1
                            directly attached to VLAN1

============ OSPF router routing table =============
R    100.100.100.254        [10] area: 0.0.0.1, ABR
                            via 192.168.1.254, VLAN1
                            [10] area: 0.0.0.0, ABR

============ OSPF external routing table ===========

Console#
```

Open Shortest Path First (OSPFv3)

Table 190: Open Shortest Path First Commands (Version 3)

Command	Function	Mode
router ipv6 ospf	Enables or disables OSPFv3 routing process	GC
area range	Summarizes routes advertised by an ABR	RC
area stub	Defines a stubby area that cannot send or receive LSAs	RC
default-information originate	Generates a default external route into an autonomous system	RC
passive-interface	Suppresses OSPF routing traffic on the specified interface	RC
redistribute	Redistribute routes from one routing domain to another	RC
router-id	Sets the router ID for this device	RC
timers spf	Configures the delay after a topology change and the hold time between consecutive SPF calculations	RC
ipv6 ospf cost	Specifies the cost of sending a packet on an interface	IC
ipv6 ospf dead-interval	Sets the interval at which hello packets are not seen before neighbors declare the router down	IC

Table 190: Open Shortest Path First Commands (Version 3) (Continued)

Command	Function	Mode
ipv6 ospf hello-interval	Specifies the interval between sending hello packets	IC
ipv6 ospf priority	Sets the router priority used to determine the designated router	IC
ipv6 ospf retransmit-interval	Specifies the time between resending a link-state advertisement	IC
ipv6 ospf transmit-delay	Estimates time to send a link-state update packet over an interface	IC
show ipv6 ospf	Displays general information about the routing processes	PE
show ipv6 ospf database	Shows information about different LSAs in the database	PE
show ipv6 ospf database external	Shows the routing information stored in the external OSPFv3 database	PE
show ipv6 ospf database inter-area-prefix	Shows the OSPFv3 inter-area prefix information stored the database	PE
show ipv6 ospf database inter-area-router	Shows the OSPFv3 inter-area router information stored the database	PE
show ipv6 ospf database intra-area-router	Shows the OSPFv3 intra-area router information stored the database	PE
show ipv6 ospf database link	Shows the OSPFv3 link state information stored in this router's database	PE
show ipv6 ospf database network	Shows the OSPFv3 network link information stored in this router's database	PE
show ipv6 ospf database router	Shows the LSAs that have been exchanged between this router and its neighbors	PE
show ipv6 ospf database self-originate	Shows information about LSAs that have been generated by this router itself	PE
show ipv6 ospf interface	Displays interface information	PE
show ipv6 ospf neighbor	Displays neighbor information	PE
show ipv6 ospf route	Displays the OSPF routing table	PE

General Guidelines

Follow these basic steps to configure OSPFv3:

1. Assign an IPv6 link-local address to each VLAN interface that will participate in an OSPF routing process. You can automatically generate a link-local address using the ipv6 enable command, or manually assign an address to an interface using the ipv6 address link-local command.

2. Use the router ipv6 ospf command to create a local OSPF router process and enter router configuration mode.

3. Use the router-id command to assign a unique identifier to the router. Note that the default router ID of "0.0.0.0" cannot be used with the current software version.

router ipv6 ospf

This command creates an Open Shortest Path First (OSPFv3) routing process and enters router configuration mode. Use the **no** form to disable OSPF for all processes or for a specified process.

Syntax

router ipv6 ospf

no router ipv6 ospf

Command Mode

Global Configuration

Default Setting

Disabled

Command Usage

This command is used to enable an OSPFv3 routing process, and to enter router configuration mode.

Example

```
Console(config)#router ipv6 ospf
Console(config-router)#end
Console#show ipv6 ospf
 OSPFv3 Routing Process (0) with Router-ID 0.0.0.0
 Running 00:18:50
 LSA minimum arrival 1000 msecs
 Maximum-paths 8
 Administrative distance 110
 Initial SPF scheduling delay 0 millisec(s)
 Minimum hold time between consecutive SPFs 50 millsecond(s)
 Maximum hold time between consecutive SPFs 5000 millsecond(s)
 Hold time multiplier is currently 1
 SPF algorithm has not been run
 SPF timer is inactive
 Number of AS scoped LSAs is 0
 Number of areas in this router is 0
 Authentication Sequence number info
  Higher sequence no 0, Lower sequence no 0

Console#
```

area range

This command summarizes the routes advertised by an Area Border Router (ABR). Use the **no** form to disable this function.

Syntax

[**no**] **area** *area-id* **range** *ipv6-prefix/prefix-length* {**advertise** | **not-advertise**}

area-id - Identifies an area for which the routes are summarized. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

ipv6-prefix - A full IPv6 address including the network prefix and host address bits.

prefix-length - A decimal value indicating how many contiguous bits (from the left) of the address comprise the prefix (i.e., the portion of the address to summarize).

advertise - Advertises the specified address range.

not-advertise - The summary is not sent, and the routes remain hidden from the rest of the network.

Command Mode
Router Configuration

Default Setting
Disabled

Command Usage
- This command can be used to summarize intra-area routes and advertise this information to other areas through Area Border Routers (ABRs).
- If the network addresses within an area are assigned in a contiguous manner, the ABRs can advertise a summary route that covers all of the individual networks within the area that fall into the specified range using a single **area range** command.
- If routes are set to be advertised by this command, the router will issue a Type 3 summary LSA for each address range specified by this command.
- This router supports up 64 summary routes for area ranges.

Example
This example creates a summary address for all area routes in the range of 73::/8, or all IPv6 address that start with the first byte 73 (hexadecimal).

```
Console(config-router)#area 1 range 73::/8 advertise
Console(config-router)#
```

area stub
This command defines a stub area. To remove a stub, use the **no** form without the optional keyword. To remove the summary attribute, use the **no** form with the summary keyword.

Syntax
[**no**] **area** *area-id* **stub** [**no-summary**]

area-id - Identifies the stub area. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

no-summary - Stops an Area Border Router (ABR) from sending summary link advertisements into the stub area.

Command Mode
Router Configuration

Default Setting
No stub is configured.
Summary advertisement are sent into the stub.

Command Usage
- All routers in a stub must be configured with the same area ID.
- Routing table space is saved by stopping an ABR from flooding Type-4 Inter-Area Router and Type 5 AS-External LSAs into the stub. Since no information on external routes is known inside the stub, an ABR will advertise the default route 0::0/0 using a Type 3 Inter-Area Prefix LSA.
- The default setting for this command blocks Type-4 Inter-Area Router and Type 5 AS-External LSAs. Therefore, any destinations that cannot be matched to an inter-area or intra-area route will have to use the default route.
- Use the **no-summary** parameter of this command on an ABR attached to the stub to define a totally stubby area, blocking all Type 3 network summary LSAs. Define an area as a totally stubby area only if routers in the area do not require summary LSAs from other areas.
- Use the area default-cost command to specify the cost of a default summary route sent into a stub by an ABR attached to the stub area.

Example
This example creates a stub area 2, and makes it totally stubby by blocking all Type 3 summary LSAs.

```
Console(config-router)#area 2 stub no-summary
Console(config-router)#
```

default-information originate

This command generates a default external route into an autonomous system. Use the **no** form to disable this feature.

Syntax

default-information originate [**always**] [**metric** *interface-metric*] [**metric-type** *metric-type*]

no default-information originate [**always** | **metric** | **metric-type**]

always - Always advertise itself as a default external route for the local AS regardless of whether the router has a default route.

interface-metric - Metric assigned to the default route. (Range: 0-16777214)

metric-type - External link type used to advertise the default route. (Options: Type 1, Type 2)

Command Mode

Router Configuration

Default Setting

Disabled
Metric: 20
Metric Type: 2

Command Usage

- If the **always** parameter is not selected, the router can only advertise a default external route into the AS if it has been configured to import external routes through other routing protocols or static routing, and such a route is known. (See the redistribute command.)
- The metric for the default external route is used to calculate the path cost for traffic passed from other routers within the AS out through the ASBR.
- When you use this command to redistribute routes into a routing domain (i.e., an Autonomous System, this router automatically becomes an Autonomous System Boundary Router (ASBR). However, an ASBR does not, by default, generate a default route into the routing domain.
  - If you use the **always** keyword, the router will advertise itself as a default external route into the AS, even if a default external route does not actually exist. To define a default route, use the ipv6 route command.
  - If you do *not* use the **always** keyword, the router can only advertise a default external route into the AS if the redistribute command is used to import external routes via RIP or static routing, and such a route is known.
- Type 1 route advertisements add the internal cost to the external route metric. Type 2 routes do not add the internal cost metric. When comparing Type 2

routes, the internal cost is only used as a tie-breaker if several Type 2 routes have the same cost.

- This command should not be used to generate a default route for a stub. To generate a default route for this area type, use the area stub command.

Example

This example assigns a metric of 20 to the default external route advertised into an autonomous system, sending it as a Type 2 external metric.

```
Console(config-router)#default-information originate metric 20 metric-type 2
Console(config-router)#
```

passive-interface

This command suppresses OSPF routing traffic on the specified interface. Use the **no** form to allow routing traffic to be sent and received on the specified interface.

Syntax

[no] **passive-interface vlan** *vlan-id*

vlan-id - VLAN ID. (Range: 1-4094)

Command Mode

Router Configuration

Default Setting

None

Command Usage

You can configure an OSPF interface as passive to prevent OSPF routing traffic from exiting or entering that interface. No OSPF adjacency can be formed if one of the interfaces involved is set to passive mode. The specified interface will appear as a stub in the OSPF domain. Also, if you configure an OSPF interface as passive where an adjacency already exists, the adjacency will drop almost immediately.

Example

```
Console(config-router)#passive-interface vlan 1
Console(config-router)#
```

redistribute

This command redistributes external routing information from other routing protocols and static routes into an autonomous system. Use the **no** form to disable this feature or to restore the default settings.

Syntax

redistribute {**connected** | **static**} [**metric** *metric-value*] [**metric-type** *type-value*]

no redistribute {**connected** | **static**} [**metric**] [**metric-type**]

connected - Imports all currently connected entries.

static - IPv6 static routes will be imported into this Autonomous System.

metric-value - Metric assigned to all external routes for the specified protocol. (Range: 0-16777214: Default: 20)

type-value

1 - Type 1 external route

2 - Type 2 external route (default) - Routers do not add internal route metric to external route metric.

Command Mode

Router Configuration

Default Setting

redistribution - none
metric-value - 20
type-metric - 2

Command Usage

- This command is used to import routes learned from other routing protocols into the OSPF domain, and to generate AS-external-LSAs.
- When you redistribute external routes into an OSPF autonomous system (AS), the router automatically becomes an autonomous system boundary router (ASBR).
- Metric type specifies the way to advertise routes to destinations outside the AS through External LSAs. When a Type 1 LSA is received by a router, it adds the internal cost to the external route metric. In other words, the cost of the route from any router within the AS is equal to the cost associated with reaching the advertising ASBR, plus the cost of the external route. When a Type 2 LSA is received by a router, it only uses the external route metric to determine route cost.

Example

This example redistributes automatically connected routes as Type 1 external routes.

```
Console(config-router)#redistribute connected metric-type 1
Console(config-router)#
```

router-id

This command assigns a unique router ID for this device within the autonomous system for the current OSPFv3 process. Use the **no** form to restore the default setting.

Syntax

router-id *ip-address*

no router-id

ip-address - Router ID formatted as an IPv4 address.

Command Mode

Router Configuration

Default Setting

None

Command Usage

- This command sets the router ID for the OSPF process specified in the router ipv6 ospf command.
- The router ID must be unique for every router in the autonomous system. (Note that the router ID can also be set to 0.0.0.0 or 255.255.255.255).
- If this router already has registered neighbors, the new router ID will be used when the router is rebooted, or manually restarted by entering the no router ipv6 ospf followed by the router ipv6 ospf command.
- If the priority values of the routers bidding to be the designated router or backup designated router for an area are equal, the router with the highest ID is elected.
- The current routing process will not be enabled until a Router ID is configured with this command.

Example

```
Console(config-router)#router-id 10.1.1.1
Console(config-router)#
```

timers spf

This command configures the delay after receiving a topology change and starting the shortest path first (SPF) calculation, and the hold time between making two consecutive SPF calculations. Use the **no** form to restore the default values.

Syntax

timers spf *spf-delay spf-holdtime spf-maxtime*

no timers spf

spf-delay - The delay after receiving a topology change notification and starting the SPF calculation. (Range: 0-600000 milliseconds)

spf-holdtime - Minimum hold time between two consecutive SPF calculations. (Range: 0-600000 milliseconds)

spf-maxtime - Minimum time between two consecutive SPF calculations. (Range: 0-600000 milliseconds)

Command Mode

Router Configuration

Default Setting

SPF delay: 0 milliseconds
SPF holdtime: 50 milliseconds
SPF maxtime: 5000 milliseconds

Command Usage

- Setting the SPF holdtime to 0 means that there is no delay between consecutive calculations.
- Using a low value for the holdtime allows the router to switch to a new path faster, but uses more CPU processing time.

Example

```
Console(config-router)#timers spf 20
Console(config-router)#
```

ipv6 ospf area

This command binds an OSPF area to the selected interface. Use the **no** form to remove an OSPF area or disable an OSPF process on an interface.

Syntax

[**no**] **ipv6 ospf area** *area-id*

area-id - Area to bind to the current Layer 3 interface. An OSPF area identifies a group of routers that share common routing information. The area ID can be in the form of an IPv4 address or as a four octet unsigned integer ranging from 0-4294967295.

Command Mode
Interface Configuration (VLAN)

Default Setting
None

Command Usage
- An area ID uniquely defines an OSPF broadcast area. The area ID 0.0.0.0 indicates the OSPF backbone for an autonomous system. Each router must be connected to the backbone via a direct connection or a virtual link.
- Set the area ID to the same value for all routers on a network segment.
- The backbone (area 0.0.0.0) must be created before any other area.

Example
This example creates the backbone 0.0.0.0.

```
Console(config)#router ipv6 ospf
Console(config-router)#router-id 192.168.0.2
Console(config-router)#exit
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf area 0
Console(config-if)#
```

ipv6 ospf cost

This command explicitly sets the cost of sending a protocol packet on an interface, where higher values indicate slower ports. Use the **no** form to restore the default value.

Syntax

ipv6 ospf cost *cost*

no ipv6 ospf cost

cost - Link metric for this interface. Use higher values to indicate slower ports. (Range: 1-65535)

Command Mode
Interface Configuration (VLAN)

Default Setting
1

Command Usage
- The interface cost indicates the overhead required to send packets across a certain interface. This is advertised as the link cost in router link state advertisements.

- Routes are assigned a metric equal to the sum of all metrics for each interface link in the route.
- This router uses a default cost of 1 for all interfaces. Therefore, if you install a 10 Gigabit module, you may need to reset the cost for all other VLAN interfaces with only 1 Gbps ports to a value greater than 1 to reflect the actual interface bandwidth.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf cost 10
Console(config-if)#
```

ipv6 ospf dead-interval

This command sets the interval at which hello packets are not seen before neighbors declare the router down. Use the **no** form to restore the default value.

Syntax

ipv6 ospf dead-interval *seconds*

no ipv6 ospf dead-interval

seconds - The maximum time that neighbor routers can wait for a hello packet before declaring the transmitting router down. This interval must be set to the same value for all routers on the network. (Range: 1-65535)

Command Mode

Interface Configuration (VLAN)

Default Setting

40 seconds, or four times the interval specified by the ipv6 ospf hello-interval command.

Command Usage

The dead-interval is advertised in the router's hello packets. It must be a multiple of the hello-interval and be the same for all routers on a specific network.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf dead-interval 50
Console(config-if)#
```

ipv6 ospf hello-interval

This command specifies the interval between sending hello packets on an interface. Use the **no** form to restore the default value.

Syntax

ipv6 ospf hello-interval *seconds*

no ipv6 ospf hello-interval

seconds - Interval at which hello packets are sent from an interface. This interval must be set to the same value for all routers on the network. (Range: 1-65535)

Command Mode

Interface Configuration (VLAN)

Default Setting

10 seconds

Command Usage

Hello packets are used to inform other routers that the sending router is still active. Setting the hello interval to a smaller value can reduce the delay in detecting topological changes, but will increase routing traffic.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf hello-interval 5
Console(config-if)#
```

ipv6 ospf priority

This command sets the router priority used when determining the designated router (DR) and backup designated router (BDR) for an area. Use the **no** form to restore the default value.

Syntax

ipv6 ospf priority *priority* [**instance** *instance-id*]

no ipv6 ospf priority [**instance** *instance-id*]

priority - Sets the interface priority for this router. (Range: 0-255)

instance-id - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-10)

Command Mode

Interface Configuration (VLAN)

Default Setting

1

Command Usage

- A designated router (DR) and backup designated router (BDR) are elected for each OSPF area based on Router Priority. The DR forms an active adjacency to all other routers in the area to exchange routing topology information. If for any reason the DR fails, the BDR takes over this role.
- Set the priority to zero to prevent a router from being elected as a DR or BDR. If set to any value other than zero, the router with the highest priority will become the DR and the router with the next highest priority becomes the BDR. If two or more routers are tied with the same highest priority, the router with the higher ID will be elected.
- If a DR already exists for a network segment when this interface comes up, the new router will accept the current DR regardless of its own priority. The DR will not change until the next time the election process is initiated.
- Configure router priority for multi-access networks only and not for point-to-point networks.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf priority 5
Console(config-if)#
```

ipv6 ospf retransmit-interval

This command specifies the time between resending link-state advertisements (LSAs). Use the **no** form to restore the default value.

Syntax

ipv6 ospf retransmit-interval *seconds*

no ipv6 ospf retransmit-interval

seconds - Sets the interval at which LSAs are retransmitted from this interface. (Range: 1-65535)

Command Mode

Interface Configuration (VLAN)

Default Setting

5 seconds

Command Usage

- A router will resend an LSA to a neighbor if it receives no acknowledgment after the specified retransmit interval. The retransmit interval should be set to a conservative value that provides an adequate flow of routing information, but does not produce unnecessary protocol traffic. Note that this value should be larger for virtual links.

- Set this interval to a value that is greater than the round-trip delay between any two routers on the attached network to avoid unnecessary retransmissions.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf retransmit-interval 7
Console(config-if)#
```

ipv6 ospf transmit-delay

This command sets the estimated time to send a link-state update packet over an interface. Use the **no** form to restore the default value.

Syntax

ipv6 ospf transmit-delay *seconds*

no ipv6 ospf transmit-delay

seconds - Sets the estimated time required to send a link-state update. (Range: 1-3600)

Command Mode

Interface Configuration (VLAN)

Default Setting

1 second

Command Usage

- LSAs have their age incremented by this delay before transmission. When estimating the transmit delay, consider both the transmission and propagation delays for an interface. Set the transmit delay according to link speed, using larger values for lower-speed links.

- If this delay is not added, the time required to transmit an LSA over the link is not taken into consideration by the routing process. On slow links, the router may send packets more quickly than devices can receive them. To avoid this problem, use the transmit delay to force the router to wait a specified interval between transmissions.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 ospf transmit-delay 6
Console(config-if)#
```

show ipv6 ospf

This command shows basic information about the routing configuration.

Command Mode

Privileged Exec

Example

```
Console#show ipv6 ospf
 Routing Process "ospf 1" with ID 0.0.0.0
 Process is not up
 Supports only single TOS(TOS0) routes
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
 Number of incoming concurrent DD exchange neighbors 0/5
 Number of outgoing concurrent DD exchange neighbors 0/5
 Number of external LSA 0. Checksum 0x000000
 Number of opaque AS LSA 0. Checksum 0x000000
 Number of LSA received 0
 Number of areas attached to this router: 0

Console#
```

show ipv6 ospf database

This command shows information about different OSPF Link State Advertisements (LSAs) stored in this router's database.

Syntax

show ipv6 ospf database

Command Mode

Privileged Exec

Examples

The following shows output for the **show ip ospf database** command.

```
Console#show ipv6 ospf database

        Area Scoped Link State Database (Area 0)

Type LSId           AdvRouter       Age   SeqNum                       Payload

        Area Scoped Link State Database (Area 2)

Type LSId           AdvRouter       Age   SeqNum                       Payload
Rtr  0.0.0.0        1.0.0.1         372 80000002               0.0.0.0/0.0.0.3

        I/F Scoped Link State Database (I/F eth3 in Area 0)

Type LSId           AdvRouter       Age   SeqNum                       Payload
Lnk  0.0.0.5        1.0.0.1         447 80000001         fe80::ed9:2bff:feea:3

        I/F Scoped Link State Database (I/F eth2 in Area 2)

Type LSId           AdvRouter       Age   SeqNum                       Payload
Lnk  0.0.0.4        1.0.0.1         385 80000001         fe80::ed9:2bff:feea:2
Lnk  0.0.0.4        1.0.0.1         385 80000001                       1001::
```

```
        AS Scoped Link State Database

Type LSId          AdvRouter       Age   SeqNum                    Payload

Console#
```

show ipv6 ospf database external

This command shows the routing information stored in the external OSPFv3 database.

Syntax

show ipv6 ospf database external

Command Mode

Privileged Exec

Examples

```
Console#show ipv6 ospf database external

        AS Scoped Link State Database

Type             LSId           AdvRouter       Age   SeqNum          Payload
AS-External      0.0.0.1        1.0.0.1         385   80000001        [Payload
  data for AS-External LSA]
AS-External      0.0.0.2        1.0.0.2         386   80000002        [Payload
  data for AS-External LSA]
AS-External      0.0.0.3        1.0.0.3         387   80000003        [Payload
  data for AS-External LSA]

Console#
```

show ipv6 ospf database inter-area-prefix

This command shows the OSPFv3 inter-area prefix information stored in this router's database.

Syntax

show ipv6 ospf database inter-area-prefix

Command Mode

Privileged Exec

Examples

```
Console#show ipv6 ospf database inter-area-prefix

        Area Scoped Link State Database (Area 1)

Type LSId          AdvRouter       Age   SeqNum                    Payload
Inter-Area Prefix Link State Database
Type             LSId           AdvRouter       Age   SeqNum          Payload
AS-External      0.0.0.1        1.0.0.1         385   80000001        [Payload
  data for inter-area-prefix]
```

```
AS-External      0.0.0.2        1.0.0.2         386   80000002        [Payload
  data for inter-area-prefix]
AS-External      0.0.0.3        1.0.0.3         387   80000003        [Payload
  data for inter-area-prefix]

Console#
```

show ipv6 ospf database inter-area-router

This command shows the OSPFv3 inter-area router information stored in this router's database.

Syntax

show ipv6 ospf database inter-area-router

Command Mode

Privileged Exec

Examples

```
Console#show ipv6 ospf database inter-area-router

        Area Scoped Link State Database (Area 1)

Type LSId           AdvRouter       Age   SeqNum                      Payload
Inter-Area-Router 0.0.0.1       1.0.0.1         385   80000001        [Payload
  data for Inter-Area-Router LSA 1]
Inter-Area-Router 0.0.0.2       1.0.0.2         386   80000002        [Payload
  data for Inter-Area-Router LSA 2]
Inter-Area-Router 0.0.0.3       1.0.0.3         387   80000003        [Payload
  data for Inter-Area-Router LSA 3]

Console#
```

show ipv6 ospf database intra-area-router

This command shows the OSPFv3 intra-area router information stored in this router's database.

Syntax

show ipv6 ospf database intra-area-router

Command Mode

Privileged Exec

Examples

```
Console#show ipv6 ospf database intra-area-router

        Area Scoped Link State Database (Area 1)

Type LSId           AdvRouter       Age   SeqNum                      Payload
Intra-Area-Prefix  0.0.0.1        1.0.0.1         385   80000001
  [Payload data for Intra-Area-Prefix LSA 1]
Intra-Area-Prefix  0.0.0.2        1.0.0.2         386   80000002
  [Payload data for Intra-Area-Prefix LSA 2]
```

```
Intra-Area-Prefix  0.0.0.3        1.0.0.3         387   80000003
  [Payload data for Intra-Area-Prefix LSA 3]

Console#
```

show ipv6 ospf database link

This command shows the OSPFv3 link state information stored in this router's database.

Syntax

show ipv6 ospf database link

Command Mode

Privileged Exec

Examples

```
Console#show ipv6 ospf database link

        I/F Scoped Link State Database (I/F eth3 in Area 0)

Type LSId           AdvRouter       Age   SeqNum                      Payload
Lnk  0.0.0.5        1.0.0.1         423 80000002          fe80::ed9:2bff:feea:3
Lnk  0.0.0.3        1.0.0.3        1033 80000001          fe80::e66:a4ff:fe2f:1
Lnk  0.0.0.3        1.0.0.3        1033 80000001                       3001::

        I/F Scoped Link State Database (I/F eth2 in Area 2)

Type LSId           AdvRouter       Age   SeqNum                      Payload
Lnk  0.0.0.4        1.0.0.1         361 80000002          fe80::ed9:2bff:feea:2
Lnk  0.0.0.4        1.0.0.1         361 80000002                       1001::

Console#
```

show ipv6 ospf database network

This command shows the OSPFv3 network link information stored in this router's database.

Syntax

show ipv6 ospf database network

Command Mode

Privileged Exec

Examples

```
Console#show ipv6 ospf database network

        Area Scoped Link State Database (Area 0)

Type LSId           AdvRouter       Age   SeqNum                      Payload
Net  0.0.0.5        1.0.0.1        1059 80000003                      1.0.0.1
Net  0.0.0.5        1.0.0.1        1059 80000003                      1.0.0.3
```

```
        Area Scoped Link State Database (Area 2)

Type LSId           AdvRouter       Age   SeqNum                    Payload

Console#
```

show ipv6 ospf database router

This command shows the LSAs that have been exchanged between this router and its neighbors.

Syntax

show ipv6 ospf database router

Command Mode

Privileged Exec

Examples

```
Console#show ipv6 ospf database router

        Area Scoped Link State Database (Area 0)

Type LSId           AdvRouter       Age   SeqNum                    Payload
Rtr  0.0.0.0        1.0.0.1        1139 80000003              1.0.0.1/0.0.0.5
Rtr  0.0.0.0        1.0.0.3        1120 80000002              1.0.0.1/0.0.0.5

        Area Scoped Link State Database (Area 2)

Type LSId           AdvRouter       Age   SeqNum                    Payload
Rtr  0.0.0.0        1.0.0.1         444 80000003              0.0.0.0/0.0.0.3

Console#
```

show ipv6 ospf database self-originate

This command shows information about LSAs that have been generated by this router itself.

Syntax

show ipv6 ospf database self-originate

Command Mode

Privileged Exec

Examples

```
Console#show ipv6 ospf database self-originate

Area Scoped Link State Database (Area 1)

Type              LSId           AdvRouter       Age   SeqNum          Payload
----              ----           ---------       ---   ------          -------
Self-Originate    0.0.0.1       1.0.0.1         385   80000001       [Payload
  data for Self-Originate LSA 1]
```

```
Self-Originate    0.0.0.2       1.0.0.2        386   80000002       [Payload
  data for Self-Originate LSA 2]
Self-Originate    0.0.0.3       1.0.0.3        387   80000003       [Payload
  data for Self-Originate LSA 3]

AS Scoped Link State Database

Type              LSId          AdvRouter       Age   SeqNum         Payload
----               ----          ---------       ---   ------

Console#
```

show ipv6 ospf interface

This command displays summary information for OSPF interfaces.

Syntax

show ipv6 ospf interface [**vlan** *vlan-id*]

vlan-id - VLAN ID (Range: 1-4094)

Command Mode

Privileged Exec

Example

```
Console#show ipv6 ospf interface vlan 1
 VLAN 1 is up, line protocol is up
 Link local Address FE80::200:E8FF:FE93:82A0/64, Area 0.0.0.0
 Tag 1, Router ID 192.168.0.2, Network Type BROADCAST, Cost: 1
 Transmit Delay is 1 sec, State DR, Priority 1
 Designated Router (ID) 192.168.0.2, Interface Address
  FE80::200:E8FF:FE93:82A0
 No backup designated router on this network
 Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
 Neighbor Count is 0, Adjacent neighbor count is 0
 Hello received 0 sent 92, DD received 0 sent 0
 LS-Req received 0 sent 0, LS-Upd received 0 sent 0
 LS-Ack received 0 sent 0, Discarded 0
Console#
```

show ipv6 ospf neighbor

This command displays information about neighboring routers on each interface within an OSPF area.

Syntax

show ipv6 ospf neighbor

Command Mode

Privileged Exec

Example

```
Console#show ipv6 ospf neighbor

       ID          Pri        State       Interface ID     Interface
--------------- ------ ---------------- --------------- --------------
    192.168.0.2      1          FULL/DR            1001    vlan1
Console#
```

show ipv6 ospf route

This command displays the OSPF routing table.

Syntax

show ipv6 ospf route

Command Mode

Privileged Exec

Example

```
Console#show ipv6 ospf route
Codes: C - connected, S - static, R - RIP, B - BGP
       O - OSPF, IA - OSPF inter area
       N1 - OSPF NSSA external type 1, N2 - OSPF NSSA external type 2
       E1 - OSPF external type 1, E2 - OSPF external type 2
      i - IS-IS, L1 - IS-IS level-1, L2 - IS-IS level-2, ia - IS-IS inter area
C    ::1/128, lo0
O    2001:DB8:2222:7272::/64, VLAN1
C    2001:DB8:2222:7272::/64, VLAN1
?    FE80::/64, VLAN1 inactive
C    FE80::/64, VLAN1
?    FF00::/8, VLAN1 inactive

Console#
```

38 BGPv4 Commands

This section includes commands for Border Gateway Protocol (BGPv4) dynamic routing and policy-based routing maps for BGP.

Table 188: BGP Routing Commands

Command Group	Function
Border Gateway Protocol (BGPv4)	Configures global and interface specific parameters for BGP
Policy-based Routing for BGP	Configures policy-based routing maps for BGP

Border Gateway Protocol (BGPv4)

An autonomous system (AS) functions as a separate routing domain under one administrative authority, which implements its own routing policies. An AS exchanges routing information within its boundaries using Interior Gateway Protocols (IGPs) such as RIP or OSPF, and connects to external organizations or to the Internet using an Exterior Gateway Protocol (EGP). BGP version 4 is the primary EGP deployed on the Internet today.

When connecting to the Internet, external BGP (eBGP) is used. Although BGP is widely used as an exterior gateway protocol (EGP), it is also used in many organizations with complex internal networks. Internal networks can be simplified by exchanging routing information among BGP peers within the same organization through internal BGP (iBGP) peering sessions.

Table 189: Border Gateway Protocol Commands – Version 4

Command	Function	Mode
General Configuration		
router bgp	Enables BGPv4 routing process and enters router configuration mode	GC
bgp as-path access-list	Configures an autonomous system path access list	GC
bgp community-list	Configures a community list	GC
bgp extcommunity-list	Configures an extended community list	GC
ip prefix-list	Configures an address prefix list	GC
aggregate-address	Configures an aggregate address in the routing table	RC
bgp client-to-client reflection	Configures route reflection between clients via route reflector	RC

Table 189: Border Gateway Protocol Commands – Version 4 (Continued)

Command	Function	Mode
bgp cluster-id	Configures cluster identifier for multiple route reflectors in the same cluster	RC
bgp confederation identifier	Configures the identifier for a confederation containing smaller multiple internal autonomous systems	RC
bgp confederation peers	Adds an internal peer autonomous system to a confederation	RC
bgp dampening	Configures route dampening to reduce the propagation of unstable routes	RC
bgp fast-external-failover	Resets sessions for any directly connected external peers if the link goes down	RC
bgp log-neighbor-changes	Enables logging of neighbor resets (that is, up or down status changes)	RC
bgp network import-check	Checks the existence of the next-hop and its accessibility to IGP	RC
bgp router-id	Sets the router ID for this device	RC
bgp conditional-advertisement timer	Sets the interval at which to validate next hop information for BGP routes	RC
network	Specifies a network to advertise	RC
redistribute	Redistribute routes from one routing domain to another	RC
timers bgp	Sets the Keep Alive time used for maintaining connectivity, and the Hold time to wait for Keep Alive messages before declaring a neighbor down	RC
clear ip bgp	Clears connections using hard or soft re-configuration	PE
clear ip bgp ipv4	Clears IPv4 connections using hard or soft re-configuration	PE
clear ip bgp dampening	Clears route dampening information and unsuppresses any suppressed routes	PE
Route Metrics and Selection		
bgp always-compare-med	Allows comparison of the Multi Exit Discriminator (MED) for paths advertised from neighbors in different autonomous systems	RC
bgp bestpath as-path confed	Compare confederation AS path length in addition to external AS path length in the selection of a path	RC
bgp bestpath as-path ignore	Ignores AS path length in the selection of a path	RC
bgp bestpath compare-routerid	Compare similar routes from external peers, and give preference to a route with the lowest router identifier	RC
bgp bestpath med	Enables comparison of MED attribute for paths learned from confederation peers, and the treatment of a route when the MED is missing	RC
bgp default local-preference	Sets the default local preference used for best path selection among local iBGP peers	RC
bgp deterministic-med	Enforces deterministic comparison of the MED attribute between all paths received from the same AS, ensuring that selection of the best path will always be the same, regardless of the order in which the paths are received by the local router	RC

Table 189: Border Gateway Protocol Commands – Version 4 (Continued)

Command	Function	Mode
distance	Sets the administrative distance for a specified external BGP (eBGP) route	RC
distance bgp	Sets the administrative distance for BGP external, internal, and local routes	RC
Neighbor Configuration		
neighbor activate	Enables exchange of routing information with a neighboring router or peer group	RC
neighbor advertisement-interval	Configures the interval between sending update messages to a neighbor	RC
neighbor allowas-in	Configures the number of times the AS path for a received route can contain the same AS number	RC
neighbor attribute-unchanged	Configures certain attributes to be kept unchanged for transparent transmission to the specified neighbor	RC
neighbor capability dynamic	Configures dynamic negotiation of capabilities between neighboring routers	RC
neighbor capability orf prefix-list	Configures negotiation of outbound route filter capabilities with neighboring router	RC
neighbor default-originate	Allows the local router to send a default route to a neighbor	RC
neighbor description	Configures the description of a neighbor or peer group	RC
neighbor distribute-list	Filters route updates to/from a neighbor or peer group	RC
neighbor dont-capability-negotiate	Disables capability negotiation when creating connections	RC
neighbor ebgp-multihop	Allows eBGP neighbors to exist in different segments, and configures the maximum hop count (TTL)	RC
neighbor enforce-first-as	Denies an update received from an external peer that does not list its own autonomous system number at the beginning of the AS path attribute	RC
neighbor enforce-multihop	Enforces the requirement for all neighbors to form multi-hop connections	RC
neighbor filter-list	Filters route updates sent to or received from a neighbor based on an AS path access-list	RC
neighbor interface	Specifies the interface to a neighbor	RC
neighbor maximum-prefix	Sets the maximum number or route prefixes that can be received from a neighbor	RC
neighbor next-hop-self	Configures the local router as the next hop for a neighbor	RC
neighbor override-capability	Overrides the result of capability negotiations, allowing a session to be formed with a peer that does not support capability negotiation	RC
neighbor passive	Passively forms a connection with the specified neighbor, not sending a TCP connection request, but waiting a request from the specified neighbor	RC
neighbor password	Enables MD5 authentication and sets the key for a neighboring router	RC

Table 189: Border Gateway Protocol Commands – Version 4 (Continued)

Command	Function	Mode
neighbor peer-group (Creating)	Configures a router peer group which can be easily configured with the same attributes	RC
neighbor peer-group (Group Members)	Assigns routers to a peer group	RC
neighbor port	Specifies the TCP port number of the partner through which communications are carried	RC
neighbor prefix-list	Configures prefix restrictions applied in inbound/outbound route updates to/from specified neighbors	RC
neighbor remote-as	Configures a neighbor and its AS number, identifying the neighbor as a local AS member	RC
neighbor remove-private-as	Removes private autonomous system numbers from outbound routing updates to an external neighbor	RC
neighbor route-map	Specifies the route mapping policy for inbound/outbound routing updates for specified neighbors	RC
neighbor route-reflector-client	Configures this router as a route reflector and the specified neighbor as its client	RC
neighbor route-server-client	Configures this router as a route server and the specified neighbor as its client	RC
neighbor send-community	Configures the router to send community attributes to a neighbor in peering messages	RC
neighbor shutdown	Closes a neighbor connection without canceling the neighbor configuration	RC
neighbor soft-reconfiguration inbound	Configures the switch to store updates in the inbound message buffer, and perform soft re-configuration from this buffer for specified neighbors when required	RC
neighbor strict-capability-match	Forces strict capability matching when establishing connections	RC
neighbor timers	Sets the Keep Alive time and Hold time used for specified neighbors	RC
neighbor timers connect	Sets the time to wait before attempting to reconnect to a neighbor whose TCP connection has failed	RC
neighbor unsuppress-map	Allows specified suppressed routes to be advertised	RC
neighbor update-source	Specifies the interface to use for a connection, instead of using the nearest interface	RC
neighbor weight	Assigns a weight to a neighbor connection	RC
Display Information		
show ip bgp	Shows entries in the routing table	PE
show ip bgp attribute-info	Shows internal attribute information	PE
show ip bgp community	Shows routes that belong to specified BGP communities	PE
show ip bgp community-info	Shows permitted community messages	PE
show ip bgp community-list	Shows the routes matching a community-list	PE
show ip bgp dampening	Shows dampened routes	PE

Table 189: Border Gateway Protocol Commands – Version 4 (Continued)

Command	Function	Mode
show ip bgp filter-list	Shows routes matching the specified filter list	PE
show ip bgp neighbors	Shows connection information for neighbor sessions	PE
show ip bgp nexthop	Shows BGP scan status	PE
show ip bgp paths	Shows all paths in the database	PE
show ip bgp prefix-list	Shows routes matching the specified prefix-list	PE
show ip bgp regexp	Shows routes matching the AS path regular expression	PE
show ip bgp route-map	Shows routes matching the specified route map	PE
show ip bgp summary	Shows summary information for all connections	PE
show ip community-list	Shows routes permitted by a community list	PE
show ip extcommunity-list	Shows routes permitted by an extended community list	PE
show ip prefix-list	Shows the specified prefix list	PE
show ip prefix-list detail	Shows detailed information for the specified prefix list	PE
show ip prefix-list summary	Shows summary information for the specified prefix list	PE

General Configuration

router bgp

This command enables the Border Gateway Protocol (BGPv4) routing process and enters router configuration mode. Use the **no** form to disable it.

Syntax

[no] **router bgp** *as-number*

as-number – Autonomous system number which identifies this router as a member of the specified domain, and tags routing messages passed to other BGP routers with this number. (Range: 1-4294967295)

Command Mode

Global Configuration

Default Setting

No routing process is defined.

Command Usage

- To enable BGP routing, you must use this command to establish a BGP routing process. After entering this command, the switch enters router configuration mode.

- AS numbers in the range 64512-65535 are normally used for private routing domains, and can be removed from the AS path attribute in outbound routing messages using the neighbor remove-private-as command. Note that AS

number 23456 is reserved for the AS-Transitive attribute which is required when setting up a new BGP speaker.

- Use this command to specify all of the routers within an autonomous system used to exchange interior or exterior BGP routing messages. Repeat this process for any other autonomous system under your administrative control to create a distributed routing core for the exchange of routing information between autonomous systems.

Example

```
Console(config)#router bgp 100
Console(config-router)#
```

bgp as-path access-list

This command configures an autonomous system path access list. Use the **no** form with only the access list name to disable its use, or with all parameters to remove a path attribute from the access list.

Syntax

bgp as-path access-list *access-list-name* [**seq** *sequence-number*] {**deny** | **permit**} *regular-expression*

no bgp as-path access-list *access-list-name* [[**seq** *sequence-number*] {**deny** | **permit**} *regular-expression*]

access-list-name – Name of the access list. (Maximum length: 16 characters, no spaces or other special characters)

sequence-number – Applies a sequence number to the entry. If not specified, the entry is added to the bottom of the list, using a default numbering interval of 5. (Range: 1-4294967295)

deny – Permits access for messages with matching path attribute.

permit – Denies access to messages with matching path attribute.

regular-expression – Autonomous system in the access list expressed as a regular expression[14].

Command Mode

Global Configuration

Default Setting

No AS path access lists are defined.

Command Usage

- If the regular expression in an AS path list is matched, then the deny/permit condition is applied to the routing message.

14. Syntax complies with the IEEE POSIX Basic Regular Expressions (BRE) standard.

- Use this command in conjunction with the neighbor filter-list command to filter route updates sent to or received from a neighbor, or with the match as-path route map command to implement a more comprehensive filter for policy-based routing.

Example

The regular expression in this example uses symbols which instruct the filter to match the character or null string at the beginning and end of an input string.

```
Console(config)#bgp as-path access-list RD deny ^100$
Console(config)#
```

bgp community-list

This command configures a community access list. Use the **no** form with only the access list name to disable its use, or with all parameters to remove a community attribute from the access list.

Syntax

[no] **bgp community-list**
{1-99 | **standard** *community-list-name* [**seq** *sequence-number*] {**deny** | **permit**}
[*AA:NN*] [**internet**] [**local-as**] [**no-advertise**] [**no-export**]} | {100-500 | **expanded** *community-list-name* [**seq** *sequence-number*] {**deny** | **permit**} *regular-expression*}

1-99 – Standard community list number that identifies one or more groups of communities.

standard *community-list-name* – Name of standard access list. A maximum of 16 communities can be configured in a standard community list (Maximum length: 32 characters, no spaces or other special characters)

sequence-number – Applies a sequence number to the entry. If not specified, the entry is added to the bottom of the list, using a default numbering interval of 5. (Range: 1-4294967295)

deny – Denies access to messages with matching community attribute.

permit – Permits access for messages with matching community attribute.

AA:NN – Standard community-number to deny or permit. The 4-byte community number is composed of a 2-byte autonomous system number and a 2-byte network number, separated by one colon. Each 2-byte number can range from 0 to 65535. One or more communities can be entered, separated by a space. Up to 16 community numbers are supported.

internet – Specifies the entire Internet. Routes with this community attribute are advertised to all internal and external peers.

local-as – Specifies the local autonomous system. Routes with this community attribute are advertised only to peers that are part of the local

autonomous system or to peers within a sub-autonomous system of a confederation. These routes are not advertised to external peers or to other sub-autonomous systems within a confederation.

no-advertise – Routes with this community attribute are not advertised to any internal or external peer.

no-export – Routes with this community attribute are advertised only to peers in the same autonomous system or to other sub-autonomous systems within a confederation. These routes are not advertised to external peers.

100-500 – Expanded community list number that identifies one or more groups of communities.

expanded *community-list-name* – Name of expanded access list. (Maximum length: 32 characters, no spaces or other special characters)

regular-expression – Regular expression indicating the community list number or name[14].

Command Mode
Global Configuration

Default Setting
No community lists are defined.

Command Usage
- Standard community lists are used to configure well-known communities or community numbers. Expanded community lists are used to filter communities using a regular expression.
- When multiple values are entered in the same community list, they form a logical AND condition. When multiple values are configured in separate community lists, the form a logical OR condition, where the first list that matches a condition is processed.
- If the criteria specified for a community list is matched, then the deny/permit condition is applied to the routing message.
- If a permit value is applied to a community list, the filter will implicitly deny other community values.
- By default, the internet community is set with a route if no other communities are defined.
- Use this command in conjunction with the neighbor send-community to filter route updates sent to or received from a neighbor, or with the match community route map command to implement a more comprehensive filter for policy-based routing.

Example

This example configures a named standard community list LN that permits routes with community value 100:10, denoting that they come from autonomous system 100 and network 10.

```
Console(config)#bgp community-list standard LN permit 100:10
Console(config)#
```

bgp extcommunity-list

This command configures an extended community access list. Use the **no** form with only the access list name to disable its use, or with the relevant parameters to remove a community attribute from the access list.

Syntax

[no] **bgp extcommunity-list**
{1-99 | **standard** *community-list-name* [**seq** *sequence-number*] {**deny** | **permit**} [{**rt** | **soo**} *extended-community-value*]} |
{100-500 | **expanded** *community-list-name* [**seq** *sequence-number*] {**deny** | **permit**} *regular-expression*}

1-99 – Standard community list number that identifies one or more groups of communities.

standard *community-list-name* – Name of standard access list. A maximum of 16 extended communities can be configured in a standard community list. (Maximum length: 32 characters, no spaces or other special characters)

sequence-number – Applies a sequence number to the entry. If not specified, the entry is added to the bottom of the list, using a default numbering interval of 5. (Range: 1-4294967295)

deny – Denies access to messages with matching extended community attribute.

permit – Permits access for messages with matching extended community attribute.

rt – The route target extended community attribute.

soo – The site of origin extended community attribute.

extended-community-value – The route target or site of origin in one of the following formats:

AAAA:*NN* or *AA*:*NNNN* – Community-number to deny or permit. The community number can either be formatted as a 4-byte autonomous system number and a 2-byte network number, or as a 2-byte autonomous system number and a 4-byte network number, separated

by one colon. Each 2-byte number can range from 0 to 65535, and 4-byte numbers from 0 to 4294967295.

IP:NN – Community to deny or permit. The community number is composed of a 4-byte IP address (representing the autonomous system number) and a 2-byte network number, separated by one colon. The 2-byte network number can range from 0 to 65535.

One or more community numbers can be entered, separated by a space. Up to 3 community numbers are supported.

100-500 – Expanded community list number that identifies one or more groups of communities.

expanded *community-list-name* – Name of expanded access list. (Maximum length: 32 characters, no spaces or other special characters)

regular-expression – Regular expression indicating the community list number or name. Syntax complies with the IEEE POSIX Basic Regular Expressions (BRE) standard.

Command Mode
Global Configuration

Default Setting
No extended community lists are defined.

Command Usage
- Standard community lists are used to configure well-known communities or community numbers. Expanded community lists are used to filter communities using a regular expression.

- When multiple values are entered in the same community list, they form a logical AND condition. When multiple values are configured in separate community lists, the form a logical OR condition, where the first list that matches a condition is processed.

- If the criteria specified for a community list is matched, then the deny/permit condition is applied to the routing message.

- If a permit value is applied to a community list, the filter will implicitly deny other community values.

- The route target (RT) attribute is used to identify sites that may receive routes tagged with a specific route target. Using this attribute allows that route to be placed in per-site forwarding tables used for routing traffic received from the corresponding sites.

- The site of origin (SOO) attribute is used to identify the site from which the provider edge (PE) router learned the route. All routes learned from a particular site are assigned the same site of origin attribute, no matter if a site is connected to a single PE router or multiple PE routers. Filtering based on this

extended community attribute can prevent routing loops from occurring when a site is multi-homed.

- Use this command in conjunction with the neighbor filter-list to filter route updates sent to or received from a neighbor, or with the match extcommunity route map command to implement a more comprehensive filter for policy-based routing.

Example

This example configures a named standard community list LR that permits routes with the route target 100:20, denoting that they destined for the autonomous system 100 and network 20.

```
Console(config)#bgp extcommunity-list standard LP permit soo 100:20
Console(config)#
```

ip prefix-list

This command configures an IP address prefix list. Use the **no** form with only the prefix list name to disable its use, or with the relevant parameters to remove an attribute from the prefix list.

Syntax

[**no**] **ip prefix-list** *prefix-list-name* [**seq** *sequence-number*] {**deny** | **permit**} **any**

[**no**] **ip prefix-list** *prefix-list-name* [**seq** *sequence-number*] {**deny** | **permit**} {*ip-address netmask* | **any**} [**ge** *min-prefix-length*] [**le** *max-prefix-length*]

prefix-list-name – Name of prefix list. (Maximum length: 128 characters, no spaces or other special characters)

sequence-number – Applies a sequence number to the entry. If not specified, the entry is added to the bottom of the list, using a default numbering interval of 5. (Range: 1-4294967295)

deny – Denies access to messages matching specified criteria.

permit – Permits access for messages matching specified criteria.

any – Any matching criteria.

ip-address – An IPv4 address expressed in dotted decimal notation.

netmask – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

ge – The minimum prefix length to match.

le – The maximum prefix length to match.

Command Mode

Global Configuration

Default Setting
No prefix lists are defined.

Command Usage
- Prefix filtering can be performed on an IP address expressed as a classful network, a subnet, or a single host route.
- Prefix lists are checked starting from the lowest sequence number and continues through the list until a match is found. Once an entry is found that covers a network, the permit or deny statement is applied to that network, and the search process stops.
- At least one "permit" statement should be included when more than one entry is defined. Commonly used "Deny" statements can be included at the top of the list to quickly remove unsuitable routing messages. If a list includes all "Deny" statements, then an entry of "permit 0.0.0.0 255.255.255.255 ge 0 le 32" can be included at the bottom of the list to grant passage for all other routing messages.
- A prefix list can be applied to inbound or outbound updates for a specific peer by entering the neighbor prefix-list command, or with the match ip address prefix-list route map command to implement a more comprehensive filter for policy-based routing.

Example
This example denies access to routing messages for the specified address.

```
Console(config)#ip prefix-list LS deny 10.0.0.0 255.0.0.0 ge 14 le 22
Console(config)#
```

aggregate-address
This command configures an aggregate address in the routing table. Use the **no** form to delete an aggregate address.

Syntax
[**no**] **aggregate-address** *ip-address netmask* [**as-set**] [**summary-only**]

ip-address – An IPv4 address expressed in dotted decimal notation.

netmask – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

as-set – Generates autonomous system set information for the AS path attribute, indicating that a route originated in multiple autonomous systems.

summary-only – Sends the summary routes only, ignoring more specific routes.

Command Mode
Router Configuration

Default Setting
No aggregate routes are defined.

Command Usage
- Using this command without any keywords will create an aggregate entry in the routing table if any more specific routes are available in the specified range. The aggregate route does not include any individual route attributes (e.g., AS-Path or Community). It is advertised as coming from this autonomous system and has the atomic aggregate attribute set to indicate that some information may be missing.

- Using the **as-set** keyword creates an aggregate route where the advertised path is an AS-Set that consists of all elements contained in all of paths being summarized. AS-Set information can be used to avoid routing loops because it records where the route has been. If a router notes its own AS number in the AS-Set of the aggregate update, it will drop the aggregate to prevents loop. However, when aggregating tens or hundreds of routes, avoid advertising routing information in this manner, since this route may be frequently withdrawn and updated as AS path reachability information for the summarized routes changes.

- Using the **summary-only** keyword creates the aggregate route, while at the same time suppressing advertisements of more specific routes to all neighbors.

Example
```
Console(config-router)#aggregate-address 100.1.0.0 255.255.0.0 summary-only
Console(config-router)#aggregate-address 100.2.0.0 255.255.0.0 summary-only
  as-set
Console(config-router)#aggregate-address 100.3.0.0 255.255.0.0 as-set
Console(config-router)#end
Console#show ip bgp
BGP table version is 0, local router ID is 192.168.0.4
Status codes: s suppressed, d damped, h history, * valid, > best, i -
  internal,
              r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*>i192.168.0.0/24   0.0.0.0                  0         32768 i
```

bgp client-to-client reflection

This command restores route reflection via this router. Use the **no** form to disable route reflection.

Syntax

[no] bgp client-to-client reflection

Command Mode

Router Configuration

Default Setting

Enabled

Command Usage

- Route reflection from this device is enabled by default, but is only functional if a client has been configured with the neighbor route-reflector-client command.
- Route reflection is not required if all of the routers in an AS are fully meshed as normally required by interior BGP. However, to make interior BGP more scalable, route reflection or confederations can be used. Route reflection uses one or more route reflectors to reflect routes between specified clients within a cluster. Clients within a reflector cluster therefore need not be fully meshed, and the exchange of routing information is thereby reduced since the clients need not communicate with any routers outside of the cluster.
- Routing information from an external BGP router is advertised to all cluster clients and non-client peers. Information from a non-client peer is advertised to all clients. And information from cluster members is reflected to all routing peers, both inside and outside of the cluster. using this model, the local AS can be divided into many clusters.
- Use the bgp cluster-id command to designate route reflectors within the same cluster so that route reflectors can recognize updates from other route reflectors in the same cluster.

Example

```
Console(config-router)#bgp client-to-client reflection
Console(config-router)#
```

bgp cluster-id

This command configures the cluster identifier for multiple route reflectors in the same cluster. Use the **no** form to remove the cluster identifier.

Syntax

bgp cluster-id *cluster-identifier*

no bgp cluster-id

cluster-identifier – The cluster identifier of this router when acting as a route reflector. This identifier can be expressed in the form an IPv4 address or an integer in the range of 1-4294967295.

Command Mode

Router Configuration

Default Setting

The router identifier of a lone route reflector in a cluster.

Command Usage

- A cluster of clients will usually have a single route reflector (RR). In that case, the cluster can be identified by the BGP Identifier of the RR. However, this represents a single point of failure. This command is used to designate multiple route reflectors used within the same cluster so that they can recognize updates from other peer route reflectors and discard them to prevent loopbacks.
- All the route reflectors in the same cluster should be fully meshed and all of them configured with identical sets of client and non-client peers.
- A route reflector uses the non-transitive cluster-list attribute to avoid routing loops. A cluster-list is a sequence of cluster IDs the route has passed through. When a RR reflects a route from its clients to non-client peers, and vice versa, it appends this ID to the cluster list. Using this attribute, an RR can determine if routing information has looped back to the same cluster due to mis-configuration. If the local cluster ID is found in the cluster list, the advertisement is ignored.

Example

```
Console(config-router)#bgp cluster-id 192.168.0.0
Console(config-router)#
```

bgp confederation identifier

This command configures the identifier for a confederation containing smaller multiple internal autonomous systems, and declares this router as a member of the confederation. Use the **no** form to remove the confederation identifier.

Syntax

bgp confederation identifier *as-number*

no bgp confederation identifier

as-number – Autonomous system number which identifies this router as a member of the specified domain, and tags routing messages passed to other BGP routers with this number. (Range: 1-4294967295)

Command Mode

Router Configuration

Default Setting

No confederation identifier is configured.

Command Usage

- BGP confederations are used to reduce the requirement for fully meshed connections between iBGP peers in the same AS. It works by dividing up a large AS into several smaller ASes, where only the peers in the same smaller AS are fully meshed, thus reducing the number of required connections and routing traffic.

- Even though different local confederation peers may have external BGP (eBGP) sessions, they exchange routing information among themselves as if they were iBGP peers. Next hop, Multi Exit Discriminator (MED), and local preference information is preserved. By preserving this information, a single Interior Gateway Protocol (IGP) can be used among the local confederations. When viewed from the outside by external peers, the larger AS is still identified as a single entity or autonomous system.

- Use the bgp confederation peers command to specify the autonomous systems within a confederation.

Example

```
Console(config-router)#bgp confederation identifier 600
Console(config-router)#
```

bgp confederation peers

This command adds an internal peer autonomous system to a confederation. Use the **no** form to remove an autonomous system from a confederation.

Syntax

[no] bgp confederation peers *as-number* [*as-number*] . . . [*as-number*]

as-number – Autonomous system number which identifies this router as a member of the specified domain, and tags routing messages passed to other BGP routers with this number. (Range: 1-4294967295)

Command Mode

Router Configuration

Default Setting

No confederation peer is configured.

Command Usage

- This command is used to add multiple ASes to a confederation. Each AS is fully meshed within itself, and the AS members are visible internally within the confederation.
- Use the bgp confederation identifier command to create a confederation.

Example

This example divides AS 600 into four smaller ASes 101-104, and assigns a neighboring router as a member of the sub-AS 101.

```
Console(config-router)#bgp confederation identifier 600
Console(config-router)#bgp confederation peers 101 102 103 104
Console(config-router)#neighbor 192.168.0.9 remote-as 101
Console(config-router)#
```

bgp dampening

This command configures route dampening to reduce the propagation of unstable routes. Use the **no** form to restore the default settings.

Syntax

bgp dampening [*half-life* [*reuse-limit* [*suppress-limit* *max-suppress-time*]]]

no dampening

half-life – The time after which a penalty is reduced. The penalty value is reduced to half of the previous value after the half-life time expires. (Range: 1-45 minutes)

reuse-limit – The point at which the penalty for a flapping route must fall before a route is unsuppressed. (Range: 1-2000)

suppress-limit – The point at which to start suppressing a route. (Range: 1-2000)

max-suppress-time – The maximum time a route can be suppressed. (Range: 1-255 minutes)

Command Mode
Router Configuration

Default Setting
half-life: 15 minutes
reuse-limit: 750
suppress-limit: 2000
max-suppress-time: 60 minutes (4 x half-life)

Command Usage
- Route dampening is used to reduce the frequency of routing updates due to unstable routes. Dampened routes are not used in the BGP decision process nor installed in the routing table.
- Each time a route flaps, the router assigns the route a penalty of 1000. If BGP receives an attribute change, BGP increases the penalty by 500. Penalties are cumulative, and the penalty for the route is stored in the BGP routing table until it exceeds the suppress limit. At that point, the route state changes to damped.
- Note that route dampening only applies to external BGP routes.

Example
```
Console(config-router)#bgp dampening 20 1200 20000 220
Console(config-router)#
```

bgp fast-external-failover

This command resets sessions for any directly connected external peers if the link goes down. Use the **no** form to disable this feature.

Syntax
[no] bgp fast-external-failover

Command Mode
Router Configuration

Default Setting
Enabled

Command Usage
- This command immediately resets the connection for directly adjacent external peers if the interface goes down for any reason other than TCP timeout.

- If fast external failover is disabled, the routing process waits until the default hold timer expires to reset the session.

Example

```
Console(config-router)#bgp fast-external-failover
Console(config-router)#
```

bgp log-neighbor-changes

This command enables logging of neighbor resets (that is, up or down status changes). Use the **no** form to disable this feature.

Syntax

[no] bgp log-neighbor-changes

Command Mode

Router Configuration

Default Setting

Disabled

Command Usage

- This command helps detect network problems by indicating if a neighbor connection is flapping. A high number of neighbor resets might indicate unacceptable error rates or high packet loss in the network.
- Log messages for neighbor resets are recorded as level 6 messages in the system log file which can viewed using the show log ram command.

Example

```
Console(config-router)#bgp log-neighbor-changes
Console(config-router)#
```

bgp network import-check

This command checks for the existence of the next-hop and its accessibility to an Interior Gateway Protocol. Use the no form to disable this feature.

Syntax

[no] bgp network import-check

Command Mode

Router Configuration

Default Setting

Disabled

Command Usage

By default, BGP will advertise a route regardless of the Interior Gateway Protocol (IGP) in use. This command forces the router to verify the existence of the next hop for an advertised route, and to ensure that the route is accessible to an IGP.

Example

```
Console(config-router)#bgp network import-check
Console(config-router)#
```

bgp router-id

This command sets the router ID for this device. Use the no form to remove this ID.

Syntax

bgp router-id *router-id*

no bgp router-id

router-id – Router ID formatted as an IPv4 address.

Command Mode

Router Configuration

Default Setting

The highest IP address configured for an interface.

Command Usage

- By default, the router ID is automatically set to the highest IP address configured for a Layer 3 interface. This command can be used manually set the router ID to a fixed value.
- The router ID must be unique for every router in the autonomous system. Using the default setting based on the highest interface address ensures that each router ID is unique.
- All neighbor sessions will be reset if the router ID is changed.

Example

```
Console(config-router)#bgp router-id 192.168.0.254
Console(config-router)#
```

bgp conditional-advertisement timer

This command sets the interval at which to validate next hop information for BGP routes. Use the **no** form to restore the default setting.

Syntax

bgp conditional-advertisement timer *time*

no bgp conditional-advertisement timer

time – Next hop validation interval. (Range: 5-240 seconds)

Command Mode

Router Configuration

Default Setting

60 seconds

Command Usage

This command sets the interval at which to check the validity of the next hop for all routes in the routing information database. During the interval between scan cycles, IGP instability or other network problems may cause black holes or routing loops to form.

Example

```
Console(config-router)#bgp conditional-advertisement timer 30
Console(config-router)#
```

network

This command specifies a network to advertise. Use the **no** form to stop advertising a network.

Syntax

network *ip-address* [*netmask*] [**route-map** *map-name* | [**backdoor**]]

no network *ip-address* [*netmask*]

ip-address – IP address of a to advertise.

netmask – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

map-name – Name of the route map. The route map can be used to filter the networks to advertise. (Range: 1-80 characters)

backdoor – Specifies a backdoor route to a BGP border router that provides better information about the network.

Command Mode

Router Configuration

Default Setting
No networks are configured.

Command Usage
- Use this command to specify the networks to advertise to BGP neighbors. BGP networks can be learned from directly connected routes, dynamic routing, or static route sources.
- BGP only sends and receives updates on interfaces specified by this command. If a network is not specified, the interfaces in that network will not be advertised in any BGP updates.
- A backdoor network has an administrative distance of 200, making routes learned through interior gateway protocols (RIP, OSPF, iBGP) preferred. A backdoor network is treated as a local network, except that it not advertised by the local router. A backdoor route should not be sourced at the local router, but should be one that has been learned from external neighbors. However, since these routes are treated as a local network, they are given priority over routes learned through eBGP, even if the distance of the external route is shorter.

Example
```
Console(config-router)#network 172.16.0.0 255.255.0.0
Console(config-router)#
```

redistribute
This command redistributes routes from one routing domain to another. Use the **no** form to stop redistributing an previously configured entry.

Syntax
redistribute {**connected** | **ospf** *process-id* | **rip** | **static**} [**metric** *metric-value*] [**route-map** *map-name*]

no redistribute {**connected** | **ospf** *process-id* | **rip** | **static**} [**metric** *metric-value*] [**route-map** *map-name*]

connected - Imports routes that are established automatically just by enabling IP on an interface.

ospf - External routes will be imported from the Open Shortest Path First (OSPF) protocol into this routing domain.

process-id - The OSPF process ID. (Range: 1-65535)

rip - External routes will be imported from the Routing Information Protocol (RIP) into this routing domain.

static - Static routes will be imported into this routing domain.

metric-value - Metric value assigned to all external routes for the specified protocol. (Range: 1-16)

map-name – Name of the route map. The route map can be used to filter the networks to advertise, and to modify their weight or other attributes. (Range: 1-80 characters)

Command Mode
Router Configuration

Default Setting
No redistribution is configured.

Command Usage
- Use this command to advertise routes that are learned by some other means, such as from another routing protocol or static routing entries. Since all internal routes are maintained by interior gateway protocols such as RIP and OSPF, careful filtering should be used to ensure that only routes that need to be advertised reach the Internet.
- A route metric must be used to resolve the problem of redistributing external routes with incompatible metrics.

Example
```
Console(config-router)#redistribute static metric 10
Console(config-router)#
```

timers bgp
This command sets the Keep Alive time used for maintaining connectivity, and the Hold time to wait for Keep Alive or Update messages before declaring a neighbor down. Use the **no** form to restore the default settings.

Syntax
timers bgp *keepalive-time hold-time*

no timers bgp

keepalive-time – The frequency at which the local router sends keep-alive messages to its neighbors. (Range: 0-65535 seconds)

hold-time – The maximum interval after which a neighbor is declared dead if a keep-alive or update message has not been received. (Range: 0-65535 seconds)

Command Mode
Router Configuration

Default Setting
Keep Alive time: 60 seconds
Hold time: 180 seconds

Command Usage

- Use this command to set global BGP timers used for monitoring connectivity to neighboring routers. These timers will be applied to all neighbors unless the neighbor timers command has been used to explicitly configure other timer settings for a neighbor.

- When the minimum acceptable hold-time is configured with this command, a remote peer session can be established only if the neighboring router is advertising a hold-time equal to, or greater than, that configured on this device.

Example

```
Console(config-router)#timers bgp 60 200
Console(config-router)#
```

clear ip bgp

This command clears connections using hard or soft re-configuration.

Syntax

clear ip bgp {* | *as-number* | **external** | **peer-group** *group-name* | *neighbor-address*} [**in** [**prefix-list**] | **out** | **soft** [**in** | **out**]]

* – All BGP peering sessions.

as-number – All peering sessions within this autonomous system number. (Range: 1-4294967295)

external – All eBGP peering sessions.

peer-group *group-name* – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

neighbor-address – IPv4 address of a neighbor.

in – Inbound sessions.

prefix-list – The outbound route filter (ORF) prefix list. This option triggers a new route refresh or soft re-configuration, which updates the ORF prefix list. This option is ignored unless ORF capabilities have been enabled using the neighbor capability orf prefix-list command or ORF capability information has been received from a sending peer. If ignored, a normal inbound soft reset is performed.

out – Outbound sessions.

soft – Uses soft re-configuration for the reset, which does not tear down the session.

Command Mode

Privileged Exec

Default Setting

None

Command Usage

- Use this command to initiate a hard reset or soft re-configuration. A hard reset clears and rebuilds specified peering sessions and routing tables. Soft re-configuration uses stored information to reconfigure and activate routing tables without clearing existing sessions. It uses stored update information to allow you to apply a new BGP policy without disrupting the network.

- To generate new inbound updates from stored information without resetting peer sessions, you must preconfigure the local router using the neighbor capability orf prefix-list command, which causes the router to store all received updates. Note that storing updates is memory intensive and should only be applied to critical links.

  Outbound soft configuration requires no memory or preconfiguration. Outbound re-configuration can be used on the other side of a peering session to make initiate a new inbound policy on the local side.

- Use this command to clear peering sessions when changes are made to any BGP access lists, weights, or route-maps.

- Route refresh (RFC 2918) allows a router to reset inbound routing tables dynamically by exchanging route refresh requests with peers. Route refresh relies on the dynamic exchange of information with supporting peers. It is advertised through BGP capability negotiation, and all BGP routers must support this capability.

Example

This example assumes that soft re-configuration has been set on the neighboring router.

```
Console(config-router)#clear ip bgp 192.168.0.254 soft in
Console(config-router)#
```

clear ip bgp ipv4

This command clears BGP connections for IPv4 using hard or soft re-configuration.

Syntax

clear ip bgp ipv4 {* | *as-number* | **external** | **peer-group** *group-name* | *neighbor-address*} [**in** [**prefix-list**] | **out** | **soft** [**in** | **out**]]

* – All BGP IPv4 peering sessions.

as-number – All peering sessions within this autonomous system number. (Range: 1-4294967295)

external – All eBGP peering sessions.

peer-group *group-name* – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

neighbor-address – IPv4 address of a neighbor.

in – Inbound sessions.

prefix-list – The outbound route filter (ORF) prefix list. This option triggers a new route refresh or soft re-configuration, which updates the ORF prefix list. This option is ignored unless ORF capabilities have been enabled using the neighbor capability orf prefix-list command or ORF capability information has been received from a sending peer. If ignored, a normal inbound soft reset is performed.

out – Outbound sessions.

soft – Uses soft re-configuration for the reset, which does not tear down the session.

Command Mode

Privileged Exec

Default Setting

None

Command Usage

- Use this command to initiate a hard reset or soft re-configuration. A hard reset clears and rebuilds specified peering sessions and routing tables. Soft re-configuration uses stored information to reconfigure and activate routing tables without clearing existing sessions. It uses stored update information to allow you to apply a new BGP policy without disrupting the network.

- To generate new inbound updates from stored information without resetting peer sessions, you must preconfigure the local router using the neighbor capability orf prefix-list command, which causes the router to store all received updates. Note that storing updates is memory intensive and should only be applied to critical links.

  Outbound soft configuration requires no memory or preconfiguration. Outbound re-configuration can be used on the other side of a peering session to make initiate a new inbound policy on the local side.

- Use this command to clear peering sessions when changes are made to any BGP access lists, weights, or route-maps.

- Route refresh (RFC 2918) allows a router to reset inbound routing tables dynamically by exchanging route refresh requests with peers. Route refresh relies on the dynamic exchange of information with supporting peers. It is advertised through BGP capability negotiation, and all BGP routers must support this capability.

Example

This example assumes that soft re-configuration has been set on the neighboring router.

```
Console(config-router)#clear ip bgp ipv4 192.168.0.254 soft in
Console(config-router)#
```

clear ip bgp dampening

This command clears route dampening information and unsuppresses any currently suppressed routes.

Syntax

clear ip bgp dampening [*ip-address* [*netmask*]]

ip-address – IP address of network or peer router.

netmask – Network mask that identifies the network address bits.

Command Mode

Privileged Exec

Default Setting

None

Example

If no keywords are entered as in this example, route dampening information is cleared for the entire routing table.

```
Console(config-router)#clear ip bgp dampening
Console(config-router)#
```

Route Metrics and Selection

bgp always-compare-med

This command allows comparison of the Multi Exit Discriminator (MED) for paths advertised from neighbors in different autonomous systems. Use the no form to disable this feature.

Syntax

[no] bgp always-compare-med

Command Mode

Router Configuration

Default Setting

Disabled

Command Usage

- The MED is an optional non-transitive[15] attribute used to discriminate among multiple exit points to a neighboring autonomous system. A path with a lower MED is preferred over a path with a higher MED.

- By default, during best-path selection, the MED is compared only among paths from the same autonomous system. This command allows the comparison of MEDs among different paths regardless of the autonomous system from which the paths are received.
- The bgp deterministic-med command can be used to enforce comparison of the MED value between all paths received from within the same autonomous system.

Example

This example assumes that a peer router is advertising the same route prefix through the two ASes (100 and 300) to the same AS (200), each of which carries a different MED.

```
Console(config-router)#bgp always-compare-med
Console(config-router)#
```

bgp bestpath as-path confed

This command compare confederation AS path length in addition to external AS path length in the selection of a path. Use the **no** form to disable this feature.

Syntax

[no] bgp bestpath as-path confed

Command Mode

Router Configuration

Default Setting

Disabled

Example

```
Console(config-router)#bgp bestpath as-path confed
Console(config-router)#
```

bgp bestpath as-path ignore

This command ignores the AS path length in the selection of a path. Use the **no** form to disable this feature.

Syntax

[no] bgp bestpath as-path ignore

Command Mode

Router Configuration

15. If a router does not understand an optional non-transitive attribute, it will be removed.

Default Setting
Disabled

Example

```
Console(config-router)#bgp bestpath as-path ignore
Console(config-router)#
```

bgp bestpath compare-routerid

This command compares similar routes from external peers, and gives preference to a route with the lowest router identifier. Use the **no** form to restore the default setting.

Syntax

[no] bgp bestpath compare-routerid

Command Mode
Router Configuration

Default Setting
When making the best-path selection, the router does not compare identical routes received from different external peers.

Command Usage
Normally, the first route arriving from different external peers (with other conditions equal) will be chosen as the best route. By using this command, the route with lowest router ID will be selected.

Example

```
Console(config-router)#bgp bestpath compare-routerid
Console(config-router)#
```

bgp bestpath med

This command enables comparison of the Multi Exit Discriminator (MED) attribute for paths learned from confederation peers, and the treatment of a route when the MED is missing. Use the **no** form to disable this feature.

Syntax

[no] bgp bestpath med {[confed] [missing-as-worst]}

confed – Compare MED in confederation path.

missing-as-worst – Consider as maximum MED value when missing.

Command Mode
Router Configuration

Default Setting
When making the best-path selection, the router does not consider the MED.

Command Usage
- The MED for paths learned from confederation peers is compared only if no external autonomous systems (AS) appear in the path. If an external AS is within the path, then the external MED is passed transparently through the confederation, and it is not compared.

- If the missing-as-worst option is disabled, the missing MED is assigned a value of 0, making a path missing the MED attribute the best path.

Example
```
Console(config-router)#bgp bestpath med config missing-as-worst
Console(config-router)#
```

bgp default local-preference
This command sets the default local preference used for best path selection among local iBGP peers. Use the **no** form to restore the default setting.

Syntax
bgp default local-preference *preference*

preference – Degree of preference iBGP peers give local routes during BGP best path selection. The higher the value, the more the route is to be preferred. (Range: 0-4294967295)

Command Mode
Router Configuration

Default Setting
100

Command Usage
Local preference is a discretionary attribute applied to a route during the BGP best path selection process. It is exchanged only between iBGP peers, and used to determine local policy.

Example
```
Console(config-router)#bgp default local-preference 100
Console(config-router)#
```

bgp deterministic-med
This command enforces deterministic comparison of the MED attribute between all paths received from the same AS, ensuring that selection of the best path will always be the same, regardless of the order in which the paths are received by the local router. Use the **no** form to disable this feature.

Syntax

[no] bgp deterministic-med

Command Mode

Router Configuration

Default Setting

Disabled

Command Usage

- The MED is compared after BGP attributes weight, local preference, AS-path and origin have been compared and are equal. When deterministic comparison of the MED is enabled, all paths for the same route prefix (received from peers within the same AS) are grouped together and arranged according to their MED value. Based on this comparison, the best path is then chosen.
- The router immediately groups and sorts all local paths when this command is entered. For correct results, deterministic comparison of the MED must be configured in the same manner (enabled or disabled) on all routers in the local AS.
- If deterministic comparison of the MED is not enabled, route selection can be affected by the order in which routes are received.
- This command compares the MED when choosing routes advertised by different peers in the same AS. To compare the MED when choosing routes from neighbors in different ASs, use the bgp always-compare-med command.

Example

```
Console(config-router)#bgp deterministic-med
Console(config-router)#
```

distance

This command sets the administrative distance for a specified external BGP (eBGP) routes. Use the no form to restore the default setting.

Syntax

distance *distance ip-address netmask* [*access-list-name*]

no distance *ip-address netmask*

distance – Administrative distance for an eBGP route. (Range: 1-255)

ip-address – IP address of a route entry.

netmask – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

access-list-name – Name of standard or extended access list. (Maximum length: 16 characters, no spaces or other special characters)

Command Mode
Router Configuration

Default Setting
None

Command Usage
- The route distance indicates the trustworthiness of a router. The higher the distance the lower the trust rating. A distance of 255 means that the routing source cannot be trusted and should be ignored.
- This distance set by this command only applies to external BGP paths routes learned from a neighbor outside of the AS. Use the distance bgp command to configure the global setting for the distance of eBGP, iBGP, and local routes.
- If an access-list is specified, it will be applied to received routes. If the received routes are not matched in the access-list or the specified list does not exist, the original distance value will be used.

Example
```
Console(config-router)#distance 90 10.1.1.64 255.255.255.255
Console(config-router)#
```

distance bgp
This command sets the administrative distance for external BGP, internal BGP, and local routes. Use the **no** form to restore the default settings.

Syntax
distance bgp *ebgp-distance ibgp-distance local-distance*

no distance bgp

ebgp-distance – Administrative distance for eBGP routes. (Range: 1-255)

ibgp-distance – Administrative distance for iBGP routes. (Range: 1-255)

local-distance – Administrative distance for local routes. (Range: 1-255)

Command Mode
Router Configuration

Default Setting
eBGP: 20
iBGP: 200
local: 200

Command Usage

- External routes are learned from an external autonomous system, and internal routes from a peer within the local autonomous system. Local routes are those configured with the network command as a back door for the router or for the networks being redistributed from another routing process.
- The route distance indicates the trustworthiness of a router. The higher the distance the lower the trust rating. A distance of 255 means that the routing source cannot be trusted and should be ignored.
- This command can be used to indicate that another protocol can provide a better route to a node than that learned via eBGP, or to indicate that some internal routes should be preferred by BGP.
- Changing the administrative distance of iBGP routes is not recommended. It may cause an accumulation of routing table inconsistencies which can break routing to many parts of the network.

Example

```
Console(config-router)#distance bgp 20 200 20
Console(config-router)#
```

Neighbor Configuration

neighbor activate

This command enables the exchange of routing information with a neighboring router or peer group. Use the **no** form to disable the exchange of routing information.

Syntax

[**no**] **neighbor** {*ip-address* | *group-name*} **activate**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode

Router Configuration

Default Setting

Enabled

Command Usage

- After a connection is opened with a neighboring router, this command is used to enable the exchange of information with the neighbor.
- The exchange of information is enabled by default for each routing session configured with the neighbor remote-as command.

Example

```
Console(config-router)#neighbor 10.1.1.64 activate
Console(config-router)#
```

neighbor advertisement-interval

This command configures the interval between sending update messages to a neighbor. Use the **no** form to restore the default setting.

Syntax

neighbor *ip-address* **advertisement-interval** *interval*

no neighbor *ip-address* **advertisement-interval**

ip-address – IP address of a neighbor.

interval – The minimum interval between sending routing updates to the specified neighbor. (Range: 0-600 seconds)

Command Mode

Router Configuration

Default Setting

iBGP: 5 seconds
eBGP: 30 seconds

Command Usage

This command can be used to reduce route flapping. However, the bgp dampening command can provide more precise control of route flapping.

Example

```
Console(config-router)#neighbor 10.1.1.64 advertisement-interval 20
Console(config-router)#
```

neighbor allowas-in

This command configures the number of times the AS path for a received route can contain the same AS number. Use the **no** form to restore the default setting.

Syntax

neighbor {*ip-address* | *group-name*} **allowas-in** [*count*]

no neighbor {*ip-address* | *group-name*} **allowas-in**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

count – Maximum number of times the same AS number can appear in the AS path of a received route. (Range: 1-10, or 3 if the count is not undefined)

Command Mode
Router Configuration

Default Setting
No repeats allowed

Command Usage
Under standard routing practices, BGP will not accept a route sent from a neighbor if the same AS number appears in the AS path more than once. This could indicate a routing loop, and the route message would therefore be dropped. However, for purposes of traffic engineering (such as degrading the preference for a certain path), this command can be used to configure the number of times the same AS is allowed re-appear in the AS path of a route received from a neighbor.

Example

```
Console(config-router)#neighbor 10.1.1.64 allowas-in 5
Console(config-router)#
```

neighbor attribute-unchanged

This command configures certain route attributes to be kept unchanged for transparent transmission to the specified neighbor. Use the **no** form to disable this feature.

Syntax

[**no**] **neighbor** {*ip-address* | *group-name*} **attribute-unchanged** [**as-path**] [**med**] [**next-hop**]

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

as-path – AS path attribute

med – Multi-Exit Discriminator (MED) attribute

next-hop – Next hop attribute

Command Mode
Router Configuration

Default Setting
Disabled

Command Usage
If this command is entered without specifying any route attributes, then all three optional attributes are used.

Example

```
Console(config-router)#neighbor 10.1.1.64 attribute-unchanged
Console(config-router)#
```

neighbor capability dynamic

This command configures dynamic negotiation of capabilities between neighboring routers. Use the **no** form to disable this feature.

Syntax

[no] **neighbor** {*ip-address* | *group-name*} **capability dynamic**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode

Router Configuration

Default Setting

Disabled

Command Usage

- BGP normally requires a router to terminate a peering session if it receives an OPEN message with an unrecognized optional parameter. This command allows new capabilities to be introduced gracefully, without requiring a peering session to be terminated if a negotiated capability is unknown.
- With dynamic negotiation of capabilities is enabled, the capabilities by both sides are negotiated in OPEN messages, with the partner responding if a capability is supported or sending a NOTIFICATION if not.

Example

```
Console(config-router)#neighbor 10.1.1.64 capability dynamic
Console(config-router)#
```

neighbor capability orf prefix-list

This command configures the negotiation of outbound route filter (ORF) capabilities with a neighboring router. Use the **no** form to disable negotiation.

Syntax

[no] **neighbor** {*ip-address* | *group-name*} **orf prefix-list** {**both** | **receive** | **send**}

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

both – Capability to send and receive the ORF to/from this neighbor.

receive – Capability to receive the ORF from this neighbor.

send – Capability to send the ORF to this neighbor.

Command Mode
Router Configuration

Default Setting
Disabled

Command Usage
When this command is entered, the side configured with inbound prefix-list filter rules will transmit its own rules to the peer, and the peer will then use these rules as its own outbound rules, thereby avoiding sending routes which will be denied by its partner.

Example

```
Console(config-router)#neighbor 10.1.1.64 orf prefix-list both
Console(config-router)#
```

neighbor default-originate

This command allows the local router to send a default route to a neighbor. Use the **no** form to disable this feature.

Syntax

neighbor {*ip-address* | *group-name*} **default-originate** [**route-map** *map-name*]

no neighbor {*ip-address* | *group-name*} **default-originate**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

map-name – Name of the route map. The route map can be used to filter the criteria used for sending the default route to a neighbor. (Range: 1-80 characters)

Command Mode
Router Configuration

Default Setting
Disabled

Command Usage
- This command is used to advertise the local router's default route (0.0.0.0) to a neighbor. This route can be used by the neighbor to reach the local router if no other routes are available.

- If several neighbors supply a default route to the same partner, the best one will be elected according to the standard path selection process.
- If a route map is specified, the default route 0.0.0.0 is advertised if the route map contains a match ip address clause and there is a route that matches an entry in the ip prefix-list.

Example

```
Console(config-router)#neighbor 10.1.1.64 default-originate
Console(config-router)#
```

neighbor description

This command configures the description of a neighbor or peer group. Use the **no** form to remove a description.

Syntax

neighbor {*ip-address* | *group-name*} **description** *description*

no neighbor {*ip-address* | *group-name*} **description**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

description – Descriptive string. (Range: 1-80 characters)

Command Mode

Router Configuration

Default Setting

No description specified

Example

```
Console(config-router)#neighbor 10.1.1.64 description bill's router
Console(config-router)#
```

neighbor distribute-list

This command filters route updates to/from a neighbor or peer group. Use the **no** form to remove this list.

Syntax

neighbor {*ip-address* | *group-name*} **distribute-list** *access-list-name* {**in** | **out**}

no neighbor {*ip-address* | *group-name*} **distribute-list** {**in** | **out**}

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

access-list-name – Name of standard or extended access list. (Maximum length: 32 characters, no spaces or other special characters)

in – Filters inbound routing messages.

out – Filters outbound routing messages.

Command Mode
Router Configuration

Default Setting
None

Command Usage
- If the specified access list for input or output mode does not exist, all input or output route updates will be filtered.
- The neighbor prefix-list and the neighbor distribute-list commands are mutually exclusive for a BGP peer. That is, only one of these commands may be applied in the inbound or outbound direction.

Example
```
Console(config-router)#neighbor 10.1.1.64 distribute-list RD in
Console(config-router)#
```

neighbor dont-capability-negotiate

This command disables capability negotiation when creating connections. Use the **no** form to restore the default setting.

Syntax
[**no**] **neighbor** {*ip-address* | *group-name*} **dont-capability-negotiate**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode
Router Configuration

Default Setting
Capability negotiation is enabled

Command Usage
Earlier versions of BGPv4 require that when a BGP speaker receives an Open message with one or more unrecognized Optional Parameters, the speaker must terminate BGP peering. This command can be used when connecting to a partner known to use an older BGP version which does not support capabilities negotiation (RFC 2842), thereby allowing the peering session to continue.

Example

```
Console(config-router)#neighbor 10.1.1.64 dont-capability-negotiate
Console(config-router)#
```

neighbor ebgp-multihop

This command allows eBGP neighbors to exist in different segments, and configures the maximum hop count (TTL). Use the **no** form to restore the default setting.

Syntax

neighbor {*ip-address* | *group-name*} **ebgp-multihop** [*count*]

no neighbor {*ip-address* | *group-name*} **ebgp-multihop**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

count – Maximum hop count. (Range: 1-255)

Command Mode

Router Configuration

Default Setting

eBGP neighbors must be located in the same segment.

Command Usage

- This command can be used to allow routers in different network segments to create a BGP neighbor relationship.
- If this command is entered without specifying a count, the hop limit is set at 255.
- To avoid creating loops through oscillating routes, a multi-hop session will not be established if the only route to a multi-hop peer is the default route.

Example

```
Console(config-router)#neighbor 10.1.1.64 ebgp-multihop 2
Console(config-router)#
```

neighbor enforce-first-as

This command denies an update received from an external peer that does not list its own autonomous system number at the beginning of the AS path attribute. Use the **no** form to disable this feature.

Syntax

[no] **neighbor enforce-first-as**

Command Mode
Router Configuration

Default Setting
Disabled

Command Usage
This command can be used to prevent a peer from misdirecting traffic by advertising a route as if sourced from another autonomous system.

Example

```
Console(config-router)#neighbor enforce-first-as
Console(config-router)#
```

neighbor enforce-multihop

This command enforces the requirement for all neighbors to form multi-hop connections. Use the **no** form to disable this requirement.

Syntax

[no] **neighbor** {*ip-address* | *group-name*} **enforce-multihop**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode
Router Configuration

Default Setting
Not enforced

Command Usage
By default, the multi-hop check is only performed on iBGP and eBGP non-direct routes. This command can be used to force the router to perform the multi-hop check on directly connected routes as well. In other words, the router will not perform the next-hop direct-connect check the specified neighbor.

Example

```
Console(config-router)#neighbor 10.1.1.64 enforce-multihop
Console(config-router)#
```

neighbor filter-list

This command filters route updates sent to or received from a neighbor based on an AS path access-list. Use the **no** form to disable route filtering.

Syntax

neighbor {*ip-address* | *group-name*} **filter-list** *access-list* {**in** | **out**}

no neighbor {*ip-address* | *group-name*} **filter-list** {**in** | **out**}

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

access-list – Name of an AS-Path access list configured with the bgp as-path access-list command.

in – Filter inbound routing updates.

out – Filter outbound routing updates.

Command Mode
Router Configuration

Default Setting
Disabled

Command Usage
Use this command in conjunction with the bgp as-path access-list command to filter route updates sent to or received from a neighbor.

Example
In this example, the AS path access list "ASPF" is first configured to deny access to any route passing through AS 100. It then enables route filtering by assigning this list to a peer.

```
Console(config)#ip as-path access-list ASPF deny 100
Console(config)#router bgp 100
Console(config-router)#redistribute static
Console(config-router)#neighbor 10.1.1.66 filter-list ASPF out
Console(config-router)#
```

neighbor interface

This command specifies the interface to a neighbor. Use the **no** form to remove this configuration setting.

Syntax

neighbor *ip-address* **interface vlan** *vlan-id*

no neighbor *ip-address* **interface**

ip-address – IP address of a neighbor.

vlan-id - VLAN ID. (Range: 1-4094)

Command Mode
Router Configuration

Default Setting
None

Example

```
Console(config-router)#neighbor 10.1.1.64 interface vlan 1
Console(config-router)#
```

neighbor maximum-prefix

This command sets the maximum number or route prefixes that can be received from a neighbor. Use the **no** form to restore the default setting.

Syntax

neighbor {*ip-address* | *group-name*} **maximum-prefix** *max-count* [*threshold* [**restart** *interval* | **warning-only**]]

no neighbor {*ip-address* | *group-name*} **maximum-prefix**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

max-count – The maximum number of route prefixes that will be accepted from a neighbor. (Range: 1-4294967295)

threshold – The percentage of the maximum number of allowed prefixes at which the router will initiate the specified response.

restart – Restarts BGP connection after the threshold is exceeded.

interval – Time to wait after a BGP connection has been terminated, before reestablishing the session. (Range: 1-65535 minutes)

warning-only – Sends a log message if the threshold is exceeded.

Command Mode
Router Configuration

Default Setting
No limit is set

Command Usage

- This command is used to control the maximum number of route prefixes that can be sent by a neighbor. It provides a method to reserve resources for other processes, or to prevent malicious attacks.
- If the threshold is specified, but neither the **restart** nor **warning-only** keywords are used), the connection will be closed until the records are cleared with the clear ip bgp command.

Example

In this example, the router warns when the number of route prefixes reaches 6, and the connection will be closed when the prefixes hit 13.

```
Console(config-router)#neighbor 10.1.1.64 maximum-prefix 12 50
Console(config-router)#
```

neighbor next-hop-self

This command configures the local router as the next hop for a neighbor in all routing messages it sends. Use the **no** form to disable this feature.

Syntax

[no] **neighbor** {*ip-address* | *group-name*} **next-hop-self**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode

Router Configuration

Default Setting

Disabled

Command Usage

- iBGP routers only connected to other iBGP routers in same segment will not be able to talk with iBGP routers outside of the segment if they are not directly connected with each other. This command can be used in these kinds of networks (i.e., un-meshed or non-broadcast) where iBGP neighbors may not have direct access to all other neighbors on the same IP subnet.

- Even when a successful BGP relationship seems to have been established within the local AS, you may not able to see some routes in the routing table. iBGP routers only connected with other iBGP routers in same AS will not be able to talk with routers outside of the AS if they are not directly connected with each other. The **neighbor next-hop-self** command can be used to configure an iBGP router which is directly connected with an eBGP neighbor so that other iBGP routers in the same AS can talk with eBGP routers outside the AS.

Example

```
Console(config-router)#neighbor 10.1.1.64 next-hop-self
Console(config-router)#
```

neighbor override-capability

This command overrides the result of capability negotiations, allowing a session to be formed with a peer that does not support capability negotiation. Use the **no** form to disable this feature.

Syntax

[no] **neighbor** {*ip-address* | *group-name*} **override-capability**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode

Router Configuration

Default Setting

Disabled

Example

```
Console(config-router)#neighbor 10.1.1.64 override-capability
Console(config-router)#
```

neighbor passive

This command passively forms a connection with the specified neighbor, not sending a TCP connection request, but waiting a connection request from the specified neighbor. Use the **no** form to disable this feature.

Syntax

[no] **neighbor** {*ip-address* | *group-name*} **passive**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode

Router Configuration

Default Setting

Disabled

Command Usage

This command configures the local router so that it remains in Active state, waiting for an inbound connection request from a neighbor, and not initiating any outbound connections with the neighbor via an Open message.

Example

```
Console(config-router)#neighbor 10.1.1.64 passive
Console(config-router)#
```

neighbor password

This command enables message-digest (MD5) authentication for the specified neighbor and assigns a password (key) to be used. Use the **no** form to remove an existing key.

Syntax

neighbor {*ip-address* | *group-name*} **password** *password*

no neighbor {*ip-address* | *group-name*} **password**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

password - Alphanumeric password used to generate a 128 bit message digest or "fingerprint." (Range: 1-16 characters)

Command Mode

Router Configuration

Default Setting

No authentication

Command Usage

- When MD5 authentication is configured on a TCP connection between two peers, neighbor authentication occurs whenever routing updates are exchanged. Authentication must be configured with the same password on both peers; otherwise, the connection between them will not be made.

- If you configure or change the password used for MD5 authentication between two peers, the local router will not tear down the existing session after you configure the password. It will attempt to maintain the peering session using the new password until the BGP hold timer expires. If the password is not entered or changed on the remote router before the hold timer expires, the session will time out.

Example

```
Console(config-router)#neighbor 10.1.1.64 password frost
Console(config-router)#
```

neighbor peer-group (Creating)

This command configures a router peer group which can be easily configured with the same attributes. Use the **no** form to remove a peer group.

Syntax

[no] **neighbor** *group-name* **peer-group**

group-name – A BGP peer group. (Range: 1-256 characters)

Command Mode

Router Configuration

Default Setting

No peer groups are defined.

Command Usage

- Neighbors with the same BGP attributes can grouped into peer groups. This simplifies the application of various policies, such as filter lists. Other configuration settings can be applied to a peer-group using any of the neighbor commands. Any changes made to the peer group affect all members.Use this command to create a peer-group.
- To assign members to a peer group, use the neighbor *ip-address* peer-group *group-name* command.

Example

```
Console(config-router)#neighbor RD peer-group
Console(config-router)#
```

neighbor peer-group (Group Members)

This command assigns routers to a peer group. Use the **no** form to remove a group member.

Syntax

[no] **neighbor** *ip-address* **peer-group** *group-name*

ip-address – IP address of a neighbor.

group-name – A BGP peer group.

Command Mode

Router Configuration

Default Setting

No group members are defined.

Command Usage

To create a peer group, use the neighbor *group-name* peer-group command.

Example

```
Console(config-router)#neighbor 10.1.1.64 peer-group RD
Console(config-router)#
```

neighbor port

This command specifies the TCP port number of the partner through which communications are carried. Use the **no** form to restore the default setting.

Syntax

neighbor *ip-address* **port** *port-number*

no neighbor *ip-address* **port**

ip-address – IP address of a neighbor.

port-number – TCP port number to use for BGP communications. (Range: 0-65535)

Command Mode

Router Configuration

Default Setting

179

Example

```
Console(config-router)#neighbor 10.1.1.64 port 1023
Console(config-router)#
```

neighbor prefix-list

This command configures prefix restrictions applied in inbound/outbound route updates to/from specified neighbors. Use the **no** form to remove the neighbor binding for a prefix list.

Syntax

neighbor {*ip-address* | *group-name*} **prefix-list** *list-name* {**in** | **out**}

no neighbor {*ip-address* | *group-name*} **prefix-list** {**in** | **out**}

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

list-name – Name of a prefix-list. The prefix list can be used to filter the networks to import or export. (Range: 1-80 characters)

in – Filter inbound routing updates.

out – Filter outbound routing updates.

Command Mode
Router Configuration

Default Setting
No prefix list restrictions are configured.

Command Usage
- First, configure a prefix list with the ip prefix-list command, and then use this command to specify the neighbors to which it applies, and whether it applies to inbound or outbound messages.
- Filtering routes based on a prefix list searches for entries matching the router specified by this command. If a match is found and the entry is configured to permit the route, the route will be imported or exported as defined by this command. An empty prefix list permits all prefixes. If a prefix does not match any entries in a list, the route is denied. When multiple entries in the list match a prefix, the entry with the smallest sequence number is used.
- The search starts at the top of the prefix list. Once an entry matches, the router stops searching. To reduce the load on system resources, the most commonly used entries should be placed at the top of the list.

Example

```
Console(config)#ip prefix-list RD permit 100.1.0.0 255.255.0.0 ge 17 le 18
Console(config)#router bgp 200
Console(config-router)#redistribute static
Console(config-router)#neighbor 10.1.1.66 prefix-list RD out
Console(config-router)#
```

neighbor remote-as

This command configures a neighbor and its AS number, identifying the neighbor as an iBGP or eBGP peer. Use the **no** form to remove a neighbor.

Syntax

neighbor {*ip-address* | *group-name*} **remote-as** *as-number*

no neighbor {*ip-address* | *group-name*} **remote-as**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

as-number – Autonomous system number which identifies this router as a member of the specified domain, and tags routing messages passed to other BGP routers with this number. (Range: 1-4294967295)

Command Mode
Router Configuration

Default Setting
No neighbors are configured.

Command Usage
- BGP neighbors must be manually configured. A neighbor relationship can only be established if partners are configured on both sides a connection.
- If the neighbor's AS number is the same as that of the local router, the neighbor is an iBGP peer. If it is different, the neighbor is an eBGP peer.

Example
```
Console(config-router)#neighbor 10.1.1.64 remote-as 100
Console(config-router)#
```

neighbor remove-private-as

This command removes private autonomous system numbers from outbound routing updates to an external neighbor. Use the **no** form to disable this feature.

Syntax
neighbor {*ip-address* | *group-name*} **remove-private-as**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode
Router Configuration

Default Setting
Disabled

Command Usage
- This command only applies to eBGP neighbors. It is used to avoid passing an internal AS number to an external AS. Internal AS numbers range from 64512-65535, and should not be sent to the Internet since they are not valid external AS numbers.
- This configuration only takes effect when the AS Path attribute of a route contains only internal AS numbers. If the AS Path attribute for a route contains both internal and external AS numbers, the route will not be processed.
- This command may be used in BGP confederations provided that the private AS numbers appear after the confederation portion of the AS path.

Example
```
Console(config-router)#neighbor 10.1.1.64 remove-private-as
Console(config-router)#
```

neighbor route-map

This command specifies the route mapping policy for inbound/outbound routing updates for specified neighbors. Use the **no** form to remove this policy binding.

Syntax

neighbor {*ip-address* | *group-name*} **route-map** *map-name* {**in** | **out**}

no neighbor {*ip-address* | *group-name*} **route-map** {**in** | **out**}

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

map-name – Name of the route map. The route map can be used to filter the networks to advertise or receive based on various attributes. (Range: 1-128 characters)

in – Filter inbound routing updates.

out – Filter outbound routing updates.

Command Mode

Router Configuration

Default Setting

No route maps are configured nor bound to any neighbor.

Command Usage

- First, use route-map command to create a route map, and the **match** and **set** commands to configure the route attributes to act upon. Then use this command to specify neighbors to which the route map is applied.
- If the specified route map does not exist, all input/output route updates will be filtered.

Example

```
Console(config-router)#neighbor 10.1.1.64 route-map RD in
Console(config-router)#
```

neighbor route-reflector-client

This command configures this router as a route reflector and the specified neighbor as its client. Use the **no** form to disable route reflection for the specified neighbor.

Syntax

[**no**] **neighbor** {*ip-address* | *group-name*} **route-reflector-client**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode
Router Configuration

Default Setting
Disabled

Command Usage
- Route reflection from this device is enabled by default, but is only functional if a client has been configured with this command.

- Under standard configuration rules, all BGP speakers within the same AS must be fully meshed. Route reflection can used to reduce the number of connections required between peers. Reflector clients exchange messages only with the route reflector, while the reflector handles message exchanges among each client and other iBGP, eBGP, and non-client routers. For more information on configuring route reflection, refer to the Command Usage section under the bgp client-to-client reflection command.

Example
```
Console(config-router)#neighbor 10.1.1.64 route-reflector-client
Console(config-router)#
```

neighbor route-server-client

This command configures this router as a route server and the specified neighbor as its client. Use the **no** form to disable the route server for the specified neighbor.

Syntax
[no] **neighbor** {*ip-address* | *group-name*} **route-server-client**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode
Router Configuration

Default Setting
None

Command Usage
- A route server is used as a replacement for full mesh eBGP routing in internet exchange points in a manner similar to the way route reflectors are used in iBGP. Instead of maintaining direct eBGP peering sessions with every other service provider, providers can acquire the same routing information through a single connection to a route server at the Internet exchange.

- Using a route server reduces the configuration complexity required for an eBGP full mesh, limits CPU and memory requirements for the exchange of peering messages, and avoids the need for negotiating a large number of individual peering agreements.

Example

In the following example, the router 10.1.1.64 (AS100) is configured as the route server for neighbors 10.1.1.66 (AS200) and 10.1.1.68 (AS300).

```
Console(config)#router bgp 100
Console(config-router)#neighbor 10.1.1.66 remote-as 200
Console(config-router)#neighbor 10.1.1.66 route-server-client
Console(config-router)#neighbor 10.1.1.68 remote-as 300
Console(config-router)#neighbor 10.1.1.68 route-server-client
Console(config-router)#
```

neighbor send-community

This command configures the router to send community attributes to a neighbor in peering messages. Use the **no** form to stop sending this attribute to a neighbor.

Syntax

[no] **neighbor** {*ip-address* | *group-name*} **send-community** [**both** | **extended** | **standard**]

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

both – Sends both extended and standard community attributes.

extended – Sends extended community attributes.

standard – Standard community attributes.

Command Mode

Router Configuration

Default Setting

No community attributes are sent. If community type is not specified, then only standard community attributes are sent.

Command Usage

Community attributes are used to group destinations into a certain community, and apply routing decisions to the overall community.

Example

```
Console(config-router)#neighbor 10.1.1.66 send-community extended
Console(config-router)#
```

neighbor shutdown

This command closes a neighbor connection without canceling the neighbor configuration. Use the **no** form to restore the connection.

Syntax

[no] **neighbor** {*ip-address* | *group-name*} **shutdown**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode

Router Configuration

Default Setting

None

Command Usage

- This command terminates any active sessions for the specified neighbor, and removes any associated routing information.
- Use the show ip bgp summary command display the neighbors which have been administratively shut down. Entries with in an Idle (Admin) state have been disabled by the **neighbor shutdown** command.

Example

```
Console(config-router)#neighbor 10.1.1.66 shutdown
Console(config-router)#
```

neighbor soft-reconfiguration inbound

This command configures the switch to store updates in the inbound message buffer, and perform soft re-configuration from this buffer for specified neighbors when required. Use the **no** form to disable this feature.

Syntax

[no] **neighbor** {*ip-address* | *group-name*} **soft-reconfiguration inbound**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode

Router Configuration

Default Setting

Disabled

Command Usage

- Use this command to employ soft reconfiguration for a neighbor. A hard reset clears and rebuilds specified peering sessions and routing tables. Soft reconfiguration uses stored information to reconfigure and activate routing tables without clearing existing sessions. It uses stored update information to allow you to restore a connection or to apply a new BGP policy without disrupting the network. Note that outbound soft reconfiguration does not require inbound soft reconfiguration to be enabled.

- The command is only available when route refresh capability is not enabled. Route refresh (RFC 2918) allows a router to reset inbound routing tables dynamically by exchanging route refresh requests with peers. Route refresh relies on the dynamic exchange of information with supporting peers. It is advertised through BGP capability negotiation, and all BGP routers must support this capability.

- To use soft reconfiguration, without preconfiguration, both BGP neighbors must support the soft route refresh capability advertised in open messages sent when a BGP session is established. To see if a BGP router supports this capability, use the show ip bgp neighbors command.

Example

```
Console(config-router)#neighbor 11.1.1.120 soft-reconfiguration inbound
Console(config-router)#
```

neighbor strict-capability-match

This command forces strict capability matching when establishing connections. Use the **no** form to disable this requirement.

Syntax

[**no**] **neighbor** {*ip-address* | *group-name*} **strict-capability-match**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

Command Mode

Router Configuration

Default Setting

Disabled

Command Usage

This command specifies that a connection can only be established when the both sides have perfectly matching capabilities.

Example

```
Console(config-router)#neighbor 10.1.1.66 strict-capability-match
Console(config-router)#
```

neighbor timers

This command sets the Keep Alive time and Hold time used for specified neighbors. Use the **no** form to restore the default settings.

Syntax

[**no**] **neighbor** {*ip-address* | *group-name*} **timers** *keepalive-time hold-time*

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

keepalive-time – The frequency at which the local router sends keep-alive messages to its neighbors. (Range: 0-65535 seconds)

hold-time – The maximum interval after which a neighbor is declared dead if a keep-alive or update message has not been received. (Range: 0-65535 seconds)

Command Mode

Router Configuration

Default Setting

Keep Alive time: 60 seconds
Hold time: 180 seconds

Command Usage

- This command sets the Keep Alive time used for maintaining connectivity, and the Hold time to wait for Keep Alive or Update messages before declaring a neighbor down.
- This command sets timers for monitoring connectivity to specific neighboring routers, which supersedes those applied to all neighbors with the global timers bgp command.

Example

```
Console(config-router)#neighbor 10.1.1.66 timers 50 200
Console(config-router)#
```

neighbor timers connect

This command sets the time to wait before attempting to reconnect to a neighbor whose TCP connection has failed. Use the **no** form to restore the default setting.

Syntax

[no] **neighbor** *ip-address* **timers connect** *retry-interval*

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

retry-interval – The amount of time the system waits for the transport protocol connection to complete. If this timer expires, the state remains in Connect state, the timer is reset, and the system tries to initiate a new transport connection. (Range: 1-65535 seconds)

Command Mode

Router Configuration

Default Setting

120 seconds

Command Usage

This command sets the time to wait before attempting to reconnect to a BGP neighbor after having failed to connect. During the idle time specified by the Connect Retry timer, the remote BGP peer can actively establish a BGP session with the local router.

Example

```
Console(config-router)#neighbor 10.1.1.66 timers connect 100
Console(config-router)#
```

neighbor unsuppress-map

This command allows routes suppressed by the aggregate-address (summary-only option) to be advertised to specified neighbors. Use the **no** form to remove this configuration entry.

Syntax

[no] **neighbor** {*ip-address* | *group-name*} **unsuppress-map** *map-name*

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

map-name – Name of the route map. The route map can be used to filter the networks to advertise. (Range: 1-80 characters)

Command Mode

Router Configuration

Default Setting
No exceptions

Command Usage
This command is used to leak routes suppressed by the aggregate-address command (with summary-only option) to specified neighbors. Other routes that meet the route map conditions, but have not been suppressed, will still be sent.

Example

```
Console(config-router)#neighbor 10.1.1.66 unsuppress-map rmp
Console(config-router)#
```

neighbor update-source

This command specifies the interface to use for a TCP connection, instead of using the nearest interface. Use the **no** form to use the default interface.

Syntax

[**no**] **neighbor** {*ip-address* | *group-name*} **update-source interface** {**vlan** *vlan-id* | **loopback** *loopback-id*}

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

vlan-id - VLAN ID. (Range: 1-4094)

loopback-id - Loopback ID. (Range: 0)

Command Mode
Router Configuration

Default Setting
The nearest (best/closest) interface is used.

Command Usage
By default the nearest interface to the neighbor is used for BGP connections. This command can be used to specify any available interface for a TCP connection.

Example

```
Console(config-router)#neighbor 10.1.1.66 update-source interface vlan 1
Console(config-router)#
```

neighbor weight

This command assigns a weight to routes sent from a neighbor. Use the **no** form to restore the default weight.

Syntax

neighbor {*ip-address* | *group-name*} **weight** *weight*

no neighbor {*ip-address* | *group-name*} **weight**

ip-address – IP address of a neighbor.

group-name – A BGP peer group containing a list of neighboring routers configured with the neighbor peer-group command.

weight – The weight to be assigned to routes received from this neighbor. (Range: 0-65535)

Command Mode

Router Configuration

Default Setting

Routes learned from a neighbor: 0
Static routes sourced by the local router: 32768

Command Usage

- Use this command to specify a weight for all the routes learned from a neighbor. The route with the highest weight gets preference over other routes to the same network.
- Weights assigned using the set weight command override those assigned by this command.

Example

```
Console(config-router)#neighbor 10.1.1.66 weight 500
Console(config-router)#
```

Display Information

show ip bgp

This command shows entries in the routing table.

Syntax

show ip bgp [*ip-address/mask* | **cidr-only**]

ip-address – IP address of a route entry.

mask – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

cidr-only – Shows routes that use classless interdomain routing network masks.

Command Mode
Privileged Exec

Example

```
Console#show ip bgp
BGP table version is 14, local router ID is 1.1.1.1, vrf id 0
Default local pref 100, local AS 100
Status codes:  s suppressed, d damped, h history, * valid, > best, =
  multipath,
               i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

   Network          Next Hop            Metric LocPrf Weight Path
*>i1.1.1.0/24       1.1.1.2                  0    100      0 ?
*> 2.2.2.0/24       2.2.2.2                  0             0 200 ?
*> 3.3.3.0/24       2.2.2.2                  0             0 200 ?
*>i4.4.4.0/24       1.1.1.2                  0    100      0 ?
*                   2.2.2.2                  0             0 200 ?
*>i5.5.5.2/32       1.1.1.2                  0    100      0 ?

Displayed  5 routes and 6 total paths
Console#
```

show ip bgp attribute-info

This command shows internal attribute hash information.

Syntax

show ip bgp attribute-info

Command Mode
Privileged Exec

Example
In the following example, Refcnt refers to the number of routes using the indicated next hop.

```
Console#show ip bgp attribute-info

attr[1] nexthop 0.0.0.0
        flags: 15 distance: 0 med: 0 local_pref: 100 origin: 0 weight: 32768
  label: 429
4836223 sid:

Console#
```

show ip bgp community

This command shows routes that belong to specified BGP communities.

Syntax

show ip bgp community [{[*AA*:*NN*] [**internet**] [**local-as**] [**no-advertise**] [**no-export**]} [**exact-match**]]

AA:*NN* – Standard community-number to match. The 4-byte community number is composed of a 2-byte autonomous system number and a 2-byte network number, separated by one colon. Each 2-byte number can range from 0 from 65535. One or more communities can be entered, separated by a space. Up to 16 community numbers are supported.

internet – Specifies the entire Internet. Routes with this community attribute are advertised to all internal and external peers.

local-as – Specifies the local autonomous system. Routes with this community attribute are advertised only to peers that are part of the local autonomous system or to peers within a sub-autonomous system of a confederation. These routes are not advertised to external peers or to other sub-autonomous systems within a confederation.

no-advertise – Routes with this community attribute are not advertised to any internal or external peer.

no-export – Routes with this community attribute are advertised only to peers in the same autonomous system or to other sub-autonomous systems within a confederation. These routes are not advertised to external peers.

exact-match – Displays only routes that match the specified communities exactly.

Command Mode

Privileged Exec

Example

```
Console#show ip bgp community
BGP table version is 12, local router ID is 1.1.1.1, vrf id 0
Default local pref 100, local AS 100
Status codes:  s suppressed, d damped, h history, * valid, > best, =
  multipath,
               i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.10.10.0/24    0.0.0.0                  0         32768 i

Displayed  1 routes and 3 total paths
Console#
```

show ip bgp community-info

This command shows community messages permitted by BGP.

Syntax

show ip bgp community-info

Command Mode

Privileged Exec

Example

```
Console#show ip bgp community-info
Address    Refcnt  Community
[0x3312558](3)     100:50
Console#
```

show ip bgp community-list

This command shows the routes matching a community-list.

Syntax

show ip bgp community-list {*community-list-number* | *community-list-name*} [exact-match]

community-list-number – Standard community list number that identifies one or more groups of communities. (Range: 1-500)

community-list-name – Name of standard or expanded access list. (Maximum length: 32 characters, no spaces or other special characters)

exact-match – Displays only routes that match the specified communities exactly.

Command Mode

Privileged Exec

Example

```
Console#show ip bgp community-list rd
BGP table version is 2, local router ID is 1.1.1.1, vrf id 0
Default local pref 100, local AS 100
Status codes:  s suppressed, d damped, h history, * valid, > best, =
  multipath,
               i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

   Network          Next Hop            Metric LocPrf Weight Path
*> 10.10.10.0/24    0.0.0.0                  0         32768 i

Displayed  1 routes and 2 total paths
Console#
```

show ip bgp dampening

This command shows dampened routes.

Syntax

show ip bgp dampening {dampened-paths | flap-statistics | parameters}

dampened-paths – Routes suppressed due to dampening.

flap-statistics – Statistics for flapping route prefixes.

parameters – Route dampening parameters.

Command Mode

Privileged Exec

Example

In the following example, "From" indicates the peer that advertised this path, while "Reuse" is the time after which the path will be made available.

```
Console#show ip bgp dampening dampened-paths
BGP table version is 2, local router ID is 1.1.1.1, vrf id 0
Default local pref 100, local AS 100
Status codes:  s suppressed, d damped, h history, * valid, > best, =
  multipath,
               i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

   Network            From                 Reuse    Path
*d 100.1.3.0/24     10.1.1.64            00:27:40 100 ?

Displayed  1 routes and 3 total paths
Console#
```

show ip bgp filter-list

This command shows routes matching the specified filter list.

Syntax

show ip bgp filter-list *access-list-name*

access-list-name – Name of a list of autonomous system paths as defined by the bgp as-path access-list command. (Maximum length: 16 characters, no spaces or other special characters)

Command Mode

Privileged Exec

Example

```
Console#show ip bgp filter-list rd
BGP table version is 2, local router ID is 11.1.1.100
Status codes: s suppressed, d damped, h history, * valid, > best, i -
  internal,
```

```
              S Stale
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*> 100.1.1.0/24     10.1.1.64                0             0 100 ?

Displayed  1 routes and 3 total paths
Console#
```

show ip bgp neighbors

This command chows connection information for neighbor sessions.

Syntax

show ip bgp neighbors [*ip-address* [**advertised-routes** | **received prefix-filter** | **received-routes** | **routes**]]

ip-address – IP address of the neighbor.

advertised-routes – Shows the routes advertised to a neighbor.

received prefix-filter – Shows the prefix-list (outbound route filter) sent from a neighbor.

received-routes – Shows all routes, both accepted and rejected, which have been received from a neighbor. To display all received routes from a neighbor, first enable soft reconfiguration with the neighbor soft-reconfiguration inbound command.

routes – Displays all accepted routes learned from a neighbor.

Command Mode

Privileged Exec

```
Console#show ip bgp neighbors
BGP neighbor is 10.1.1.66, remote AS 200, local AS 100, external link
  BGP version 4, remote router ID 11.1.1.100
  BGP state = Established, up for 00:13:43
  Last read 00:13:43, hold time is 240, keep alive interval is 60 seconds
  Neighbor capabilities:
    Route refresh: advertised and received (old and new)
    Address family IPv4 Unicast: advertised and received
  Received 17 messages, 0 notifications, 0 in queue
  Sent 17 messages, 0 notifications, 0 in queue
  Route refresh request: received 0, sent 0
  Minimum time between advertisement runs is 30 seconds

 For address family: IPv4 Unicast
  BGP table version 2, neighbor version 2
  Index 1, Offset 0, Mask 0x2
  Community attribute sent to this neighbor (both)
  0 accepted prefixes
  1 announced prefixes

 Connections established 7; dropped 6
Console#
```

show ip bgp nexthop

This command shows the BGP nexthop table.

Syntax

show ip bgp nexthop

Command Mode

Privileged Exec

Example

```
Console#show ip bgp nexthop
Current BGP nexthop cache:
 1.1.1.2 valid [IGP metric 0], #paths 0, peer 1.1.1.2
  if VLAN1
  Last update: Thu Dec  8 06:51:48 2022

 2.2.2.2 valid [IGP metric 0], #paths 0, peer 2.2.2.2
  if VLAN2
  Last update: Thu Dec  8 06:20:22 2022
Console#
```

show ip bgp paths

This command shows all paths in the database.

Syntax

show ip bgp paths

Command Mode

Privileged Exec

Example

```
Console#show ip bgp paths
Address     RefCnt  ASpath
0x331dad0:0      1
0x331d850:93     1  600
0x331d8d8:249    2  200 300
Console#
```

show ip bgp prefix-list

This command shows routes matching the specified prefix-list.

Syntax

show ip bgp prefix-list *list-name*

list-name – Name of a prefix-list. The prefix list can be used to filter the networks to import or export as defined by the match ip address prefix-list command. (Range: 1-80 characters)

Command Mode
Privileged Exec

Example

```
Console#show ip bgp prefix-list rd
BGP table version is 0, local router ID is 192.168.0.2
Status codes: s suppressed, d damped, h history, * valid, > best, i internal,
              r RIB-failure, S Stale, R Removed
Origin codes: i - IGP, e - EGP, ? - incomplete

   Network          Next Hop            Metric LocPrf Weight Path
*  100.1.1.0/24     10.1.1.66                              0 200 300 ?
*>                  10.1.1.100               0         32768 ?
Console#
```

show ip bgp regexp

This command shows routes matching the AS path regular expression.

Syntax

show ip bgp regexp *regular-expression*

regular-expression – Regular expression indicating the path attributes to match. Syntax complies with the IEEE POSIX Basic Regular Expressions (BRE) standard.

Command Mode
Privileged Exec

Example

```
Console#show ip bgp regexp 100
BGP table version is 12, local router ID is 1.1.1.1, vrf id 0
Default local pref 100, local AS 100
Status codes:  s suppressed, d damped, h history, * valid, > best, =
  multipath,
               i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

   Network          Next Hop            Metric LocPrf Weight Path
*  100.1.1.0/24     10.1.1.64                0             0 500 100 600 ?

Displayed  1 routes and 3 total paths
Console#
```

show ip bgp route-map

This command shows routes matching the specified route map.

Syntax

show ip bgp route-map *map-name*

map-name – Name of the route map as defined by the route-map command. The route map can be used to filter the networks to advertise. (Range: 1-80 characters)

Command Mode

Privileged Exec

Example

```
Console#show ip bgp route-map rd
BGP table version is 5, local router ID is 1.1.1.1, vrf id 0
Default local pref 100, local AS 100
Status codes:  s suppressed, d damped, h history, * valid, > best, =
  multipath,
               i internal, r RIB-failure, S Stale, R Removed
Nexthop codes: @NNN nexthop's vrf id, < announce-nh-self
Origin codes:  i - IGP, e - EGP, ? - incomplete
RPKI validation codes: V valid, I invalid, N Not found

   Network          Next Hop            Metric LocPrf Weight Path
*> 5.5.5.1/32       0.0.0.0                  0         32768 ?

Displayed  1 routes and 5 total paths
Console#
```

show ip bgp summary

This command shows summary information for all connections.

Syntax

show ip bgp summary

Command Mode

Privileged Exec

Example

In the following example, "Up/Down" refers to the length of time the session has been in the Established state, or the current status if not in Established state.

```
Console#show ip bgp summary
BGP router identifier 10.1.1.66, local AS number 200
BGP table version is 1
1 BGP AS-PATH entries
0 BGP community entries

Neighbor V AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down State/PfxRcd
10.1.1.68 4 300 0 0 0 0 0 never Active

Total number of neighbors 1
```

```
Console#
```

show ip community-list

This command shows routes permitted by a community list.

Syntax

show ip community-list [*community-list-number* | *community-list-name*]

community-list-number – Standard community list number that identifies one or more groups of communities. (Range: 1-500)

community-list-name – Name of standard or expanded access list. (Maximum length: 32 characters, no spaces or other special characters)

Command Mode

Privileged Exec

Example

```
Console#show ip community-list rd
Named Community standard list rd
    permit 100:10
Console#
```

show ip extcommunity-list

This command shows routes permitted by an extended community list.

Syntax

show ip extcommmunity-list [*community-list-number* | *community-list-name*]

community-list-number – Standard community list number that identifies one or more groups of communities. (Range: 1-500)

community-list-name – Name of standard or expanded access list. (Maximum length: 32 characters, no spaces or other special characters)

Command Mode

Privileged Exec

Example

```
Console#show ip extcommunity-list rd
Named extended community standard list rd
    permit RT:192.168.0.0:10
Console#
```

show ip prefix-list

This command shows the specified prefix list.

Syntax

show ip prefix-list [*prefix-list-name* [*ip-address netmask* [**first-match** | **longer**] | **seq** *sequence-number*]]

prefix-list-name – Name of prefix list. (Maximum length: 128 characters, no spaces or other special characters)

ip-address – An IPv4 address expressed in dotted decimal notation.

netmask – Network mask for the route. This mask identifies the network address bits used for the associated routing entries.

first-match – First matched prefix.

longer – All entries more specific than the specified network/mask.

sequence-number – The sequence number of an entry. (Range: 1-4294967295)

Command Mode

Privileged Exec

Example

```
Console#show ip prefix-list rd
ip prefix-list rd: 1 entries
   seq 5 deny 10.0.0.0/8 ge 14 le 22
Console#
```

show ip prefix-list detail

This command shows detailed information for the specified prefix list.

Syntax

show ip prefix-list detail [*prefix-list-name*]

prefix-list-name – Name of prefix list. (Maximum length: 128 characters, no spaces or other special characters)

Command Mode

Privileged Exec

Example

```
Console#show ip prefix-list detail rd
ip prefix-list rd:
   count: 1, range entries: 0, sequences: 5 - 5
   seq 5 deny 10.0.0.0/8 ge 14 le 22 (hit count: 0, refcount: 0)
Console#
```

show ip prefix-list summary

This command shows summary information for the specified prefix list.

Syntax

show ip prefix-list summary [*prefix-list-name*]

prefix-list-name – Name of prefix list. (Maximum length: 128 characters, no spaces or other special characters)

Command Mode

Privileged Exec

Example

```
Console#show ip prefix-list summary rd
ip prefix-list rd:
   count: 1, range entries: 0, sequences: 5 - 5
Console#
```

Policy-based Routing for BGP

This section describes commands used to configure policy-based routing (PBR) maps for Border Gateway Protocol (BGP).

Policy-based routing is performed before regular routing. PBR inspects traffic on the interface where the policy is applied and then, based on the policy, makes some decision. First, the traffic is "matched" according to the policy. Second, for each match, there is something "set." What is set could be that the traffic matches must exit out a different interface, or the traffic could be given a higher priority, or it could choose to just drop that traffic.

Matching of the traffic is usually done with an ACL (access-control list) that is referenced by a route-map. In the route-map, if there is a "match" for the traffic defined in that ACL, then a "set" defines what the administrator wants to happen to that traffic (prioritize it, route it differently, drop it, or other actions). Policies can be based on IP address, port numbers, protocols, or size of packets.

If matching criteria is found and the specified action is to permit the packet, then it will be forwarded to the next hop based on policy-based routing. If the action is to deny the packet, normal unicast routing is used to determine the packet's next hop, instead of using policy-based routing. If no matching criteria are found in the route map, normal unicast routing is used to determine the packet's next hop. Although route redistribution is protocol-independent, some of the route-map match and set commands defined in this section are specific to BGP.

Like matches in the same route map subblock are filtered with "or" semantics. If any one match clause is matched in the entire route map subblock, this match is treated as a successful match. Dissimilar match clauses are filtered with "and" semantics. If the first set of conditions is not met, the second match clause is filtered. This process continues until a match occurs or there are no more match clauses.

A route map can have several sequences. A route that does not match at least one match command defined in a route-map will be ignored; that is, the route will not be advertised for outbound route maps nor accepted for inbound route maps.

Table 190: Policy-based Routing Configuration Commands

Command	Function	Mode
route-map	Enters route-map configuration mode, allowing route maps to be created or modified	GC
call	Jumps to another route map after match and set commands are executed	RM
continue	Goes to a route-map entry with a higher sequence number after a successful match occurs	RM
description	Creates a description of an entry in the route map	RM
match as-path	Sets an AS path access list to match	RM
match community	Sets a BGP community access list to match	RM
match extcommunity	Sets a BGP extended community access list to match	RM
match ip address	Specifies destination addresses to match in a standard access list, extended access list, or prefix list	RM
match ip next-hop	Specifies next hop addresses to match in a standard access list, extended access list, or prefix list	RM
match ip route-source	Specifies the source of routing messages to match in a standard access list, extended access list, or prefix list	RM
match metric	Sets the metric value to match in routing messages	RM
match origin	Sets the originating protocol to match in routing messages	RM
match peer	Sets the peer address to match in routing messages	RM
on-match	Sets the next entry to go to when this entry matches	RM
set aggregator as	Assigns an AS number and IP address to the aggregator attribute of a route	RM
set as-path	Modifies the AS path by prepending or excluding an AS number	RM
set atomic-aggregate	Indicates the loss of some information in the route aggregation process	RM
set comm-list delete	Removes communities from the community attribute of inbound or outbound routing messages	RM
set community	Sets the community attributes of routing messages	RM
set extcommunity	Sets the extended community attributes of routing messages	RM
set ip next-hop	Sets the next-hop for a routing message	RM
set local-preference	Sets the priority within the local AS for a routing message	RM
set metric	Sets the metric value of a route to external neighbors	RM
set origin	Sets the origin code for the routing protocol which generated this message	RM
set originator-id	Sets the IP address of the routing message's originator	RM

Table 190: Policy-based Routing Configuration Commands (Continued)

Command	Function	Mode
set weight	Sets the weight for routing messages	RM
show route-map	Shows the configuration setting for a route map	PE

route-map

This command enters route-map configuration mode, allowing route maps to be created or modified. Use the **no** form to remove a route map.

Syntax

[**no**] **route-map** *map-name* {**deny** | **permit**} *sequence-number*

map-name – Name for the route map. (Range: 1-128 case-sensitive alphanumeric characters)

deny – Route-map denies set operations.

permit – Route-map permits set operations.

sequence-number – Sequence to insert to or delete from existing route-map entry. (Range: 1-65535)

Command Mode

Global Configuration

Default Setting

Disabled

Command Usage

- This command enters the route map configuration mode. In this mode, a new route map can be created, or an existing route map modified.
- The match commands specify the conditions under which policy routing occurs, and the set commands specify the routing actions to perform if the criteria enforced by the match commands are met.
- If the match criteria are met for a route map, and the permit keyword specified, the packet is policy routed based on defined set commands.
- If the match criteria are not met, and the permit keyword specified, the next route map with the same map-name is tested. If a route passes none of the match criteria for the set of route maps sharing the same name, it is not policy routed by that set.
- If the match criteria are met for the route map and the deny keyword specified, the packet is not policy routed, and no further route maps sharing the same map-name are examined. If the packet is not policy routed, the normal forwarding process is used.

- Processing for exceptions include the following results:
  - For a deny route-map, if it does not have a match clause, any routing message is matched, and therefore all routes are denied.
  - For a deny route-map which includes a match clause for an access-list, if the access-list does not exist, no routing message will be matched, and therefore all routes are skipped.
  - For a permit route-map, if it does not have a match clause, any routing message is matched, and therefore all routes are permitted.
  - For a permit route-map which includes a match clause for an access-list, if the access-list does not exist, no routing messages are matched, and therefore all routes are skipped.

Example

```
Console(config)#route-map r1 permit 1
Console(config-route-map)#match as-path 60
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

call This command jumps to another route map after match and set commands are executed. Use the **no** form to remove an entry from a route map.

Syntax

call *map-name*

no call

map-name – Name for the route map. (Range: 1-128 case-sensitive alphanumeric characters)

Command Mode

Route Map

Command Usage

Only one call clause is permitted per route map. The call clause executed only after all match and set commands are executed.

Example

```
Console(config)#route-map r1 permit 1
Console(config-route-map)#match as-path 60
Console(config-route-map)#set weight 30
Console(config-route-map)#call FD
Console(config-route-map)#
```

continue

This command goes to a route-map entry with a higher sequence number after a successful match occurs. Use the **no** form to remove this entry from a route map.

Syntax

continue [*sequence-number*]

no continue

sequence-number – Sequence number at which to continue processing. (Range: 1-65535)

Command Mode

Route Map

Command Usage

If no match statements precede the call entry, the call is automatically executed. If no sequence number is specified by the call entry, the next entry is executed.

Example

```
Console(config)#route-map RD permit 1
Console(config-route-map)#match as-path 60
Console(config-route-map)#set weight 30
Console(config-route-map)#continue 3
Console(config-route-map)#
```

description

This command creates a description of an entry in the route map. Use the **no** form to remove the description.

Syntax

description *text*

no description

text – Comment describing this route-map rule. (Maximum length: 128 characters, no spaces or other special characters)

Command Mode

Route Map

Example

```
Console(config)#route-map RD permit 1
Console(config-route-map)#description AS-Path rule
Console(config-route-map)#match as-path 60
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

match as-path

This command sets a BGP autonomous system path access list to match. Use the **no** form to remove this entry from a route map.

Syntax

[**no**] **match as-path** *access-list-name*

access-list-name – Name of the access list. (Maximum length: 16 characters, no spaces or other special characters)

Command Mode

Route Map

Command Usage

The weights assigned by the **match as-path** and set weight route-map commands command override the weight assigned using the BGP neighbor weight command.

Example

```
Console(config)#route-map RD permit 1
Console(config-route-map)#match as-path 60
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

match community

This command sets a BGP community access list to match. Use the **no** form to remove this entry from a route map.

Syntax

match community {1-99 | 100-500 | *community-list-name*} [**exact-match**]

no match community

1-99 – Standard community list number that identifies one or more groups of communities.

100-500 – Expanded community list number that identifies one or more groups of communities.

community-list-name – Name of standard or expanded community list. (Maximum length: 32 characters, no spaces or other special characters)

exact-match – Must exactly match the specified community list. All and only those communities specified must be present.

Command Mode

Route Map

Command Usage

This command matches the community attributes of the BGP routing message following the rules specified with the bgp community-list command.

Example

```
Console(config)#route-map RD permit 2
Console(config-route-map)#match community 60
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

match extcommunity

This command sets a BGP extended community access list to match. Use the **no** form to remove this entry from a route map.

Syntax

match extcommunity {1-99 | 100-500} [**exact-match**]

no match extcommunity

1-99 – Standard community list number that identifies one or more groups of communities.

100-500 – Expanded community list number that identifies one or more groups of communities.

Command Mode

Route Map

Command Usage

This command matches the extended community attributes of the BGP routing message following the rules specified with the bgp extcommunity-list command.

Example

```
Console(config)#route-map RD permit 3
Console(config-route-map)#match extcommunity 160
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

match ip address

This command specifies the destination addresses to be matched in a standard access list, an extended access list, or a prefix list. Use the **no** form to remove this entry from a route map.

Syntax

match ip address {*access-list-name* | **prefix-list** *prefix-list-name*}

no match ip address

access-list-name – Name of standard or extended access list. (Maximum length: 32 characters, no spaces or other special characters)

prefix-list-name – Name of a specific prefix list.

Command Mode
Route Map

Example

```
Console(config)#route-map RD permit 4
Console(config-route-map)#match ip address rd-addresses
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

match ip next-hop

This command specifies the next-hop addresses to be matched in a standard access list, an extended access list, or a prefix list. Use the **no** form to remove this entry from a route map.

Syntax

match ip next-hop {*access-list-name* | **prefix-list** *prefix-list-name*}

no match ip next-hop

access-list-name – Name of standard or extended access list. (Maximum length: 32 characters, no spaces or other special characters)

prefix-list-name – Name of a specific prefix list.

Command Mode
Route Map

Command Usage
When inbound update messages are received from a neighbor, next-hop information contained in Network Layer Reachability Information (NLRI) entries is checked against the specified access-list or prefix-list before any routes are learned.

Example

```
Console(config)#route-map RD permit 5
Console(config-route-map)#match ip next-hop rd-next-hops
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

match ip route-source

This command specifies the source of routing messages advertised by routers and access servers to be matched in a standard access list, an extended access list, or a prefix list. Use the **no** form to remove this entry from a route map.

Syntax

match ip route-source {*access-list-name* | **prefix-list** *prefix-list-name*}

no match ip route-source [*access-list-name* | **prefix-list**]

access-list-name – Name of standard or extended access list. (Maximum length: 32 characters, no spaces or other special characters)

prefix-list-name – Name of a specific prefix list.

Command Mode

Route Map

Command Usage

Note that there may be situations in which the next hop and source router address of the route are not the same.

Example

```
Console(config)#route-map RD permit 6
Console(config-route-map)#match ip route-source rd-sources
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

match metric

This command sets the metric value to match in routing messages. Use the **no** form to remove this entry from a route map.

Syntax

match metric *metric-value*

no match metric

metric-value – The metric value in the routing messages. (Range: 0-4294967295)

Command Mode

Route Map

Example

```
Console(config)#route-map RD permit 7
Console(config-route-map)#match metric 60
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

match origin

This command sets the originating protocol to match in routing messages. Use the **no** form to remove this entry from a route map.

Syntax

match origin {**egp** | **igp** | **incomplete**}

no match origin

egp – Routes learned from exterior gateway protocols.

igp – Routes learned from internal gateway protocols.

incomplete – Routes of uncertain origin.

Command Mode

Route Map

Example

```
Console(config)#route-map RD permit 8
Console(config-route-map)#match origin igp
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

match peer

This command sets the peer address to match in routing messages. Use the **no** form to remove this entry from a route map.

Syntax

match peer {*peer-address* | **local**}

no match peer [*peer-address* | **local**]

peer-address – IP address of neighboring router sending routing messages.

local – Static or redistributed routes.

Command Mode

Route Map

Example

```
Console(config)#route-map RD permit 9
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set weight 30
Console(config-route-map)#
```

on-match

This command sets the next entry to go to when this entry matches. Use the **no** form to remove this entry from a route map.

Syntax

on-match peer {**goto** *sequence-number* | **next**}

no on-match peer {**goto** | **next**}

goto – On match, go to specified entry.

sequence-number – Route-map entry. (Range: 1-65535)

next – Go to next entry.

Command Mode

Route Map

Command Usage

Use this command when no set action is for a match clause.

Example

```
Console(config)#route-map RD permit 8
Console(config-route-map)#match pathlimit as 5
Console(config-route-map)#on match goto 20
Console(config-route-map)#
```

set aggregator as

This command assigns an AS number and IP address to the aggregator attribute of a route. Use the **no** form to remove this entry from a route map.

Syntax

set aggregator as *as-number ip-address*

no set aggregator as [*as-number ip-address*]

as-number – Autonomous system number. (Range: 1-4294967295)

ip-address – IP address of aggregator.

Command Mode

Route Map

Command Usage

Aggregate routes advertised to a neighbor contain an aggregator attribute. This attribute contains an AS number and IP address. The AS number is the creator's AS number (or confed ID in a confederation) and an IP address which is the creator's router-id. The **set aggregator as** command can be used to overwrite the aggregator attribute in routes created locally with the aggregate-address command, or in routes learned from a neighbor which already carry an aggregator attribute, or to add a new aggregator attribute to a route which has no aggregator attribute.

Example

```
Console(config)#route-map RD permit 8
Console(config-route-map)#match pathlimit as 5
Console(config-route-map)#set aggregator 1 192.168.0.0
Console(config-route-map)#
```

set as-path

This command modifies the AS path by prepending or excluding an AS number. Use the **no** form to remove this entry from a route map.

Syntax

set as-path {**exclude** | **prepend**} *as-number...*

no set as-path {**exclude** | **prepend**}

exclude – Removes one or more autonomous system numbers from the AS path of the route that is matched.

prepend – Appends one or more autonomous system numbers to the AS path of the route that is matched.

as-number – Autonomous system number. (Range: 1-4294967295)

Command Mode

Route Map

Command Usage

Note that best path selection may be influenced with this command by varying the length of the autonomous system path.

Example

```
Console(config)#route-map RD permit 8
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set as-path prepend 2
Console(config-route-map)#
```

set atomic-aggregate

This command indicates the loss of some information in the route aggregation process. Use the **no** form to remove this entry from a route map.

Syntax

[**no**] **set atomic-aggregate**

Command Mode

Route Map

Command Usage

The purpose of the atomic-aggregate attribute is to alert BGP speakers along the path that some information have been lost due to the route aggregation process and that the aggregate path might not be the best path to the destination. This attribute should be set when the BGP speaker advertises ONLY the less-specific prefix and suppresses more specific ones.

Example

```
Console(config)#route-map RD permit 9
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set atomic-aggregate
Console(config-route-map)#
```

set comm-list delete

This command removes communities from the community attribute of inbound or outbound routing messages. Use the **no** form to remove this entry from a route map.

Syntax

[**no**] **set comm-list** {1-99 | 100-500 | *community-list-name*} [**delete**]

1-99 – Standard community list number that identifies one or more groups of communities.

100-500 – Expanded community list number that identifies one or more groups of communities.

community-list-name – Name of standard or expanded community list. (Maximum length: 32 characters, no spaces or other special characters)

Command Mode

Route Map

Command Usage

When using the bgp community-list command to configure a community access list, each entry of a standard community list should list only one community. Otherwise, the **set comm-list delete** command will not succeed. For example, in order to be able to delete communities 100 and 200, you must create two separate entries with the bgp community-list command.

Example

```
Console(config)#route-map RD permit 10
Console(config-route-map)#match peer 192.168.0.77
Console(config-route-map)#set comm-list 10:01 delete
Console(config-route-map)#exit
Console(config)#route-map RD permit 11
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set comm-list 20:01 delete
Console(config-route-map)#
```

set community

This command sets the community attributes of routing messages. Use the **no** form to remove this entry from a route map.

Syntax

set community
[*AA:NN...*]
[**additive** {[*AA:NN...*] [**internet**] [**local-as**] [**no-advertise**] [**no-export**]}
[**internet** [[*AA:NN...*] [**local-as**] [**no-advertise**] [**no-export**]]
[**local-as** [[*AA:NN...*] [**no-advertise**] [**no-export**]]
[**no-advertise** [*AA:NN...*] [**no-export**]]
[**no-export** [*AA:NN...*]]
[**none**]

no set community

AA:NN – Standard community-number. The 4-byte community number is composed of a 2-byte autonomous system number and a 2-byte network number, separated by one colon. Each 2-byte number can range from 0 from 65535. One or more communities can be entered, separated by a space. Up to 16 community numbers are supported.

additive – Adds community attributes to already existing community attributes.

internet – Specifies the entire Internet. Routes with this community attribute are advertised to all internal and external peers.

local-as – Specifies the local autonomous system. Routes with this community attribute are advertised only to peers that are part of the local autonomous system or to peers within a sub-autonomous system of a confederation. These routes are not advertised to external peers or to other sub-autonomous systems within a confederation.

no-advertise – Routes with this community attribute are not advertised to any internal or external peer.

no-export – Routes with this community attribute are advertised only to peers in the same autonomous system or to other sub-autonomous systems within a confederation. These routes are not advertised to external peers.

none – Delete the community attributes from the prefix of this route.

Command Mode

Route Map

Example

```
Console(config)#route-map RD permit 11
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set community 10:01
Console(config-route-map)#exit
Console(config)#route-map RD permit 12
Console(config-route-map)#match peer 192.168.0.99
```

```
Console(config-route-map)#set community 20:01
Console(config-route-map)#
```

set extcommunity

This command sets the extended community attributes of routing messages. Use the **no** form to remove this entry from a route map.

Syntax

set extcommunity {**rt** *extended-community-value* | **soo** *extended-community-value*}

no set extcommunity [**rt** | **soo**]

rt – The route target extended community attribute.

soo – The site of origin extended community attribute.

extended-community-value – The route target or site of origin in one of the following formats:

AAAA:*NN* or *AA*:*NNNN* – Community-number to deny or permit. The community number can either be formatted as a 4-byte autonomous system number and a 2-byte network number, or as a 2-byte autonomous system number and a 4-byte network number, separated by one colon. Each 2-byte number can range from 0 to 65535, and 4-byte numbers from 0 to 4294967295.

IP:*NN* – Community to deny or permit. The community number is composed of a 4-byte IP address (representing the autonomous system number) and a 2-byte network number, separated by one colon. The 2-byte network number can range from 0 to 65535.

One or more community numbers can be entered, separated by a space. Up to 3 community numbers are supported.

Command Mode

Route Map

Command Usage

- Using the **rt** keyword to specify new route targets replaces existing route targets.
- The route target (RT) attribute is used to identify sites that may receive routes tagged with a specific route target. Using this attribute allows that route to be placed in per-site forwarding tables used for routing traffic received from the corresponding sites.
- The site of origin (SOO) attribute is used to identify the site from which the provider edge (PE) router learned the route. All routes learned from a particular site are assigned the same site of origin attribute, no matter if a site is connected to a single PE router or multiple PE routers. Filtering based on this extended community attribute can prevent routing loops from occurring when a site is multi-homed.

Example

```
Console(config)#route-map RD permit 13
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set extcommunity 100:0 192.168.1.1:1
Console(config-route-map)#
```

set ip next-hop

This command sets the next-hop for a routing message. Use the **no** form to remove this entry from a route map.

Syntax

set ip next-hop {*ip-address* | **peer-address**}

no set ip next-hop [*ip-address*]

ip-address – An IPv4 address of the next hop, expressed in dotted decimal notation.

peer-address – Sets the next hop as the BGP peering address.

Command Mode

Route Map

Command Usage

- The IP address specified as the next hop need not be an adjacent router.
- When this command is used with the **peer-address** keyword in an inbound route map received from a BGP peer, the next hop of the received matching routes are set to be the neighbor peer address, overriding any other next hops.
- When this command is used with the **peer-address** keyword in an outbound route map for a BGP peer, the next hop of the advertised matching routes will be set to be the peering address of the local router, thus disabling next hop calculation. This command therefore has finer granularity than the neighbor next-hop-self command, because it can set the next hop for some routes, but not others. While the neighbor next-hop-self command sets the next hop for all routes sent to the specified neighbor(s).

Example

```
Console(config)#route-map RD permit 14
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set ip next-hop 192.168.0.254
Console(config-route-map)#
```

set local-preference

This command sets the priority within the local AS for a routing message. Use the **no** form to remove this entry from a route map.

Syntax

set local-preference *preference*

no set local-preference

preference – Degree of preference iBGP peers give local routes during BGP best path selection. The higher the value, the more the route is to be preferred. (Range: 1-4294967295)

Command Mode

Route Map

Command Usage

- The preference is sent only to routers in the local autonomous system. To specify the metric for inter-autonomous systems, use the set metric command.
- A route with a higher local priority level when compared with other routes to the same destination will be preferred over other routes.

Example

```
Console(config)#route-map RD permit 15
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set local-preference 2
Console(config-route-map)#
```

set metric

This command sets the metric value of a route to external neighbors. Use the **no** form to restore the default value.

Syntax

set metric [+ | -]*metric-value*

no set metric

metric-value – Metric value assigned to all external routes for the specified protocol. (Range: 0-4294967295)

Default Setting

The dynamically learned metric value.

Command Mode

Route Map

Command Usage

- Lower metric values indicate a higher priority.

- This command can modify the current metric for a route using the "+" or "-" keywords.
- The metric applies to external routers in the inter-autonomous system. To specify the metric for the local AS, use the set local-preference command.
- This path metric is normally only compared with neighbors in the local AS. To extend the comparison to paths advertised from neighbors in different autonomous systems, use the bgp always-compare-med command.

Example

```
Console(config)#route-map RD permit 16
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set metric +1
Console(config-route-map)#
```

set origin

This command sets the BGP origin code for the routing protocol which generated this message. Use the **no** form to remove this entry from a route map.

Syntax

set origin {**egp** | **igp** | **incomplete**}

no set origin

egp – Exterior gateway protocols.

igp – Interior gateway protocols.

incomplete – Route origin unknown.

Default Setting

As indicated in main IP routing table

Command Mode

Route Map

Command Usage

EGP is an inter-domain routing protocol which has been superceded by BGP. IGP indicates any intra-domain routing protocol such as RIP or OSPF.

Example

```
Console(config)#route-map RD permit 16
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set origin egp
Console(config-route-map)#
```

set originator-id

This command sets the IP address of the routing message's originator. Use the **no** form to remove this entry from a route map.

Syntax

set originator-id *ip-address*

no set originator-id

ip-address – An IPv4 address of the route source, expressed in dotted decimal notation.

Command Mode

Route Map

Command Usage

This attribute is commonly used for loop prevention by rejecting updates that contain the receiving router's own router-ID in the originator-ID attribute.

Example

```
Console(config)#route-map RD permit 17
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set originator-id 192.168.0.254
Console(config-route-map)#
```

set weight

This command sets the weight for routing messages. Use the **no** form to remove this entry from a route map.

Syntax

set weight *weight*

no set weight

weight – The weight assigned to this route. (Range: 0-4294967295)

Command Mode

Route Map

Command Usage

- Weights are used to determine the best path available to the local switch. The route with the highest weight gets preference over other routes to the same network.
- Weights assigned using this command override those assigned by the neighbor weight command.

Example

```
Console(config)#route-map RD permit 19
Console(config-route-map)#match peer 192.168.0.99
```

```
Console(config-route-map)#set weight 255
Console(config-route-map)#
```

show route-map

This command shows the configuration setting for a route map.

Syntax

show route-map [*map-name*]

map-name – Name for the route map. (Range: 1-128 case-sensitive alphanumeric characters)

Command Mode

Privileged Exec

Example

```
Console#show route-map RD
route-map RD, permit, sequence 1
  Match clauses:
    peer 102.168.0.99
  Set clauses:
    comm-list 100 delete
  Call clause:
  Action:
    Exit routemap
Console#
```

39 Policy-Based Routing Commands

This section describes commands used to configure policy-based routing (PBR).

Policy-based routing is performed before regular destination-based routing. PBR inspects traffic on the interface where the policy is applied and then, based on the policy, makes a decision. First, the traffic is "matched" according to the policy. Second, for each match, there is an action "set." The action could be that the matched packets are routed to a specified IP address, or given a higher priority.

You can use a standard IP access list (ACL) to specify the match criteria for a packet's source address, and an extended ACL to specify match criteria based on source and destination addresses, application, protocol type, and ToS (according to ACL implementation). If the match statements are satisfied, you can use a "set" statement to specify the criteria for forwarding the packets. Route-map contents cannot be modified if the route-map policy is already configured on an interface.

A route specified by configured policies might differ from the best route as determined by routing protocols, enabling packets to take different routes depending on their source and content. The added flexibility to route traffic on user-defined paths rather than paths determined by routing protocols can make the environment more difficult to manage and might cause routing loops. Policies should be defined in a deterministic manner to keep the environment simple and manageable.

Table 191: Policy-Based Routing Commands

Command	Function	Mode
pbr	Enters PBR configuration mode	GC
ip policy route-map	Enables policy routing and specifies a route-map on a VLAN	IC
route-map	Enters route-map configuration mode, allowing route maps to be created or modified	PBR
match ip address	Specifies destination addresses to match in a standard access list, extended access list	PBR-RM
set ip next-hop	Sets the next-hop for a routing message	PBR-RM
set ip dscp	Sets the DSCP value for a routing message	PBR-RM
show pbr ip-policy	Shows route maps bound to VLAN interfaces	PE
show pbr route-map	Shows the configuration setting for a route map	PE

pbr

This command enters PBR configuration mode, allowing route maps to be created or modified.

Syntax

pbr

Command Mode

Global Configuration

Default Setting

None

Example

```
Console(config)#pbr
Console(config-pbr)#
```

ip policy route-map

This command enables policy routing and specifies a route map on a VLAN interface. Use the no form to disable policy routing on a VLAN interface.

Syntax

ip policy route-map *map-name*

no ip policy route-map

map-name – Name for the route map. (Range: 1-128 case-sensitive alphanumeric characters)

Command Mode

Interface Configuration (VLAN)

Default Setting

Disabled

Command Usage

- This command sets policy route rules for the switch to use when a route-map is bound to a VLAN.
- Do not modify the contents of a route-map if it is already bound to a VLAN interface.
- When network conditions change, such as interface up/down or adjacent router change, the rules of a route-map on the specified interface must be updated.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip policy route-map rmap1
Console(config-if)#
```

route-map

This command enters PBR route-map configuration mode, allowing route maps to be created or modified. Use the **no** form to remove a route map.

Syntax

[**no**] **route-map** *map-name* {**deny** | **permit**} *sequence-number*

map-name – Name for the route map. (Range: 1-128 case-sensitive alphanumeric characters)

deny – Route-map denies set operations.

permit – Route-map permits set operations.

sequence-number – Sequence to insert to or delete from existing route-map entry. (Range: 1-65535)

Command Mode

PBR Configuration

Default Setting

Disabled

Command Usage

- This command enters the route map configuration mode. In this mode, a route map can be created or modified using **match** and **set** commands. The match commands specify the conditions under which policy routing occurs, and the set commands specify the routing actions to perform if the criteria enforced by the match commands are met.
- The total number of route-maps that can be created is equal the number of ports on the switch.
- Route maps sharing the same name have a match priority based on the sequence number, with low sequence values having a higher priority. Up to 100 route-map sequence entries can be defined.
- If the match criteria are met for a route map, and the **permit** keyword specified, the packet is policy routed based on defined set commands.
- If the match criteria are not met, and the **permit** keyword specified, the next route map with the same map-name is tested. If a route passes none of the match criteria for the set of route maps sharing the same name, it is not policy routed by that set.

- If the match criteria are met for the route map and the **deny** keyword specified, the packet is not policy routed, and no further route maps sharing the same map-name are examined. If the packet is not policy routed, normal destination-based routing is used.
- If the match criteria are met for a route map, and the **deny** keyword specified, the packet is forwarded by normal destination-based routing.
- If no match is found in a route map, the packet is forwarded by normal destination-based routing. If you want to drop the packet instead, you can configure an action to forward the packet to the null0 interface as the last entry in the route-map.

Example

```
Console(config-pbr)#route-map test3 permit 20
Console(config-route-map)#match ip address r66
Console(config-route-map)#
```

match ip address

This command specifies the destination addresses to be matched in an IP standard access list or an extended access list. Use the **no** form to remove this entry from a route map.

Syntax

match ip address {*access-list-name*}

no match ip address

access-list-name – Name of an IP standard or extended access list. (Maximum length: 32 characters, no spaces or other special characters)

Command Mode

PBR Route Map

Example

```
Console(config-pbr)#route-map test3 permit 20
Console(config-route-map)#match ip address rd-addresses
Console(config-route-map)#
```

set ip next-hop

This command sets the next-hop for a routing message. Use the **no** form to remove this entry from a route map.

Syntax

[**no**] **set ip next-hop** *ip-address*

ip-address – An IPv4 address of the next hop, expressed in dotted decimal notation.

Command Mode
PBR Route Map

Command Usage
- The IP address specified as the next hop must be an adjacent router. The next-hop address affects all packet types and is always used if configured.
- If more than one IP address is specified, the first IP address associated with a currently up connected interface is used to route the packets.
- The routing table is checked only to determine whether the next hop can be reached. It is not checked to determine whether there is an explicit route for the packet's destination address.

Example

```
Console(config)#route-map RD permit 15
Console(config-route-map)#set ip next-hop 192.168.0.254
Console(config-route-map)#
```

set ip dscp

This command sets the DSCP value for a routing message. Use the **no** form to remove this entry from a route map.

Syntax

[**no**] **set ip dscp** *dscp-value*

dscp-value – A DSCP value. (Range: 0-63)

Command Mode
PBR Route Map

Command Usage
Use this command to set the first 6 bits of the differentiated services field in the IP packet header.

Example

```
Console(config)#route-map RD permit 15
Console(config-route-map)#set ip dscp 9
Console(config-route-map)#
```

show pbr ip-policy

This command shows the route maps bound to VLAN interfaces.

Syntax

show pbr ip-policy

Command Mode

Privileged Exec

Example

```
Console#show pbr ip-polcy
Vlan: 1, Route map: 1, Details is below:
******Binding rules******
******Unbinding rules******
type: permit
sequence: 1
match ip address: 2
set ip nexthop: 192.168.3.3
set ip dscp: 33
Console#
```

show pbr route-map

This command shows the configuration setting for a route map.

Syntax

show pbr route-map [*map-name*]

map-name – Name for the route map. (Range: 1-128 case-sensitive alphanumeric characters)

Command Mode

Privileged Exec

Example

```
Console#show route-map RD
route-map 1, permit, sequence 1
  Match clauses:
    ip address(access-lists): 2
  Set clauses:
    ip next-hop: 192.168.3.3
    ip dscp: 33
Console#
```

40 PIM Commands

This section includes commands for Protocol-Independent Multicast (PIM) routing.

This device can route multicast traffic to different subnetworks using Protocol-Independent Multicast - Sparse Mode (PIM-SM) for IPv4. PIM for IPv4 (PIMv4) relies on messages sent from IGMP-enabled Layer 2 switches and hosts to determine when hosts want to join or leave multicast groups.

PIM-SM is designed for networks where the probability of multicast group members is low, such as the Internet. PIM Source Specific Multicast (PIM-SSM) for multicast groups is also supported, which enables clients to receive multicast traffic directly from a source.

Table 192: PIM-SM and PIM-SSM Multicast Routing Commands

Command	Function	Mode
router pim	Enables IPv4 PIM globally for the router	GC
ip pim	Enables PIM-SM on the specified interface	IC
ip pim hello-holdtime	Sets the time to wait for hello messages from a neighboring PIM router before declaring it dead	IC
ip pim hello-interval	Sets the interval between sending PIM hello messages	IC
ip pim override-interval	Specifies the time it takes a downstream router to respond to a lan-prune-delay message	IC
ip pim propagation-delay	Configures the propagation delay required for a LAN prune delay message to reach downstream routers	IC
show ip pim interface	Displays information about interfaces configured for PIM	NE, PE
show ip pim neighbor	Displays information about PIM neighbors	NE, PE
ip pim rp-address	Sets a static address for the rendezvous point	GC
ip pim spt-threshold	Prevents the last-hop PIM router from switching to Shortest Path Source Tree (SPT) mode	GC
ip pim dr-priority	Sets the priority value for a DR candidate	IC
ip pim join-prune-interval	Sets the join/prune timer	IC
ip pim ssm range	Configures a PIM-SSM address	GC

router pim

This command enables IPv4 Protocol-Independent Multicast routing globally on the router. Use the **no** form to disable PIM multicast routing.

Syntax

[no] router pim

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

This command enables PIM-SM globally for the router. You also need to enable PIM-SM for each interface that will support multicast routing using the ip pim sparse mode command, and make any changes necessary to the multicast protocol parameters.

Example

```
Console(config)#router pim
Console(config)#exit
Console#show ip pim interface
PIM is enabled.
VLAN 1 is down.
 PIM Mode               :     Sparse Mode
 IP Address             :    192.168.2.10
 Hello Interval         :          30 sec
 Hello HoldTime         :         105 sec
 Triggered Hello Delay  :           5 sec
 Join/Prune Holdtime    :         210 sec
 Lan Prune Delay        :         Enabled
 Propagation Delay      :         500  ms
 Override Interval      :        2500  ms
 DR Priority            :           1
 Join/Prune Interval    :          60 sec

Console#
```

ip pim

This command enables PIM-SM on the specified interface. Use the **no** form to disable PIM-SM on this interface.

Syntax

[no] ip pim {sparse-mode}

sparse-mode - Enables PIM Sparse Mode.

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- To fully enable PIM, you need to enable multicast routing globally for the router with the ip multicast-routing command, enable PIM globally for the router with the router pim command, and also enable PIM-SM for each interface that will participate in multicast routing with this command.

- If you enable PIM on an interface, you should also enable IGMP on that interface. PIM mode selection determines how the switch populates the multicast routing table, and how it forwards packets received from directly connected LAN interfaces. Sparse mode interfaces are added only when periodic join messages are received from downstream routers, or a group member is directly connected to the interface.

- Sparse-mode interfaces forward multicast traffic only if a join message is received from a downstream router or if group members are directly connected to the interface. When routers want to receive a multicast flow, they periodically send join messages to the Rendezvous Point (RP), and are subsequently added to the shared path for the specified flow back up to the RP. If routers want to join the source path up through the Shortest Path Source Tree (SPT), they periodically send join messages toward the source. They also send prune messages toward the RP to prune the shared path if they have already connected to the source through the SPT, or if there are no longer any group members connected to the interface.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip pim sparse-mode
Console(config-if)#end
Console#show ip pim interface
PIM is enabled.
VLAN 1 is down.
 PIM Mode               :     Sparse Mode
 IP Address             :    192.168.2.10
 Hello Interval         :          30 sec
 Hello HoldTime         :         105 sec
 Triggered Hello Delay  :           5 sec
 Join/Prune Holdtime    :         210 sec
 Lan Prune Delay        :         Enabled
 Propagation Delay      :         500  ms
 Override Interval      :        2500  ms
 DR Priority            :           1
 Join/Prune Interval    :          60 sec

Console#
```

ip pim hello-holdtime

This command configures the interval to wait for hello messages from a neighboring PIM router before declaring it dead. Use the **no** form to restore the default value.

Syntax

ip pim hello-holdtime *seconds*

no ip pim hello-interval

seconds - The hold time for PIM hello messages. (Range: 1-65535)

Default Setting

105 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

The **ip pim hello-holdtime** should be greater than the value of ip pim hello-interval.

Example

```
Console(config-if)#ip pim hello-holdtime 210
Console(config-if)#
```

ip pim hello-interval

This command configures the frequency at which PIM hello messages are transmitted. Use the **no** form to restore the default value.

Syntax

ip pim hello-interval *seconds*

no pim hello-interval

seconds - Interval between sending PIM hello messages. (Range: 1-65535)

Default Setting

30 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

Hello messages are sent to neighboring PIM routers from which this device has received probes, and are used to verify whether or not these neighbors are still active members of the multicast tree.

Example

```
Console(config-if)#ip pim hello-interval 60
Console(config-if)#
```

ip pim override-interval

This command configures the override interval, or the time it takes a downstream router to respond to a lan-prune-delay message. Use the **no** form to restore the default setting.

Syntax

ip pim override-interval *milliseconds*

no ip pim override-interval

milliseconds - The time required for a downstream router to respond to a lan-prune-delay message by sending back a Join message if it wants to continue receiving the flow referenced in the message. (Range: 500-6000 milliseconds)

Default Setting

2500 milliseconds

Command Mode

Interface Configuration (VLAN)

Command Usage

The override interval configured by this command and the propagation delay configured by the ip pim propagation-delay command are used to calculate the LAN prune delay. If a downstream router has group members which want to continue receiving the flow referenced in a LAN prune delay message, then the override interval represents the time required for the downstream router to process the message and then respond by sending a Join message back to the upstream router to ensure that the flow is not terminated.

Example

```
Console(config-if)#ip pim override-interval 3500
Console(config-if)#
```

ip pim propagation-delay

This command configures the propagation delay required for a LAN prune delay message to reach downstream routers. Use the **no** form to restore the default setting.

ip pim propagation-delay *milliseconds*

no ip pim propagation-delay

milliseconds - The time required for a lan-prune-delay message to reach downstream routers attached to the same VLAN interface. (Range: 100-5000 milliseconds)

Default Setting
500 milliseconds

Command Mode
Interface Configuration (VLAN)

Command Usage
The override interval configured by the ip pim override-interval command and the propagation delay configured by this command are used to calculate the LAN prune delay. If a downstream router has group members which want to continue receiving the flow referenced in a LAN prune delay message, then the propagation delay represents the time required for the lan-prune-delay message to be propagated down from the upstream router to all downstream routers attached to the same VLAN interface.

Example

```
Console(config-if)#ip pim propagation-delay 600
Console(config-if)#
```

show ip pim interface

This command displays information about interfaces configured for PIM.

Syntax

show ip pim interface [**vlan** *vlan-id*]

vlan-id - VLAN ID (Range: 1-4094)

Command Mode
Normal Exec, Privileged Exec

Command Usage
This command displays the PIM settings for the specified interface as described in the preceding pages. It also shows the address of the designated PIM router and the number of neighboring PIM routers.

Example

```
Console#show ip pim interface vlan 1
PIM is enabled.
VLAN 1 is down.
 PIM Mode               :     Sparse Mode
 IP Address             :    192.168.2.10
 Hello Interval         :          30 sec
 Hello HoldTime         :         105 sec
 Triggered Hello Delay  :           5 sec
 Join/Prune Holdtime    :         210 sec
```

```
 Lan Prune Delay        :         Enabled
 Propagation Delay      :         500  ms
 Override Interval      :        2500  ms
 DR Priority            :           1
 Join/Prune Interval    :          60 sec

Console#
```

show ip pim neighbor

This command displays information about PIM neighbors.

Syntax

show ip pim neighbor [**interface vlan** *vlan-id*]

vlan-id - VLAN ID (Range: 1-4094)

Default Setting

Displays information for all known PIM neighbors.

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show ip pim neighbor
Neighbor Address VLAN Interface Uptime (sec.) Expiration Time (sec) DR
---------------- -------------- ------------- ---------------------- ---
192.168.0.3/32   1              00:00:21      00:01:30
Console#
```

ip pim rp-address

This command sets a static address for the Rendezvous Point (RP) for a particular multicast group. Use the **no** form to remove an RP address or an RP address for a specific group.

Syntax

[**no**] **ip pim rp-address** *rp-address* [**group-prefix** *group-address mask*]

rp-address - Static IP address of the router that will be an RP for the specified multicast group(s).

group-address - An IP multicast group address. If a group address is not specified, the RP is used for all multicast groups.

mask - Subnet mask that is used for the group address.

Default Setting

None

Command Mode

Global Configuration

Command Usage

- The router specified by this command will act as an RP for all multicast groups in the local PIM-SM domain if no groups are specified. A static RP can either be configured for the whole multicast group range 224.0.0.0/4, or for specific group ranges.

- Using this command to configure multiple static RPs with the same RP address is not allowed. If an IP address is specified that was previously used for an RP, then the older entry is replaced.

- Multiple RPs can be defined for different groups or group ranges. If a group is matched by more than one entry, the router will use the RP associated with the longer group prefix length. If the prefix lengths are the same, then the static RP with the highest IP address is chosen.

- Static definitions for RP addresses may be used together with RP addresses dynamically learned through the bootstrap router (BSR). If an RP address learned by the BSR and one statically configured using this command are both available for a group range, the RP address learned by the BSR is chosen over the one statically configured with this command.

- All routers within the same PIM-SM domain must be configured with the same RP(s). Selecting an RP through the dynamic election process is therefore preferable for most situations. Using the dynamic RP election process also allows a backup RP to automatically take over if the active RP router becomes unavailable.

- If the **no** form of this command is used without specifying a multicast group, the default 224.0.0.0 (with the mask 240.0.0.0) is removed. In other words, all multicast groups are removed.

Example

In the following example, the first PIM-SM command just specifies the RP address 192.168.1.1 to indicate that it will be used to service all multicast groups. The second PIM-SM command includes the multicast groups to be serviced by the RP.

```
Console(config)#ip pim rp-address 192.168.1.1
Console(config)#ip pim rp-address 192.168.2.1 group-prefix 224.9.0.0
  255.255.0.0
Console(config)#
```

ip pim spt-threshold

This command prevents the last-hop PIM router from switching to Shortest Path Source Tree (SPT) mode. Use the **no** form to allow the router to switch over to SPT mode.

Syntax

ip pim spt-threshold infinity [**group-prefix** *group-address mask*]

no ip pim spt-threshold infinity

group-address - An IP multicast group address. If a group address is not specified, the command applies to all multicast groups.

mask - Subnet mask that is used for the group address.

Default Setting

The last-hop PIM router joins the shortest path tree immediately after the first packet arrives from a new source.

Command Mode

Global Configuration

Command Usage

- The default path for packets from a multicast source to a receiver is through the RP. However, the path through the RP is not always the shortest path. Therefore, the router uses the RP to forward only the first packet from a new multicast group to its receivers. Afterwards, it calculates the shortest path tree (SPT) directly between the receiver and source, and then uses the SPT to send all subsequent packets from the source to the receiver instead of using the shared tree. Note that when the SPT threshold is not set by this command, the PIM leaf router will join the shortest path tree immediately after receiving the first packet from a new source.

- This command forces the router to use the shared tree for all multicast groups, or just for the specified multicast groups.

- Only one entry is allowed for this command.

Example

This example prevents the switch from using the SPT for multicast groups 224.1.0.0~224.1.255.255.

```
Console(config-if)#ip pim sparse-mode
Console(config-if)#exit
Console(config)#ip multicast-routing
Console(config)#router pim
Console(config)#ip pim spt-threshold infinity group-prefix 224.1.0.0
  0.0.255.255
Console#
```

ip pim dr-priority

This command sets the priority value for a Designated Router (DR) candidate. Use the **no** form to restore the default setting.

Syntax

ip pim dr-priority *priority-value*

no ip pim dr-priority

priority-value - Priority advertised by a router when bidding to become the DR. (Range: 0-4294967294)

Default Setting

1

Command Mode

Interface Configuration (VLAN)

Command Usage

- More than one PIM-SM router may be connected to an Ethernet or other shared-media LAN. If multicast hosts are directly connected to the LAN, then only one of these routers is elected as the DR, and acts on behalf of these hosts, sending periodic Join/Prune messages toward a group-specific RP for each group. A single DR is elected per interface (LAN or otherwise) using a simple election process.

- The router with the highest priority configured on an interface is elected as the DR. If more than one router attached to this interface uses the same priority, then the router with the highest IP address is elected to serve as the DR.

- If a router does not advertise a priority in its hello messages, it is assumed to have the highest priority and is elected as the DR. If more than one router is not advertising its priority, then the router with the highest IP address is elected to serve as the DR.

Example

This example sets the priority used in the bidding process for the DR.

```
Console(config)#interface vlan 1
Console(config-if)#ip pim dr-priority 20
Console(config-if)#end
Console#show ip pim interface
PIM is enabled.
VLAN 1 is up.
 PIM Mode               :     Sparse Mode
 IP Address             :     192.168.0.2
 Hello Interval         :          30 sec
 Hello HoldTime         :         105 sec
 Triggered Hello Delay  :           5 sec
 Join/Prune Holdtime    :         210 sec
 Lan Prune Delay        :        Disabled
 Propagation Delay      :         500  ms
 Override Interval      :        2500  ms
 DR Priority            :          20
```

```
 Join/Prune Interval    :          60 sec

Console#
```

ip pim join-prune-interval

This command sets the join/prune timer. Use the no form to restore the default setting.

Syntax

ip pim join-prune-interval *seconds*

no ip pim join-prune-interval

seconds - The interval at which join/prune messages are sent. (Range: 1-65535 seconds)

Default Setting

60 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

- By default, the switch sends join/prune messages every 210 seconds to inform other PIM-SM routers about clients who want to join or leave a multicast group.
- Use the same join/prune message interval on all the PIM-SM routers in the same PIM-SM domain, otherwise the routing protocol's performance will be adversely affected.
- The multicast interface that first receives a multicast stream from a particular source forwards this traffic only to those interfaces on the router that have requested to join this group. When there are no longer any requesting groups on that interface, the leaf node sends a prune message upstream and enters a prune state for this multicast stream. The protocol maintains both the current join state and the pending Reverse Path Tree (RPT) prune state for this (source, group) pair until the join/prune-interval timer expires.

Example

This example sets the priority used in the bidding process for the DR.

```
Console(config)#interface vlan 1
Console(config-if)#ip pim join-prune-interval 210
Console#show ip pim interface
PIM is enabled.
VLAN 1 is up.
 PIM Mode               :     Sparse Mode
 IP Address             :     192.168.0.2
 Hello Interval         :          30 sec
 Hello HoldTime         :         105 sec
 Triggered Hello Delay  :           5 sec
```

```
Join/Prune Holdtime    :         210 sec
Lan Prune Delay        :        Disabled
Propagation Delay      :         500  ms
Override Interval      :        2500  ms
DR Priority            :          20
Join/Prune Interval    :          80 sec

Console#
```

ip pim ssm range

This command configures the address of a PIM-SSM for multicast groups. Use the **no** form to remove an SSM address.

Syntax

ip pim ssm range *group-address mask*

no ip pim ssm

group-address - An IP multicast group address. If a group address is not specified, the command applies to all multicast groups.

mask - Subnet mask that is used for the group address.

Default Setting

None configured

Command Mode

Global Configuration

Example

```
Console(config)#ip pim ssm range 225.1.1.1 255.255.255.0

Console(config)#
```

41 Multicast Routing Commands

This section describes commands used to configure multicast routing globally on the switch.

Table 193: General Multicast Routing Commands

Command	Function	Mode
ip multicast-routing	Enables IPv4 multicast routing	GC
show ip mroute	Shows the IPv4 multicast routing table	PE

ip multicast-routing

This command enables IPv4 multicast routing. Use the **no** form to disable IP multicast routing.

Syntax

[no] ip multicast-routing

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

This command is used to enable IPv4 multicast routing globally for the router. A specific multicast routing protocol also needs to be enabled on the interfaces that will support multicast routing using the router pim command, and then specify the interfaces that will support multicast routing using the ip pim dense-mode or ip pim sparse-mode commands.

Example

```
Console(config)#ip multicast-routing
Console(config)#
```

show ip mroute

This command displays the IPv4 multicast routing table.

Syntax

show ip mroute [*group-address source*] [**summary**]

group-address - An IPv4 multicast group address with subscribers directly attached or downstream from this router.

source - The IPv4 subnetwork at the root of the multicast delivery tree. This subnetwork contains a known multicast source.

summary - Displays summary information for each entry in the IP multicast routing table.

Command Mode

Privileged Exec

Command Usage

This command displays information for multicast routing. If no optional parameters are selected, detailed information for each entry in the multicast address table is displayed. If you select a multicast group and source pair, detailed information is displayed only for the specified entry. If the **summary** option is selected, an abbreviated list of information for each entry is displayed on a single line.

Example

This example shows detailed multicast information for a specified group/source pair

```
Console#show ip mroute 224.0.255.3 192.111.46.8

IP Multicast Forwarding is enabled.

IP Multicast Routing Table
Flags: D - Dense, S - Sparse, s - SSM Channel, C - Connected, P - Pruned,
       F - Register flag, R - RPT-bit set, T - SPT-bit set, J - Join SPT
Interface state: F - Forwarding, P - Pruned, L - Local

(192.168.2.1, 224.0.17.17), uptime 00:00:05
Owner: PIM-DM, Flags: D
Incoming Interface: VLAN2, RPF neighbor: 192.168.2.1
Outgoing Interface List:
VLAN1(F)

Console#
```

This example lists all entries in the multicast table in summary form:

```
Console#show ip mroute summary

IP Multicast Forwarding is enabled

IP Multicast Routing Table (Summary)
Flags: F - Forwarding,  P - Pruned
     Group          Source        Source Mask    Interface  Owner   Flags
--------------- --------------- --------------- ---------- ------- ------
```

```
    224.0.17.17     192.168.2.1 255.255.255.255 VLAN2       PIM-DM  F
 Total Entry is 1

Console#
```

Section III

Appendices

This section provides additional information and includes these items:

A Troubleshooting

Problems Accessing the Management Interface

Table 194: Troubleshooting Chart

Symptom	Action
Cannot connect using Telnet, or SNMP software	■ Be sure the switch is powered up. ■ Check network cabling between the management station and the switch. Make sure the ends are properly connected and there is no damage to the cable. Test the cable if necessary. ■ Check that you have a valid network connection to the switch and that the port you are using has not been disabled. ■ Be sure you have configured the VLAN interface through which the management station is connected with a valid IP address, subnet mask and default gateway. ■ Be sure the management station has an IP address in the same subnet as the switch's IP interface to which it is connected. ■ If you are trying to connect to the switch via the IP address for a tagged VLAN group, your management station, and the ports connecting intermediate switches in the network, must be configured with the appropriate tag. ■ If you cannot connect using Telnet, you may have exceeded the maximum number of concurrent Telnet/SSH sessions permitted. Try connecting again at a later time.
Cannot connect using Secure Shell	■ If you cannot connect using SSH, you may have exceeded the maximum number of concurrent Telnet/SSH sessions permitted. Try connecting again at a later time. ■ Be sure the control parameters for the SSH server are properly configured on the switch, and that the SSH client software is properly configured on the management station. ■ Be sure you have generated an RSA public key on the switch, exported this key to the SSH client, and enabled SSH service. Try using another SSH client or check for updates to your SSH client application. ■ Be sure you have set up an account on the switch for each SSH user, including user name, authentication level, and password. ■ Be sure you have imported the client's public key to the switch (if public key authentication is used).
Cannot access the on-board configuration program via a serial port connection	■ Be sure you have set the terminal emulator program to VT100 compatible, 8 data bits, 1 stop bit, no parity, and the baud rate set to 115200 bps. ■ Verify that you are using the RJ-45 to DB-9 null-modem serial cable supplied with the switch. If you use any other cable, be sure that it conforms to the pin-out connections provided in the Installation Guide.
Forgot or lost the password	■ Contact your local distributor.

Using System Logs

If a fault does occur, refer to the Installation Guide to ensure that the problem you encountered is actually caused by the switch. If the problem appears to be caused by the switch, follow these steps:

1. Enable logging.
2. Set the error messages reported to include all categories.
3. Enable SNMP.
4. Enable SNMP traps.
5. Designate the SNMP host that is to receive the error messages.
6. Repeat the sequence of commands or other actions that lead up to the error.
7. Make a list of the commands or circumstances that led to the fault. Also make a list of any error messages displayed.
8. Set up your terminal emulation software so that it can capture all console output to a file. Then enter the “show tech-support” command to record all system settings in this file.
9. Contact your distributor’s service engineer, and send a detailed description of the problem, along with the file used to record your system settings.

For example:

```
Console(config)#logging on
Console(config)#logging history flash 7
Console(config)#snmp-server host 192.168.1.23
⋮
```

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