Edge-corE®

10G/40G Top-of-Rack Switches

AS5700-54X
AS6700-32X

Software Release v1.1.166.154

CLI Reference Guide

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CLI Reference Guide

AS5700-54X

54-Port 10G Ethernet Switch with
48 10GBASE SFP+ Ports,
6 40GBASE QSFP Ports,
2 Power Supply Units,
and 4 Fan Trays (4 Fans – F2B and B2F Airflow)

AS6700-32X

32-Port 40G Data Center Switch
with 20 40G QSFP+ Ports,
2 40G Expansion Slots,
2 Power Supply Units,
and 5 Fan Trays (5 Fans – F2B or B2F Airflow)

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How to Use 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 refer to the *Administrator's Guide*.

The guide includes these sections:

- Section I "Getting Started" — Includes information on connecting to the switch and basic configuration procedures.
- Section II "Command Line Interface" — 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

Note: For a general description of switch features, refer to "Introduction" in the *Web Management Guide*.

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

Installation 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.

Revision History

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

March 2016 Revision

This is the second version of this guide. This guide is valid for software release v1.1.166.154. It contains the following changes:

Table 1: Revision History

Description of Changes
Added:
Updated:
Deleted:

October 2015 Revision

This is the first version of this guide. This guide is valid for software release v1.1.0.152.

Contents

Figures

Tables

Section I

Getting Started

This section provides an overview of the switch, and introduces some basic concepts about network switches. It also describes the basic settings required to access the management interface.

This section includes these chapters:

1 Initial Switch Configuration

This chapter includes information on connecting to the switch and basic configuration procedures.

Connecting to the Switch

The switch includes a built-in network management agent. The agent offers a variety of management options, including SNMP, RMON and a web-based interface. A PC may also be connected directly to the switch for configuration and monitoring via a command line interface (CLI).

Note: An IPv4 address for this switch is obtained via DHCP by default. To change this address, see "Setting an IP Address" on page 62.

Configuration Options

The switch's HTTP web agent allows you to configure switch parameters, monitor port connections, and display statistics using a standard web browser such as Internet Explorer 8 or above, Mozilla Firefox 32 or above, and Google Chrome 39 or above. The switch's web management interface can be accessed from any computer attached to the network.

The CLI program can be accessed by a direct connection to the RS-232 serial console port on the switch, or remotely by a Telnet connection over the network.

The switch's management agent also supports SNMP (Simple Network Management Protocol). This SNMP agent permits the switch to be managed from any system in the network using network management software.

The switch's web interface, console interface, and SNMP agent allow you to perform the following management functions:

- Set user names and passwords
- Set an IP interface for any VLAN
- Configure SNMP parameters
- Enable/disable any port
- Set the speed/duplex mode for any port
- Configure the bandwidth of any port by limiting input or output rates

- Control port access through IEEE 802.1X security or static address filtering
- Filter packets using Access Control Lists (ACLs)
- Configure up to 4094 IEEE 802.1Q VLANs
- Configure IP routing for unicast or multicast traffic
- Configure router redundancy
- Configure IGMP multicast filtering
- Upload and download system firmware or configuration files via HTTP (using the web interface) or FTP/TFTP (using the command line or web interface)
- Configure Spanning Tree parameters
- Configure Class of Service (CoS) priority queuing
- Configure static or LACP trunks (up to 8)
- Enable port mirroring
- Set storm control on any port for excessive broadcast, multicast, or unknown unicast traffic
- Display system information and statistics

Connecting to the Console Port

The switch provides an RS-232 serial port that enables a connection to a PC or terminal for monitoring and configuring the switch. A null-modem console cable is provided with the switch.

Attach a VT100-compatible terminal, or a PC running a terminal emulation program to the switch. You can use the console cable provided with this package, or use a null-modem cable that complies with the wiring assignments shown in the Installation Guide.

To connect a terminal to the console port, complete the following steps:

1. Connect the console cable to the serial port on a terminal, or a PC running terminal emulation software, and tighten the captive retaining screws on the DB-9 connector.

2. Connect the other end of the cable to the RS-45 serial port on the switch.

3. 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.
   - When using HyperTerminal, select Terminal keys, not Windows keys.

4. Power on the switch.

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

Selecting Legacy or Hybrid Operation Mode

The switch supports two operating modes:

- **Legacy Mode** – Basic feature set, accessible via CLI, web interface, or SNMP.
- **Hybrid Mode** – Provides OpenFlow agent and OF-Data Plane Abstraction flow tables, switch configuration from OpenFlow controller, and partial legacy feature set. This operating mode is only accessible via the CLI and SNMP.

Note: For a list of differences in the features provided by Legacy Mode and Hybrid Mode, see "Legacy and Hybrid Operating Mode Feature Set Differences" on page 1073.

To select the operating mode, select one of the following options during bootup:

```
Select operation mode.  If no selection is made within 5 seconds,
the mode, Legacy (example), you used last time will start automatically.....

1 - Legacy mode
2 - Hybrid mode
Select (1, 2): Operation Mode : Legacy......
```

Logging Onto the Command Line Interface

The CLI program provides two different command levels — normal access level (Normal Exec) and privileged access level (Privileged Exec). The commands available at the Normal Exec level are a limited subset of those available at the Privileged Exec level and allow you to only display information and use basic utilities. 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. To log into the CLI at the Privileged Exec level using the default user name and password, perform these steps:

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

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

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

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

Setting Passwords

If this is your first time to log into the CLI program, you should define new passwords for both default user names 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 AOS5700-54X* 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)#
```

* This manual covers the AS5700-54X 10G and AS6700-32X 40G Layer 3 Ethernet switches. AS5700-54X and AS6700-32X are the bare metal switch names without any operating system installed. AOS5700-54X and AOS6700-32X are the same switches with the AOS operating system as described in this manual. Other than the difference in port types, there are no significant differences. Therefore most of the screen display examples are based on the AOS5700-54X.

Remote Connections (Network Interface or Craft Port)

Prior to accessing the switch's onboard agent via a network connection, you must first configure the switch's network interface or craft port with a valid IPv4 or IPv6 address.

The default network interface is VLAN 1 which includes ports 1-32/54. However, note that the switch also includes a Craft port on the front panel which provides a secure management channel that is 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.

When configuring the network interface, the IP address, subnet mask, and default gateway may all be set using a console connection, or DHCP protocol as described in the following sections.

An IPv4 address for the primary network interface is obtained via DHCP by default. To manually configure this address or enable dynamic address assignment via DHCP, see "Setting an IP Address" on page 62.

After configuring the switch's IP parameters, you can access the onboard configuration program from anywhere within the attached network. The onboard configuration program 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 web browser (Internet Explorer 8 or above, Mozilla Firefox 32 or above, and Google Chrome 39 or above).

Note: This switch supports eight Telnet sessions or SSH sessions.

The onboard program only provides access to basic configuration functions. To access the full range of SNMP management functions, you must use SNMP-based network management software.

Obtaining and Installing a License for the Network Ports

The operational ports (that is network ports but not the craft port) are disabled by default. These ports will only function when a port usage license is obtained from your distributor and installed on the switch.

To verify whether or not a port usage license is installed on the switch, enter the following command from the craft port. If the Link Down Reason displays "Invalid or Trial License, then you need to obtain and install a license for the network ports. Note that a trial licence limits the number of usable ports, whereas a valid license provides full access to all ports.

Note: A trial license provides access to ports 1-12 and 49-52 for one month.

```
Console#show interfaces status ethernet 1/1
Information of Eth 1/1
 Basic Information:
  Member port of trunk 1 was created by user.
  Port Type                      : 10GBASE SFP+
  MAC Address                    : 70-72-CF-EA-1B-72
 Configuration:
  Port Admin                     : Up
  Speed-duplex                   : 10G full
  Capabilities                   : 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
  Flow Control                   : Disabled
  LACP                           : Disabled
  MAC Learning                   : Enabled
  Link-up-down Trap              : Enabled
  Media Type                     : None
  MTU                            : 1518
```

```
Current Status:
 Link Status                  : Down
 Link Down Reason             : Invalid License or Trial License
 Operation Speed-duplex       : 10G full
 Flow Control Type            : None
 Max Frame Size               : 1522 bytes (1522 bytes for tagged frames)
 MAC Learning Status          : Enabled
```

To order a licence, you must provide the following information to your distributor:

- Switch model number (AOS5700-54X or AOS6700-32X)
- System MAC address. Enter the “show system” command from the craft port to display this information.

```
Console#show system
System Description : AOS5700-54X
System OID String  : 1.3.6.1.4.1.259.12.1.2.101
System Information
 System Up Time         : 0 days, 1 hours, 22 minutes, and 57.7 seconds
 System Name            :
 System Location        :
 System Contact         :
 MAC Address (Unit 1)   : 70-72-CF-EA-1B-71
 Web Server             : Enabled
 Web Server Port        : 80
 Web Secure Server      : Enabled
 Web Secure Server Port : 443
 Telnet Server          : Enabled
 Telnet Server Port     : 23
 Jumbo Frame            : Disabled
...
```

To install a license, first verify that the craft port is configured with a valid IP address using the “show interface” command. If no information is displayed for the craft interface, use the ”ip address” command to configure the IP address for the craft port as shown in the following example:

```
Console#configure
Console(config)#interface craft
Console(config-if)#ip address 192.168.0.200 255.255.255.0
Console(config-if)#
```

Download the corresponding license file as shown in the following example. Note that the license file is named according to the device MAC address. The network ports will be automatically activated within two minutes after successful installation.

```
Console#copy tftp file
TFTP server IP address: 192.168.0.102
Choose file type:
1. config; 2. opcode; 3. license: 3
Source file name: 7072CFEB9CE4.lic
```

```
Flash programming started.
Flash programming completed.
Success.
```

To display information on the installed file, enter the “show license file” command.

```
Console#show license file
aos-license/1.0
Name: Steve Rayward
CPU-MAC-Address: 70-72-CF-EA-1B-71
Project-Number: AOS5700-54X
License-Number: fef8deac-da47-43e5-9749-8e388b12dddc
License-Issue-Date: Fri May  8 05:41:01 2015
License-Valid-Start-Date: Fri May  8 00:00:00 2015
License-Valid-End-Date: Tue Jun 30 23:59:59 2015
License-Access-List: gf5zGdtiN8WPaSgQEPBm7WsU0MvylPKyKIC0mfIjbeCRz1GrK1TVm3IB
Yk9QLzbZl2Yq5OfZyseMpOszYpRFmxD969aLn9oWFYfUAX9pZi2KRp+A6m+PwYYaABDFw5NxoumC
yqS0vvZO63d8jpvoZMuBu+C69uIHmGw0dWKjtGwHty5xWDfMY44LvZbfktH7vTmVgnm/Ty/mSwll
lJd FtWTPfC7rRzXcngfiiMUmbJs=
Signature1: ImNS2m9IqBDVxzTsw+PZnHvFC6Z+irLIDylJNWPn65Lpv/AtxzmEAAhPrXgHJk4P9
VcNnYGmJ6CB0X9jnWYox86W5RCB6p+HbC7MFDY0gtUFmfNz16th+DaWOi+m2gAvc5Y/mXS9l/LZt
9Kcm4EfBi7Qxv2r0qayPu/QN9LMqOAi0RFs48Rz752fCwnCWgUYtgzI9YnK/Eq3lsWDC+w7y2CDS
vF/5IWGvr2xF5QFXJM8UG7BmK6A1fED/4CBjxwCgjRdTC/EAAllBN1/rHNNVGE82b6RhcBbmpgay
ijNc+ouARNguSIQdNfL8OrE7EdB3xLuxqw0WkAkLxvLMdJwtA==
Signature2: Gnd3p8D/
TuSee5ol1s3TF3fuGazqWaqYSy270I97Syoaztq3DfsAtd0NPoVOabb8iWqIGFqy43ieDkIaYB+E
pTZkUY8vFt6JOiIDsPQLrzu8W+HU6xcX9YS0UmBisZoSHSu+eJeHzpGupwdYhccOQ5gL2O5YK9f1
LGjsQz8sjHVwaa7u7NsOu26zt1XGrwq1Pj5jIzJc6uJ7QZBicjqbpqhNyUM9vmx2qnwYALfz2k8e
4IEsim3NrkleEkMcJTcHk7KiAkat5sEq83vgOoA0l+m/4fGC8Gmw84LPhSbeHwZDqY8Ziedt
tfX9IYDhU1DMh7ZlhMXsDVOWv+WQVYi22Q==
Console#
```

Configuring the Switch for Remote Management

Using the Service Port or Network Interface

The service port is a dedicated for out-of-band management. In general, the service 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 service port still allows you to access the switch’s management interface and troubleshoot network problems. Configuration options on the service 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 via a connection to any network port (1-32/54).

Setting an IP Address

You must establish IP address information for the switch to obtain management access through the network. This can be done in either of the following ways:

- **Manual** — You have to input the information, including IP address and subnet mask. If your management station is not in the same IP subnet as the switch, you will also need to specify the default gateway router.

- **Dynamic** — The switch can send IPv4 configuration requests to DHCP address allocation servers on the network, or can automatically generate a unique IPv6 host address based on the local subnet address prefix received in router advertisement messages. An IPv6 link local address for use in a local network can also be dynamically generated as described in "Obtaining an IPv6 Address" on page 66.

  This switch is designed as a router, and therefore does not support DHCP for IPv6, so an IPv6 global unicast address for use in a network containing more than one subnet can only be manually configured as described in "Assigning an IPv6 Address" on page 63.

Manual Configuration

You can manually assign an IP address to the switch. You may also need to specify a default gateway that resides between this device and management stations that exist on another network segment. Valid IPv4 addresses consist of four decimal numbers, 0 to 255, separated by periods. Anything outside this format will not be accepted by the CLI program.

Note: The IPv4 address for the network interface on this switch is obtained via DHCP by default.

Assigning an IPv4 Address

Before you can assign an IP address to the switch, you must obtain the following information from your network administrator:

- IP address for the switch

- Network mask for this network

- Default gateway for the network

To assign an IPv4 address to the switch, complete the following steps

1. From the Global Configuration mode prompt, type "interface vlan 1" to access the interface-configuration mode. Press <Enter>.

2. Type "ip address *ip-address netmask*," where "ip-address" is the switch IP address and "netmask" is the network mask for the network. Press <Enter>.

3. Type "exit" to return to the global configuration mode prompt. Press <Enter>.

4. To set the IP address of the default gateway for the network to which the switch belongs, type "ip default-gateway *gateway*," where "gateway" is the IP address of the default gateway. Press <Enter>.

```
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
```

Assigning an IPv6 Address

This section describes how to configure a "link local" address for connectivity within the local subnet only, and also how to configure a "global unicast" address, including a network prefix for use on a multi-segment network and the host portion of the address.

An IPv6 prefix or 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 to indicate the appropriate number of zeros required to fill the undefined fields. For detailed information on the other ways to assign IPv6 addresses, see "IPv6 Interface" on page 754.

Link Local Address — All link-local addresses must be configured with a prefix in the range of FE80~FEBF. Remember that this address type makes the switch accessible over IPv6 for all devices attached to the same local subnet only. Also, if the switch detects that the address you configured conflicts with that in use by another device on the subnet, it will stop using the address in question, and automatically generate a link local address that does not conflict with any other devices on the local subnet.

To configure an IPv6 link local address for the switch, complete the following steps:

1. From the Global Configuration mode prompt, type "interface vlan 1" to access the interface-configuration mode. Press <Enter>.

2. Type "ipv6 address" followed by up to 8 colon-separated 16-bit hexadecimal values for the *ipv6-address* similar to that shown in the example, followed by the "link-local" command parameter. Then press <Enter>.

```
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)#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):
(None)
Joined group address(es):
ff02::2
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: 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 advertised router lifetime is 1800 seconds

Console#
```

Address for Multi-segment Network — Before you can assign an IPv6 address to the switch that will be used to connect to a multi-segment network, you must obtain the following information from your network administrator:

- Prefix for this network
- IP address for the switch
- Default gateway for the network

For networks that encompass several different subnets, 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. The prefix length for an IPv6 network is the number of bits (from the left) of the prefix that form the network address, and is expressed as a decimal number. For example, all IPv6 addresses that start with the first byte of 73 (hexadecimal) could be expressed as 73:0:0:0:0:0:0:0/8 or 73::/8.

To generate an IPv6 global unicast address for the switch, complete the following steps:

1. From the global configuration mode prompt, type “interface vlan 1” to access the interface-configuration mode. Press <Enter>.

2. From the interface prompt, type “ipv6 address *ipv6-address*” or “ipv6 address *ipv6-address/prefix-length*,” where “prefix-length” indicates the address bits used to form the network portion of the address. (The network address starts from the left of the prefix and should encompass some of the ipv6-address bits.) The remaining bits are assigned to the host interface. Press <Enter>.

3. Type “exit” to return to the global configuration mode prompt. Press <Enter>.

4. To set the IP address of the IPv6 default gateway for the network to which the switch belongs, type “ipv6 default-gateway *gateway*,” where “gateway” is the IPv6 address of the default gateway. Press <Enter>.

```
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
Joined group address(es):
ff02::2
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: 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 advertised router lifetime is 1800 seconds

Console#show ipv6 default-gateway
ipv6 default gateway: 2001:DB8:2222:7272::254
Console#
```

Dynamic Configuration

Obtaining an IPv4 Address

If you select the “dhcp” option, the system will immediately start broadcasting service requests. IP will be enabled but will not function until a DHCP reply has been received. Requests are broadcast every few minutes using exponential backoff until IP configuration information is obtained from a DHCP server. DHCP values can include the IP address, subnet mask, and default gateway. If the DHCP server is slow to respond, you may need to use the “ip dhcp restart client” command to re-start broadcasting service requests.

Note that the “ip dhcp restart client” command can also be used to start broadcasting service requests for all VLANs configured to obtain address assignments through DHCP. It may be necessary to use this command when DHCP is configured on a VLAN, and the member ports which were previously shut down are now enabled.

If the “dhcp” option is saved to the startup-config file (step 6), then the switch will start broadcasting service requests as soon as it is powered on.

To automatically configure the switch by communicating with DHCP address allocation servers on the network, complete the following steps:

1. From the Global Configuration mode prompt, type “interface vlan 1” to access the interface-configuration mode. Press <Enter>.

2. At the interface-configuration mode prompt, use the following command:

   - To obtain IP settings via DHCP, type “ip address dhcp” and press <Enter>.

3. Type “end” to return to the Privileged Exec mode. Press <Enter>.

4. Wait a few minutes, and then check the IP configuration settings by typing the “show ip interface” command. Press <Enter>.

5. Then save your configuration changes by typing “copy running-config startup-config.” Enter the startup file name and press <Enter>.

```
Console(config)#interface vlan 1
Console(config-if)#ip address dhcp
Console(config-if)#end
Console#show ip interface
VLAN 1 is Administrative Up - Link Up
  Address is 00-E0-0C-00-00-FB
  Index: 1001, MTU: 1500
  Address Mode is DHCP
  IP Address: 192.168.0.2 Mask: 255.255.255.0
  Proxy ARP is disabled
Console#copy running-config startup-config
Startup configuration file name []: startup
\Write to FLASH Programming.

\Write to FLASH finish.
Success.
```

Obtaining an IPv6 Address

Link Local Address — There are several ways to configure IPv6 addresses. The simplest method is to automatically generate a “link local” address (identified by an address prefix in the range of FE80~FEBF). This address type makes the switch accessible over IPv6 for all devices attached to the same local subnet.

To generate an IPv6 link local address for the switch, complete the following steps:

1. From the Global Configuration mode prompt, type “interface vlan 1” to access the interface-configuration mode. Press <Enter>.

2. Type “ipv6 enable” and press <Enter>.

```
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::260:3EFF:FE11:6700/64
Global unicast address(es):
  2001:DB8:2222:7272::/64, subnet is 2001:DB8:2222:7272::/64
Joined group address(es):
FF02::1:FF00:0
FF02::1:FF11:6700
FF02::1
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 advertised router lifetime is 1800 seconds

Console#
```

Enabling SNMP Management Access

The switch can be configured to accept management commands from Simple Network Management Protocol (SNMP) applications such as Edge-Core ECView Pro. You can configure the switch to respond to SNMP requests or generate SNMP traps.

When SNMP management stations send requests to the switch (either to return information or to set a parameter), the switch provides the requested data or sets the specified parameter. The switch can also be configured to send information to SNMP managers (without being requested by the managers) through trap messages, which inform the manager that certain events have occurred.

The switch includes an SNMP agent that supports SNMP version 1, 2c, and 3 clients. To provide management access for version 1 or 2c clients, you must specify a community string. The switch provides a default MIB View (i.e., an SNMPv3 construct) for the default “public” community string that provides read access to the entire MIB tree, and a default view for the “private” community string that provides read/write access to the entire MIB tree. However, you may assign new views to version 1 or 2c community strings that suit your specific security requirements (see snmp-server view command).

Community Strings (for SNMP version 1 and 2c clients)

Community strings are used to control management access to SNMP version 1 and 2c stations, as well as to authorize SNMP stations to receive trap messages from the switch. You therefore need to assign community strings to specified users, and set the access level.

The default strings are:

- **public** - with read-only access. Authorized management stations are only able to retrieve MIB objects.
- **private** - with read/write access. Authorized management stations are able to both retrieve and modify MIB objects.

To prevent unauthorized access to the switch from SNMP version 1 or 2c clients, it is recommended that you change the default community strings.

To configure a community string, complete the following steps:

1. From the Privileged Exec level global configuration mode prompt, type “snmp-server community *string mode*,” where “string” is the community access string and “mode” is **rw** (read/write) or **ro** (read only). Press <Enter>. (Note that the default mode is read only.)

2. To remove an existing string, simply type “no snmp-server community *string*,” where “string” is the community access string to remove. Press <Enter>.

```
Console(config)#snmp-server community admin rw
Console(config)#snmp-server community private
Console(config)#
```

Note: If you do not intend to support access to SNMP version 1 and 2c clients, we recommend that you delete both of the default community strings. If there are no community strings, then SNMP management access from SNMP v1 and v2c clients is disabled.

Trap Receivers

You can also specify SNMP stations that are to receive traps from the switch. To configure a trap receiver, use the “snmp-server host” command. From the Privileged Exec level global configuration mode prompt, type:

> “snmp-server host *host-address community-string* [version {1 | 2c | 3 {auth | noauth | priv}}]”

where “host-address” is the IP address for the trap receiver, “community-string” specifies access rights for a version 1/2c host, or is the user name of a version 3 host, “version” indicates the SNMP client version, and “auth | noauth | priv” means that authentication, no authentication, or authentication and privacy is used for v3 clients. Then press <Enter>. For a more detailed description of these parameters, see the snmp-server host command. The following example creates a trap host for each type of SNMP client.

```
Console(config)#snmp-server host 10.1.19.23 batman
Console(config)#snmp-server host 10.1.19.98 robin version 2c
Console(config)#snmp-server host 10.1.19.34 barbie version 3 auth
Console(config)#
```

Configuring Access for SNMP Version 3 Clients

To configure management access for SNMPv3 clients, you need to first create a view that defines the portions of MIB that the client can read or write, assign the view to a group, and then assign the user to a group. The following example creates one view called “mib-2” that includes the entire MIB-2 tree branch, and then another view that includes the IEEE 802.1d bridge MIB. It assigns these respective read and read/write views to a group call "r&d" and specifies group authentication via MD5 or SHA. In the last step, it assigns a v3 user to this group, indicating that MD5 will be used for authentication, provides the password "greenpeace" for authentication, and the password "einstien" for encryption.

```
Console(config)#snmp-server view mib-2 1.3.6.1.2.1 included
Console(config)#snmp-server view 802.1d 1.3.6.1.2.1.17 included
Console(config)#snmp-server group r&d v3 auth mib-2 802.1d
Console(config)#snmp-server user steve r&d v3 auth md5 greenpeace priv des56
  einstien
Console(config)#
```

For a more detailed explanation on how to configure the switch for access from SNMP v3 clients, refer to the *CLI Reference Guide* or *Web Management Guide*.

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/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 71 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/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 switch has a total of 2 GB of flash memory for system files.

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: 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#config
Console(config)#boot system opcode: m360.bix
Console(config)#exit
Console#dir
        File Name                  Type  Startup Modify Time         Size(bytes)
------------------------- -------------- ------- ------------------- ----------
 Unit 1:
runtime.bix                  OpCode  Y       1972-05-18 21:50:04     32842013
Factory_Default_Config.cfg   Config  N       2014-12-30 02:34:32          455
startup1.cfg                 Config  Y       2014-12-30 02:34:38         2917
 ---------------------------------------------------------------------------
                        Free space for compressed user config files:1593241600
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#
```

Configuring Automatic Installation of Operation Code and Configuration Settings

Downloading Operation Code from a File Server

Automatic Operation Code Upgrade can automatically download an operation code file when a file newer than the currently installed one is discovered on the file server. After the file is transferred from the server and successfully written to the file system, it is automatically set as the startup file, and the switch is rebooted.

Usage Guidelines

- If this feature is enabled, the switch searches the defined URL once during the bootup sequence.
- 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.
- 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 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 ecs5610-52s.bix (using lower case letters as indicated).
- 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 switch-based search function is case-insensitive in that it will accept a file name in upper or lower case (i.e., the switch will accept *AOS5700-54X.BIX* from the server even though *AOS5700-54X.bix* was requested). However, keep in mind that the file systems of many operating systems such as Unix and most Unix-like systems (FreeBSD, NetBSD, OpenBSD, and most Linux distributions, etc.) are case-sensitive, meaning that two files in the same directory, *aos5700-52x.bix*. and *AOS5700-*54X.*BIX* are considered to be unique files. Thus, if

the upgrade file is stored as *AOS5700-54X.BIX* (or even *Aos5700-54x.bix*) on a case-sensitive server, then the switch (requesting *AOS5700-54X.bix*) will not be upgraded because the server does not recognize the requested file name and the stored file name as being equal. A notable exception in the list of case-sensitive Unix-like operating systems is Mac OS X, which by default is case-insensitive. Please 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.

To enable automatic upgrade, enter the following commands:

1. Specify the TFTP or FTP server to check for new operation code.

   - 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.

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)#
```

2. Set the switch to automatically reboot and load the new code after the opcode upgrade is completed.

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

3. Set the switch to automatically upgrade the current operational code when a new version is detected on the server. When the switch starts up and automatic image upgrade is enabled by this command, the switch will follow these steps when it boots up:

   a. 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 aos5700-54x.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.

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

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

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

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

4. Display the automatic upgrade settings.

```
Console#show upgrade
Auto Image Upgrade Global Settings:
  Status     : Enabled
  Reload Status : Enabled
  Path       :
  File Name : aos5700-54x.bix
Console#
```

Specifying a DHCP Client Identifier

DHCP servers index their database of address bindings using the client's Media Access Control (MAC) Address or a unique client identifier. The client identifier 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.

DHCP client Identifier (Option 60) is used by DHCP clients to specify their unique identifier. The client identifier is optional and can be specified while configuring DHCP on the primary network interface. DHCP Option 60 is disabled by default.

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 (vendor-class-identifier), 66 (tftp-server-name) and 67 (bootfile-name) statements can be added to the server daemon's configuration file as described in the following section.

If the DHCP server has an index entry for a switch requesting service, it should reply with the TFTP server name and boot file name. Note that the vendor class identifier can be formatted in either text or hexadecimal, but the format used by both the client and server must be the same.

```
Console(config)#interface vlan 2
Console(config-if)#ip dhcp client class-id hex 0000e8666572
Console(config-if)#
```

Downloading a Configuration File Referenced by a DHCP Server

Information passed on to the switch from a DHCP server may also include a configuration file to be downloaded and the TFTP servers where that file can be accessed. If the Factory Default Configuration file is used to provision the switch at startup, in addition to requesting IP configuration settings from the DHCP server, it will also ask for the name of a bootup configuration file and TFTP servers where that file is stored.

If the switch receives information that allows it to download the remote bootup file, it will save this file to a local buffer, and then restart the provision process.

Note the following DHCP client behavior:

- The bootup configuration file received from a TFTP server is stored on the switch with the original file name. If this file name already exists in the switch, the file is overwritten.

- If the name of the bootup configuration file is the same as the Factory Default Configuration file, the download procedure will be terminated, and the switch will not send any further DHCP client requests.

- If the switch fails to download the bootup configuration file based on information passed by the DHCP server, it will not send any further DHCP client requests.

- If the switch does not receive a DHCP response prior to completing the bootup process, it will continue to send a DHCP client request once a minute. These requests will only be terminated if the switch's address is manually configured, but will resume if the address mode is set back to DHCP.

To successfully transmit a bootup configuration file to the switch, the DHCP daemon (using a Linux based system for this example) must be configured with the following information:

- Options 60, 66 and 67 statements can be added to the daemon's configuration file.

Table 2: 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 these items, the client request also includes a "vendor class identifier" 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 3: Options 55 and 124 Statements

Option	Statement	
	Keyword	Parameter
55	dhcp-parameter-request-list	a list of parameters, separated by a comma ', '
124	vendor-class-identifier	a string indicating the vendor class identifier

The following configuration example is provided for a Linux-based DHCP daemon (dhcpd.conf file). In the "Vendor class" section, the server will always send Option 66 and 67 to tell the switch to download the "test" configuration file from server 192.168.255.101.

```
ddns-update-style ad-hoc;

default-lease-time 600;
max-lease-time 7200;
```

```
log-facility local7;

server-name "Server1";
Server-identifier 192.168.255.250;
#option 66, 67
 option space dynamicProvision code width 1 length 1 hash size 2;
 option dynamicProvision.tftp-server-name code 66 = text;
 option dynamicProvision.bootfile-name code 67 = text;

subnet 192.168.255.0 netmask 255.255.255.0 {
  range 192.168.255.160 192.168.255.200;
  option routers 192.168.255.101;
  option tftp-server-name "192.168.255.100"; #Default Option 66
  option bootfile-name "bootfile";           #Default Option 67
}

class "Option66,67_1" {               #DHCP Option 60 Vendor class
two
  match if option vendor-class-identifier = "aos5700-54x.cfg";
  option tftp-server-name "192.168.255.101";
  option bootfile-name "test";
}
```

Note: Use “aos5700-54x.cfg” for the vendor-class-identifier in the dhcpd.conf file.

Setting the System Clock

Simple Network Time Protocol (SNTP) or Network Time Protocol (NTP) can be used to set the switch’s internal clock based on periodic updates from a time server. Maintaining an accurate time on the switch enables the system log to record meaningful dates and times for event entries. You can also manually set the clock. If the clock is not set manually or via SNTP or NTP, the switch will only record the time from the factory default set at the last bootup.

When the SNTP client is enabled, the switch periodically sends a request for a time update to a configured time server. You can configure up to three time server IP addresses. The switch will attempt to poll each server in the configured sequence.

The switch also supports the following time settings:

- Time Zone – You can specify the offset from Coordinated Universal Time (UTC), also known as Greenwich Mean Time (GMT).
- Summer Time/Daylight Saving Time (DST) – In some regions, the time shifts by one hour in the fall and spring. The switch supports manual entry for one-time or recurring clock shifts.

Setting the Time Manually

To manually set the clock to 14:11:36, April 1st, 2013, enter this command.

```
Console#calendar set 14 11 36 1 April 2013
Console#
```

To set the time zone, enter a command similar to the following.

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

To set the time shift for summer time, enter a command similar to the following.

```
Console(config)#clock summer-time SUMMER date 2 april 2013 0 0 30 june 2013 0
  0
Console(config)#
```

To display the clock configuration settings, enter the following command.

```
Console#show calendar
 Current Time           : Apr  2 15:56:12 2013
 Time Zone              : UTC, 08:00
 Summer Time            : SUMMER, offset 60 minutes
                          Apr 2 2013 00:00 to Jun 30 2013 00:00
 Summer Time in Effect : Yes
Console#
```

Configuring SNTP

Setting the clock based on an SNTP server can provide more accurate clock synchronization across network switches than manually-configured time. To configure SNTP, set the switch as an SNTP client, and then set the polling interval, and specify a time server as shown in the following example.

```
Console(config)#sntp client
Console(config)#sntp poll 60
Console(config)#sntp server 10.1.0.19
Console(config)#exit
Console#show sntp
Current Time   : Apr  2 16:06:07 2013
Poll Interval  : 60 seconds
Current Mode   : Unicast
SNTP Status    : Enabled
SNTP Server    : 10.1.0.19
Current Server : 10.1.0.19
Console#
```

Configuring NTP

Requesting the time from a an NTP server is the most secure method. 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.

When more than one time server is configured, the client will poll all of the time servers, and compare the responses to determine the most reliable and accurate time update for the switch.

To configure NTP time synchronization, enter commands similar to the following.

```
Console(config)#ntp client
Console(config)#ntp authentication-key 45 md5 thisiskey45
Console(config)#ntp authenticate
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)#exit
Console#show ntp
Current Time              : Apr 29 13:57:32 2011
Polling                   : 1024 seconds
Current Mode              : unicast
NTP Status                : Enabled
NTP Authenticate Status   : Enabled
Last Update NTP Server    : 192.168.0.88        Port: 123
Last Update Time          : Mar 12 02:41:01 2013 UTC
NTP Server 192.168.0.88 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

Current Time              : Apr  2 16:28:34 2013
Polling                   : 1024 seconds
Current Mode              : unicast
NTP Status                : Enabled
NTP Authenticate Status   : Enabled
Last Update NTP Server    : 192.168.5.23     Port: 0
Last Update Time          : Apr  2 16:00:00 2013 UTC
NTP Server 192.168.3.20 version 3
NTP Server 192.168.3.21 version 3
NTP Server 192.168.5.23 version 3 key 19
NTP Authentication Key 45 md5 2662T75S5658RU5424180034777
Console#
```

Section II

Command Line Interface

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

This section includes these chapters:

- "Class of Service Commands" on page 507
- "Quality of Service Commands" on page 527
- "Multicast Filtering Commands" on page 581
- "LLDP Commands" on page 653
- "CFM Commands" on page 681
- "DHCP Commands" on page 733
- "IP Interface Commands" on page 741
- "VRRP Commands" on page 791
- "IP Routing Commands" on page 801
- "Multicast Routing Commands" on page 1013

2

Using the Command Line Interface

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

Accessing the CLI

When accessing the management interface for the switch over a direct connection to the server’s console port, or via a Telnet or Secure Shell connection (SSH), the switch can be managed by entering command keywords and parameters at the prompt. Using the switch's command-line interface (CLI) is very similar to entering commands on a UNIX system.

Console Connection

To access the switch through the console port, perform these steps:

1. At the console prompt, enter the user name and password. (The default user names are “admin” and “guest” with corresponding passwords of “admin” and “guest.”) When the administrator user name and password is entered, the CLI displays the “Console#” prompt and enters privileged access mode (i.e., Privileged Exec). But when the guest user name and password is entered, the CLI displays the “Console>” prompt and enters normal access mode (i.e., Normal Exec).

2. Enter the necessary commands to complete your desired tasks.

3. When finished, exit the session with the “quit” or “exit” command.

After connecting to the system through the console port, the login screen displays:

```
User Access Verification
Username: admin
Password:
  CLI session with the AOS5700-54X is opened.
  To end the CLI session, enter [Exit].
Console#
```

Telnet Connection

Telnet operates over the IP transport protocol. In this environment, your management station and any network device you want to manage over the network must have a valid IP address. Valid IP addresses consist of four numbers, 0 to 255, separated by periods. Each address consists of a network portion and host portion. For example, the IP address assigned to this switch, 10.1.0.1, consists of a network portion (10.1.0) and a host portion (1).

Note: The IP address for this switch is obtained via DHCP by default.

To access the switch through a Telnet session, you must first set the IP address for the Master unit, and set the default gateway if you are managing the switch from a different IP subnet. For example,

```
Console(config)#interface vlan 1
Console(config-if)#ip address 10.1.0.254 255.255.255.0
Console(config-if)#exit
Console(config)#ip default-gateway 10.1.0.254
Console(config)#
```

If your corporate network is connected to another network outside your office or to the Internet, you need to apply for a registered IP address. However, if you are attached to an isolated network, then you can use any IP address that matches the network segment to which you are attached.

After you configure the switch with an IP address, you can open a Telnet session by performing these steps:

1. From the remote host, enter the Telnet command and the IP address of the device you want to access.
2. At the prompt, enter the user name and system password. The CLI will display the "Vty-*n*#" prompt for the administrator to show that you are using privileged access mode (i.e., Privileged Exec), or "Vty-*n*>" for the guest to show that you are using normal access mode (i.e., Normal Exec), where *n* indicates the number of the current Telnet session.
3. Enter the necessary commands to complete your desired tasks.
4. When finished, exit the session with the "quit" or "exit" command.

After entering the Telnet command, the login screen displays:

```
Username: admin
Password:

  CLI session with the AOS5700-54X is opened.
  To end the CLI session, enter [Exit].

Vty-0#
```

Note: You can open up to eight sessions to the device via Telnet or SSH.

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.

You can enter commands as follows:

- To enter a simple command, enter the command keyword.
- To enter multiple commands, enter each command in the required order. For example, to enable Privileged Exec command mode, and display the startup configuration, enter:

  ```
  Console>enable
  Console#show startup-config
  ```

- To enter commands that require parameters, enter the required parameters after the command keyword. For example, to set a password for the administrator, enter:

  ```
  Console(config)#username admin password 0 smith
  ```

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 ?**" displays a list of possible show commands:

```
Console#show ?
  access-group          Access groups
  access-list           Access lists
  arp                   Information of ARP cache
  banner                Banner info
  bridge-ext            Bridge extension information
  calendar              Date and time information
  class-map             Displays class maps
  cn                    Displays congestion notification information
  dcbx                  DCBX
  debug                 State of each debugging option
  dns                   DNS information
  dot1q-tunnel          802.1Q tunnel
  dot1x                 802.1X content
  ecmp                  ECMP information
  ethernet              Shows Metro Ethernet information
  ets                   802.1Qaz configuration
  hardware              Hardware ralated functions
  hash-selection        Hash selection lists
  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               show license
  line                  TTY line information
  lldp                  LLDP
  location-led          Location LED operation
  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
  management            Shows management information
  memory                Memory utilization
  mlag                  Displays MLAG information
  network-access        Shows the entries of the secure port
  nlm                   Show notification log
  ntp                   Network Time Protocol configuration
  pfc                   Displays Priority-based Flow Control Information
  policy-map            Displays policy maps
  port                  Port characteristics
  port-channel          Port channel information
  process               Device process
  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 Protocol
  route-map             Shows route-map
  rspan                 Display status of the current RSPAN configuration
  running-config        Information on the running configuration
  sflow                 Shows the sflow 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
  system                System information
  tacacs-server         TACACS server information
  tech-support          Technical information
  traffic-segmentation  Traffic segmentation 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
  vrrp                  Shows VRRP
  vxlan                 Shows VXLAN 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                  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 which 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           snmp            snmp-server     sntp            spanning-tree
ssh             startup-config  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 4: General Command Modes

Class	Mode	
Exec	Normal Privileged	
Configuration	Global*	Access Control List CFM Class Map DHCP IGMP Profile Interface Line Multiple Spanning Tree Policy Map Route Map Router ~~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 AOS5700-54X is opened.
  To end the CLI session, enter [Exit].

Console#
```

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

  CLI session with the AOS5700-54X 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.

The configuration commands are organized into different modes:

- Global Configuration - These commands modify the system level configuration, and include commands such as **hostname** and **snmp-server community**.
- Access Control List Configuration - These commands are used for packet filtering.
- CFM Configuration - Configures connectivity monitoring using continuity check messages, fault verification through loopback messages, and fault isolation by examining end-to-end connections between Provider Edge devices or between Customer Edge devices.
- Class Map Configuration - Creates a DiffServ class map for a specified traffic type.
- DHCP Configuration - These commands are used to configure the DHCP server.

- IGMP Profile - Sets a profile group and enters IGMP filter profile configuration mode.
- Interface Configuration - These commands modify the port configuration such as **speed-duplex** and **negotiation**.
- Line Configuration - These commands modify the console port and Telnet configuration, and include command such as **parity** and **databits**.
- Multiple Spanning Tree Configuration - These commands configure settings for the selected multiple spanning tree instance.
- Policy Map Configuration - Creates a DiffServ policy map for multiple interfaces.
- Route Map Configuration - These commands specify the action (next hop or silently drop) to take when a match is found.
- Router Configuration - These commands configure global settings for unicast and multicast routing protocols.
- ~~Time Range - Sets a time range for use by other functions, such as Access Control Lists.~~
- VLAN Configuration - Includes the command to create VLAN groups.

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 5: Configuration Command Modes

Mode	Command	Prompt	Page
Access Control List	access-list ip standard	Console(config-std-acl)	336
	access-list ip extended	Console(config-ext-acl)	336
	access-list ipv6 standard	Console(config-std-ipv6-acl)	342
	access-list ipv6 extended	Console(config-ext-ipv6-acl)	342
	access-list mac	Console(config-mac-acl)	347
CFM	ethernet cfm domain	Console(config-ether-cfm)	681
Class Map	class-map	Console(config-cmap)	528
Interface	interface {ethernet *port* | port-channel *id*| vlan *id*}	Console(config-if)	360
Line	line {console | vty}	Console(config-line)	142

Table 5: Configuration Command Modes (Continued)

Mode	Command	Prompt	Page
MSTP	spanning-tree mst-configuration	Console(config-mstp)	449
Policy Map	policy-map	Console(config-pmap)	531
Route Map	route-map	Console(config-route-map)	993
Router	router { bgp | ipv6 ospf | ospf } pim } pim6 | rip	Console(config-router)	908 882 839 1022 1047 820
~~Time Range~~	~~time-range~~	~~Console(config-time-range)~~	178
VLAN	vlan database	Console(config-vlan)	472

For example, you can use the following commands to enter interface configuration mode, and then return to Privileged Exec mode

```
Console(config)#interface ethernet 1/5
.
.
.
Console(config-if)#exit
Console(config)#
```

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 6: 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.

CLI Command Groups

The system commands can be broken down into the functional groups shown below.

Table 7: Command Group Index

Command Group	Description	Page
General	Basic commands for entering privileged access mode, restarting the system, or quitting the CLI	95
System Management	Display and setting of system information, basic modes of operation, maximum frame size, file management, console port and telnet settings, system logs, SMTP alerts, and the system clock,	103
Simple Network Management Protocol	Activates authentication failure traps; configures community access strings, and trap receivers	181
Remote Monitoring	Supports statistics, history, alarm and event groups	203
User Authentication	Configures user names and passwords, logon access using local or remote authentication, management access through the web server, Telnet server and Secure Shell; as well as port security, IEEE 802.1X port access control, and restricted access based on specified IP addresses,	211
General Security Measures	Segregates traffic for clients attached to common data ports; and prevents unauthorized access by configuring valid static or dynamic addresses, web authentication, MAC address authentication, filtering DHCP requests and replies, and discarding invalid ARP responses	255
Access Control List	Provides filtering for IPv4 frames (based on address, protocol, TCP/UDP port number or TCP control code), IPv6 frames (based on address, or non-IP frames (based on MAC address or Ethernet type)	335
Interface	Configures the connection parameters for all Ethernet ports, aggregated links, and VLANs	359
Link Aggregation	Statically groups multiple ports into a single logical trunk; configures Link Aggregation Control Protocol for port trunks	389
Mirror Port	Mirrors data to another port for analysis without affecting the data passing through or the performance of the monitored port	409
Congestion Control	Sets the input/output rate limits, traffic storm thresholds, and thresholds for broadcast and multicast storms which can be used to trigger configured rate limits or to shut down a port.	419
UniDirectional Link Detection	Detect and disables unidirectional links	429
Address Table	Configures the address table for filtering specified addresses, displays current entries, clears the table, or sets the aging time	437
Spanning Tree	Configures Spanning Tree settings for the switch	443
VLANs	Configures VLAN settings, and defines port membership for VLAN groups	467
Class of Service	Sets port priority for untagged frames, selects strict priority or weighted round robin, relative weight for each priority queue, also sets priority for TCP/UDP traffic types, IP precedence, and DSCP	507

Table 7: Command Group Index (Continued)

Command Group	Description	Page
Quality of Service	Configures Differentiated Services	527
Multicast Filtering	Configures IGMP multicast filtering, query, profile, and proxy parameters; specifies ports attached to a multicast router	581
Link Layer Discovery Protocol	Configures LLDP settings to enable information discovery about neighbor devices	653
Domain Name Service	Configures DNS services.	723
Dynamic Host Configuration Protocol	Configures DHCP client, relay and server functions	733
Router Redundancy	Configures router redundancy to create primary and backup routers	791
IP Interface	Configures IP address for the switch interfaces; also configures ARP parameters	741
IP Routing	Configures static unicast routing, policy-based unicast routing for BGP, and dynamic unicast routing	801
Multicast Routing	Configures static multicast routing for IPv4	1013
Data Center	Configures Database Center Bridging Exchange (DCBX), Congestion Notification (CN), Enhanced Transmission Selection (ETS), Priority-Based Flow Control (PFC), and OpenFlow	545
Debug	Displays debugging information for all key function These commands are not described in this manual Please refer to the prompt messages included in the CLI interface.	

The access mode shown in the following tables is indicated by these abbreviations:

ACL (Access Control List Configuration)
CFM (Connectivity Fault Management Configuration)
CM (Class Map Configuration)
DC (DHCP Server Configuration)
GC (Global Configuration)
IC (Interface Configuration)
IPC (IGMP Profile Configuration)
LC (Line Configuration)
MST (Multiple Spanning Tree)
NE (Normal Exec)
PE (Privileged Exec)
PM (Policy Map Configuration)
RC (Router Configuration)
RM (Route Map Configuration)
VC (VLAN Database Configuration)

3 General Commands

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

Table 8: 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
help	Shows how to use help	any mode
?	Shows options for command completion (context sensitive)	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: 255 characters)

Default Setting

Console

Command Mode

Global Configuration

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*} |
regularity *hour minute* [**period** {**daily** | **weekly** *day-of-week* | **monthly** *day*}] |
cancel [**at** | **in** | **regularity**]}

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: 0-59)

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

reload cancel - Cancels the specified reload option.

Default Setting

None

Command Mode

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 129).

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 2013 ---
***

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 88.

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#
```

Related Commands

disable (100)
enable password (212)

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 88.

Default Setting

None

Command Mode

Privileged Exec

Example

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

Related Commands

end (101)

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 88.

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>
```

Related Commands

enable (97)

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 2001.
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:
```

4

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 9: System Management Commands

Command Group	Function
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
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~~

Device Designation

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

Table 10: 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.
- This command and the prompt 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)#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 11: 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

Table 11: Banner Commands (Continued)

Command	Function	Mode
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	NE, 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: Edge-Core 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 ECS4660-28F
  floor 3 row 10 rack 15 shelf-rack 12 manufacturer Edge-Core
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

Normal Exec, Privileged Exec

Example

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

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

Station's information:
710_Network_Path,_Indianapolis

 Edge-Core - ECS4660-28F
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 12: System Status Commands

Command	Function	Mode
location-led	Flashes the Locator LED to indicate the unit to which you are connected	PE
show access-list tcam-utilization	Shows utilization parameters for TCAM	PE

Table 12: System Status Commands (Continued)

Command	Function	Mode
show license file	Shows information on the installed license file required for the network ports	PE
show location-led status	Shows if location LED function is enabled or not	PE
show memory	Shows memory utilization parameters	NE, PE
show process cpu	Shows CPU utilization parameters	NE, 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

location-led

This command flashes the Locator LED to indicate the unit to which you are connected.

Syntax

location-led {**on** | **off**}

Command Mode

Privileged Exec

Command Usage

The Locator LED is labeled “Loc.” It is located in the upper right corner of the front panel.

Example

```
Console#location-led on
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, the number of free entries, and the overall percentage of TCAM in use.

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,
  AEM - Egress MAC ACL, AE4 - Egress IPv4 ACL,
  AE6S - Egress IPv6 standard ACL, AE6E - Egress IPv6 extended ACL,
  DEM - Egress MAC diffServ, DE4 - Egress IPv4 diffServ,
  DE6S - Egress IPv6 standard diffServ,
  DE6E - Egress IPv6 extended diffServ, W - Web authentication,
  I - IP source guard, I6 - IPv6 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     0   128 A6S D6S
   1      0    1   128     0   128 A6E D6E C L
   1      0    2   128     0   128 A4 D4
   1      0    3   128     0   128 AM DM
   1      0    4   128   128     0 I
   1      0    5   128   128     0 Reserved
   1      0    6    64    64     0 C
   1      0    7   128   128     0 I6
   1      0    8   128   128     0 W
   1      0    9   128     0   128 AE6S DE6S
   1      0   10   128     0   128 AE6E DE6E
   1      0   11   128     0   128 AE4 DE4
   1      0   12   128     0   128 AEM DEM

Console#
```

Table 13: show access-list tcam-utilization - display description

Field	Description
Pool Capability Code	Abbreviation for processes shown in the TCAM List.
Unit	Stack unit identifier.
Device	Memory chip used for indicated pools.

Table 13: show access-list tcam-utilization - display description (Continued)

Field	Description
Pool	Rule slice (or call group). Each slice has a fixed number of rules that are used for the specified features.
Total	The maximum number of policy control entries allocated to the each pool.
Used	The number of policy control entries used by the operating system.
Free	The number of policy control entries available for use.
Capability	The processes assigned to each pool.

show license file

This command shows information on the installed license file required to enable the network ports. For information on the port usage license, see "Obtaining and Installing a License for the Network Ports" on page 59.

Command Mode

Privileged Exec

Example

```
Console#show license file
aos-license/1.0
Name: Steve Rayward
CPU-MAC-Address: 70-72-CF-EA-1B-71
Project-Number: AOS5700-54X
License-Number: fef8deac-da47-43e5-9749-8e388b12dddc
License-Issue-Date: Fri May  8 05:41:01 2015
License-Valid-Start-Date: Fri May  8 00:00:00 2015
License-Valid-End-Date: Tue Jun 30 23:59:59 2015
License-Access-List: gf5zGdtiN8WPaSgQEPBm7WsU0MvylPKyKIC0mfIjbeCRz1GrK1TVm3IB
Yk9QLzbZl2Yq5OfZyseMpOszYpRFmxD969aLn9oWFYfUAX9pZi2KRp+A6m+PwYYaABDFw5NxoumC
yqS0vvZO63d8jpvoZMuBu+C69uIHmGw0dWKjtGwHty5xWDfMY44LvZbfktH7vTmVgnm/Ty/mSwll
lJd FtWTPfC7rRzXcngfiiMUmbJs=
Signature1: ImNS2m9IqBDVxzTsw+PZnHvFC6Z+irLIDylJNWPn65Lpv/AtxzmEAAhPrXgHJk4P9
VcNnYGmJ6CB0X9jnWYox86W5RCB6p+HbC7MFDY0gtUFmfNz16th+DaWOi+m2gAvc5Y/mXS9l/LZt
9Kcm4EfBi7Qxv2r0qayPu/QN9LMqOAi0RFs48Rz752fCwnCWgUYtgzI9YnK/Eq3lsWDC+w7y2CDS
vF/5IWGvr2xF5QFXJM8UG7BmK6A1fED/4CBjxwCgjRdTC/EAAllBN1/rHNNVGE82b6RhcBbmpgay
ijNc+ouARNguSIQdNfL8OrE7EdB3xLuxqw0WkAkLxvLMdJwtA==
Signature2: Gnd3p8D/
TuSee5ol1s3TF3fuGazqWaqYSy270I97Syoaztq3DfsAtd0NPoVOabb8iWqIGFqy43ieDkIaYB+E
pTZkUY8vFt6JOiIDsPQLrzu8W+HU6xcX9YS0UmBisZoSHSu+eJeHzpGupwdYhccOQ5gL2O5YK9f1
LGjsQz8sjHVwaa7u7NsOu26zt1XGrwq1Pj5jIzJc6uJ7QZBicjqbpqhNyUM9vmx2qnwYALfz2k8e
4IEsim3NrkleEkMcJTcHk7KiAkat5sEq83vgOoA0l+m/4fGC8Gmw84LPhSbeHwZDqY8Ziedt
tfX9IYDhU1DMh7ZlhMXsDVOWv+WQVYi22Q==
Console#
```

show location-led status

This command shows if location LED function is enabled or not.

Command Mode

Privileged Exec

Example

```
Console#show location-led status
 Location Led Status:On
Console#
```

show memory

This command shows memory utilization parameters, and alarm thresholds.

Command Mode

Normal Exec, 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    404119552  18
 Used   1743364096  82
 Total  2147483648

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

Console#
```

Related Commands

memory (201)

show process cpu

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

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show process cpu
 CPU Utilization in the past 5 seconds : 7%
 CPU Utilization in the past 60 seconds
  Average Utilization      : 8%
  Maximum Utilization      : 9%

 Alarm Status
  Current Alarm Status     : Off
  Last Alarm Start Time    : Jun  9 15:10:09 2011
  Last Alarm Duration Time : 10 seconds

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

Console#
```

Related Commands

process cpu (202)

show running-config

This command displays the configuration information currently in use.

Syntax

show running-config

Command Mode

Privileged Exec

Command Usage

- 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 for the switch
  - 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 management VLAN
  - 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
Building startup configuration. Please wait...
!<stackingDB>00</stackingDB>
!<stackingMac>01_00-e0-0c-00-00-fd_00</stackingMac>
!
snmp-server community public ro
snmp-server community private rw
!
snmp-server enable traps authentication
!
username admin access-level 15
username admin password 7 21232f297a57a5a743894a0e4a801fc3
username guest access-level 0
username guest password 7 084e0343a0486ff05530df6c705c8bb4
enable password level 15 7 1b3231655cebb7a1f783eddf27d254ca
!
vlan database
 VLAN 1 name DefaultVlan media ethernet state active
!
spanning-tree mst configuration
!
interface ethernet 1/1
 no negotiation
⋮

!
interface ethernet 1/1
 switchport allowed vlan add 1 untagged
 switchport native vlan 1
 switchport allowed vlan add 4093 tagged
⋮

!
control-plane
!
interface vlan 1
 ip address dhcp
!
interface craft
!
line console
!
line vty
!
end
!
Console#
```

Related Commands

show startup-config (120)

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 for the switch
  - 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 management VLAN
  - Interface settings
  - Any configured settings for the console port and Telnet

- For security reasons, user passwords are only displayed in encrypted format.

Example

Refer to the example for the running configuration file.

Related Commands

show running-config (118)

show system

This command displays system information.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Command Usage

- There is one fan tray in the switch. The tray includes four fixed fans and supports manual fan speed control using the fan-speed force-full command. These fans provide cooling for the internal components using front-to-back or back-to-front airflow. (Note that the power supply units include built-in fans.)

- There are two thermal detectors in the switch The first detector is near the air flow intake vents. The second detector is near the switch ASIC and CPU.

Example

```
Console#show system
System Description : AOS5700-54X
System OID String  : 1.3.6.1.4.1.259.12.1.2

System Information
 System Up Time          : 0 days, 5 hours, 44 minutes, and 42.28 seconds
 System Name             :
 System Location         :
 System Contact          :
 MAC Address (Unit 1)    : 00-00-0C-00-00-FD
 Web Server              : Enabled
 Web Server Port         : 80
 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

System Temperature:
Unit 1
 Temperature 1:  39 degrees     Temperature 2:  37 degrees
 Temperature 3:  38 degrees     Temperature 4:  31 degrees
 Temperature 5:  31 degrees     Temperature 6:  29 degrees
 Temperature 7:  29 degrees     Temperature 8:  36 degrees
 Temperature 9:  36 degrees

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

Table 14: show system – display description

Parameter	Description
System Description	Brief description of device type.
System Object ID	MIB II object ID for switch’s network management subsystem.
System Up Time	Length of time the management agent has been up.
System Name	Name assigned to the switch system.
System Location	Specifies the system location.
System Contact	Administrator responsible for the system.
MAC Address	MAC address assigned to this switch.
Web Server/Port	Shows administrative status of web server and UDP port number.
Web Secure Server/Port	Shows administrative status of secure web server and UDP port number.
Telnet Server/Port	Shows administrative status of Telnet server and TCP port number.

Table 14: show system – display description (Continued)

Parameter	Description
Jumbo Frame	Shows if jumbo frames are enabled or disabled.
System Fan	Shows if forced full-speed mode is enabled.
System Temperature	Temperature at specified thermal detection point.
Main Power Status	Displays the status of the internal power supply.
Redundant Power Status	Displays the status of the redundant power supply. (This switch does not support a redundant power supply.

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

```
Console#show tech-support

show system:
System Description : AOS5700-54X
System OID String  : 1.3.6.1.4.1.259.12.1.2
System Information
 System Up Time:          0 days, 2 hours, 17 minutes, and 6.23 seconds
 System Name:             [NONE]
 System Location:         [NONE]
 System Contact:          [NONE]
 MAC Address (Unit1):     00-12-CF-61-24-2F
 Web Server:              Enabled
 Web Server Port:         80
 Web Secure Server:       Enabled
 Web Secure Server Port:  443
 Telnet Server:           Enable
 Telnet Server Port:      23
 Jumbo Frame:             Disabled
⋮
```

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
  steve                                   15 RSA

 Online Users:
  Line    User Name                        Idle time (h:m:s) Remote IP addr
  ------- -------------------------------- ----------------- ---------------
 *console admin                                      0:14:14
  VTY 0   admin                                      0:00:00    192.168.1.19
  SSH 1   steve                                      0:00:06    192.168.1.19

 Web Online Users:
  Line  User Name                        Idle time (h:m:s) Remote IP Addr
  ----- -------------------------------- ----------------- ---------------
  HTTP  admin                                      0:00:06 192.168.0.99

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          : 571054X1452023
 Hardware Version       : R01A
 EPLD Version           : 05/05/05
 Number of Ports        : 54
 Main Power Status      : Up
 Redundant Power Status : Down
 Role                   : Master
 Loader Version         : 1.4.0.5
 Linux Kernel Version   : 3.8.13-rt9-QorIQ-SD
 Operation Code Version : 1.0.102.152

Console#
```

Table 15: show version – display description

Parameter	Description
Serial Number	The serial number of the switch.
Hardware Version	Hardware version of the main board.
EPLD Version	Version number of Erasable Programmable Logic Device.
Number of Ports	Number of built-in ports.
Main Power Status	Displays the status of the internal power supply.
Redundant Power Status	Displays the status of the redundant power supply. (This switch does not support a redundant power supply.
Role	Shows that this switch is operating as Master or Slave.
Loader Version	Version number of loader code.
Linux Kernel Version	Version number of Linux kernel.
Operation Code Version	Version number of runtime code.

show watchdog

This command shows if watchdog debugging is enabled.

Command Mode

Privileged Exec

Example

```
Console#show watchdog

Software Watchdog Information
 Status :    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
Console#
```

Fan Control

This section describes the command used to force fan speed.

Table 16: 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.

Syntax

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

Default Setting

Normal speed

Command Mode

Global Configuration

Example

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

Frame Size

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

Table 17: 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 of up to 12288 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.

- This command globally enables support for jumbo frames on all Gigabit and 10 Gigabit ports and trunks. To set the MTU for a specific interface, enable jumbo frames and use the switchport mtu command to specify the required size of the MTU.

- 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/TFTP server or through the USB port. By saving runtime code to a file on an FTP/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/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/TFTP server, but cannot be used as the destination on the switch.

Table 18: 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/TFTP server	PE
delete	Deletes a file or code image	PE
dir	Displays a list of files in flash memory	PE
umount usbdisk	Prepares the USB memory device to be safely removed	PE
onie	Configures the switch to install, rescue or update the open network installation environment	PE
umount usbdisk	Prepares the USB memory device to be safely removed	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/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)#
```

Related Commands

dir (133)
whichboot (136)

copy

This command moves (upload/download) a code image or configuration file between the switch's flash memory and an FTP/TFTP server or a USB memory stick. When you save the system code or configuration settings to a file on an FTP/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/TFTP server and the quality of the network connection.

Syntax

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

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 230.)

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

startup-config - The configuration used for system initialization.

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

usbdisk - Keyword that allows you to copy to/from a USB memory stick. (USB slot only supports simple data storage devices using a FAT16/32 file system with or without a partition table.)

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 128 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.

- 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/ 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.

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; 3. license: 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; 3. license: 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 configuration file name: startup
Flash programming started.
Flash programming completed.
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]:
Flash programming started.
Flash programming completed.
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
Choose public key type:
 1. RSA:  2. DSA: 1
Source 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; 3. license: 2
Source file name: BLANC.BIX
Destination file name: BLANC.BIX
Console#
```

delete

This command deletes a file or image.

Syntax

delete file name *filename*

file name - System file in switch memory.

filename - Name of configuration file or code image.

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#
```

Related Commands

dir (133)
delete public-key (235)

dir

This command displays a list of files in flash memory.

Syntax

dir {**boot-rom:** | **config:** | **opcode:** | **usbdisk:**} [*filename*]}

boot-rom - Boot ROM (or diagnostic) image file.

config - Switch configuration file.

opcode - Run-time operation code image file.

usbdisk - System file on a USB memory stick or disk.

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 19: File Directory Information

Column Heading	Description
File Name	The name of the file.
File Type	File types: Boot-Rom, Operation Code, and Config file.
Startup	Shows if this file is used when the system is started.
Modified Time	The date and time the file was created.
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:
AOS5700-54X_V1.1.0.152_EC.swi  OpCode  N       2014-04-01 09:22:34     32688391
Factory_Default_Config.cfg     Config  N       2015-01-20 12:04:50          455
startup1.cfg                   Config  Y       2015-03-23 04:14:32         2143
-------------------------------------------------------------------------------
                        Free space for compressed user config files: 2878332928
Console#
```

onie

This command configures the switch to install, rescue or update runtime code under the open network installation environment (ONIE).

Syntax

onie {**install** | **rescue** | **upgrade**}

install - Installs a new operating system. This option will reboot the switch and the ONIE install process will run again.

rescue - Boots into the ONIE environment for troubleshooting. The discovery and installer mechanisms do not run while in rescue mode:

upgrade - Upgrades the ONIE version on the system.

Command Mode

Privileged Exec

Command Usage

When the switch powers up, ONIE will run and attempt to find an installer. This is done by placing the installer code on a local TFTP server, and following the on-screen instructions to load the runtime code.

Example

The ONIE install, rescue, and upgrade procedures can be run during system bootup or from the CLI using the command options listed above. The following procedure shows how to upgrade the switch runtime code from the ONIE loader backdoor.

1. Power off and on the device, press any key to enter ONIE loader backdoor. Boot up ONIE Rescue mode by using the following command.

   LOADER=> run onie_rescue

2. By default ONIE will try to request the IP address through DHCP protocol. A default IP (192.168.3.10) will be set automatically if the request failed.

```
Loading Open Network Install Environment ...
Platform: powerpc-edgecore_as5700_54x-r0
Version : 2014.08.00.03
WARNING: adjusting available memory to 30000000
## Booting kernel from FIT Image at 02000000 ...
   Using 'edgecore_as5600_54x' configuration
   Trying 'kernel' kernel subimage
     Description:  edgecore_as5700_54x-r0 PowerPC Kernel
     Type:         Kernel Image
     Compression:  gzip compressed
     Data Start:   0x020000e8
     Data Size:    2763012 Bytes = 2.6 MiB
     Architecture: PowerPC
     OS:           Linux
     Load Address: 0x00000000
       Entry Point:  0x00000000
       Hash algo:    crc32
       Hash value:   185b962f
     Verifying Hash Integrity ... crc32+ OK
….

pci 0000:00:00.0: ignoring class b20 (doesn't match header type 01)
Info: Mounting kernel filesystems... done.
Info: Using eth0 MAC address: 00:11:22:33:44:55
Info: eth0:  Checking link... scsi 0:0:0:0: Direct-Access
          USB DISK 2.0     PMAP PQ: 0 ANSI: 0 CCS
sd 0:0:0:0: [sda] 3911680 512-byte logical blocks: (2.00 GB/1.86 GiB)
sd 0:0:0:0: [sda] Write Protect is off
sd 0:0:0:0: [sda] No Caching mode page present
sd 0:0:0:0: [sda] Assuming drive cache: write through
sd 0:0:0:0: [sda] No Caching mode page present
sd 0:0:0:0: [sda] Assuming drive cache: write through
sd 0:0:0:0: [sda] No Caching mode page present
sd 0:0:0:0: [sda] Assuming drive cache: write through
sd 0:0:0:0: [sda] Attached SCSI disk up.
Info: Trying DHCPv4 on interface: eth0

DHCPv4 on interface: eth0 failedONIE:
Using default IPv4 addr: eth0: 192.168.3.10/255.255.255.0
Starting: dropbear ssh daemon... done.
Starting: telnetd... done.
discover: Rescue mode detected.  Installer disabled.

 Please press Enter to activate this console.
 To check the install status inspect /var/log/onie.log.
 Try this:  tail -f /var/log/onie.log

 ** Rescue Mode Enabled **
 ONIE:/ #
 ONIE:/ # ifconfig eth0 192.168.1.1 netmask 255.255.255.0
```

3. Use the "install_url" command to install the AOS runtime image through ONIE rescue mode. Device will be automatically restarted and tje AOS runtime will be booted up after the installation succeeds. Please manually power off and on the device if you see tje console is freeze like below.

```
 ONIE:/ # install_url tftp://192.168.1.20/
AOS5700-54X_V0.0.1.13_EC.installer
Stopping: discover... done.
Info: Fetching tftp://192.168.1.20/AOS5700-54X_V0.0.1.0.installer ...
runtime.installer    100% |*******************************| 24751k
0:00:00 ETA
ONIE: Executing installer: tftp://192.168.1.20/
AOS5700-54X_V0.0.1.0.installer
Verifying image checksum ... OK.
Preparing image archive ... OK.
support_machines="as5700_54x"
runtime_image_name=runtime.bix
Installer: support_machines: as5700_54x
edgecore_as5610_54x
Match found!(as5610_54x)
Partition layout is the same as expected.
Install Image
```

```
EXT3-fs (sda1): warning: checktime reached, running e2fsck is
recommended
filemapping file write OK!!
FS_GenFilemappingFile OK
Updating U-Boot environment variables
ONIE:/ # umount: can't remount rootfs read-only
The system is going down NOW!
Sent SIGTERM to all processes
Sent SIGKILL toRestarting system.
```

umount usbdisk

This command prepares the USB memory device to be safely removed from the switch.

Syntax

umount usbdisk

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Before disconnecting a USB memory device, you must unmount it first. This is similar to “Safely Remove Hardware” in Windows where the device will not unmount until all data transfers have been finished.

Example

```
Console#umount usbdisk
You can safely remove your 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:
AOS5700-54X_V1.0.102.152.swi   OpCode  Y       2015-03-23 04:19:15     32688392
startup1.cfg                   Config  Y       2015-03-23 04:14:32         2143
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 aos5700-54x.swi. 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 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 server must be aos5600-54x.bix. However, note that file name is not to be included in this command.

- 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.

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 automatically reboot and load the new code after the opcode upgrade is completed.

```
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 : aos5700-54x.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 20: Line Commands

Command	Function	Mode
line	Identifies a specific line for configuration and starts the line configuration mode	GC
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
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)#
```

Related Commands

show line (152)
show users (123)

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

Related Commands

parity (145)

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

600 seconds

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

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

Related Commands

username (213)
password (146)

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

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 during system bootup or when downloading the configuration file from a TFTP server. There is no need for you to manually configure encrypted passwords.

Example

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

Related Commands

login (144)
password-thresh (147)

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

Related Commands

silent-time (148)

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; where 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)#silent-time 60
Console(config-line)#
```

Related Commands

password-thresh (147)

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

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

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#
```

Related Commands

show ssh (239)
show users (123)

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: 0-512, 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: 0-80)

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 21: Event Logging Commands

Command	Function	Mode
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 on	Controls logging of error messages	GC
logging trap	Limits syslog messages saved to a remote server based on severity	GC
clear log	Clears messages from the logging buffer	PE
show log	Displays log messages	PE
show logging	Displays the state of logging	PE

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 22: 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 - The 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 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)#
```

Related Commands

logging history (154)
logging trap (156)
clear log (157)

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 154. 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 4
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#
```

Related Commands

show log (157)

show log

This command displays the log messages stored in local memory.

Syntax

show 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

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#
```

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 {**flash** | **ram** | **sendmail** | **trap**}

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).

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#
```

Table 23: show logging flash/ram - display description

Field	Description
Syslog logging	Shows if system logging has been enabled via the logging on command.
History logging in FLASH	The message level(s) reported based on the logging history command.
History logging in RAM	The message level(s) reported based on the logging history command.

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#
```

Table 24: show logging trap - display description

Field	Description
Syslog logging	Shows if system logging has been enabled via the logging on command.
Status	Shows if remote logging has been enabled via the logging trap command.
Facility Type	The facility type for remote logging of syslog messages as specified in the logging facility command.
Level Type	The severity threshold for syslog messages sent to a remote server as specified in the logging trap command.

~~SMTP Alerts~~

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

Table 25: Event Logging Commands

Command	Function	Mode
logging sendmail	Enables SMTP event handling	GC
logging sendmail host	SMTP servers to receive alert messages	GC
logging sendmail level	Severity threshold used to trigger alert messages	GC
logging sendmail destination-email	Email recipients of alert messages	GC

Table 25: Event Logging Commands (Continued)

Command	Function	Mode
logging sendmail source-email	Email address used for “From” field of alert messages	GC
show logging sendmail	Displays SMTP event handler settings	NE, 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 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 or IPv6 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 154). 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 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 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

Normal Exec, 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 Email 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 26: 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

Table 26: Time Commands (Continued)

Command	Function	Mode
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
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
clock timezone-predefined	Sets the time zone for the switch's internal clock using predefined time zone configurations	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 (i.e., 00:00:00, Jan. 1, 2001).

- 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   : Mar 12 02:33:00 2013
Poll Interval  : 60 seconds
Current Mode   : Unicast
SNTP Status    : Enabled
SNTP Server    : 10.1.0.19
Current Server : 137.92.140.80
Console#
```

Related Commands

sntp server (166)
sntp poll (165)
show sntp (166)

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#
```

Related Commands

sntp client (164)

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/v6 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#
```

Related Commands

sntp client (164)
sntp poll (165)
show sntp (166)

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 2006
Poll Interval  : 16 seconds
Current Mode   : Unicast
SNTP Status    : Enabled
SNTP Server    : 137.92.140.80
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)#
```

Related Commands

ntp authentication-key (168)

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: 1-65535)

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)#
```

Related Commands

ntp authenticate (167)

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 (i.e., 00:00:00, Jan. 1, 2001).

- This command enables client time requests to time servers specified via the **ntp servers** command. It issues time synchronization requests based on the interval set via the **ntp poll** command.

Example

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

Related Commands

sntp client (164)
ntp server (169)

ntp server

This command sets the IP addresses of the servers to which NTP time requests are issued. 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 - IP address of an NTP time server.

key-number - The number of an authentication key to use in communications with the server. (Range: 1-65535)

Default Setting

Version number: 3

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. It issues time synchronization requests based on the interval set with the **ntp poll** command. 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 50 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)#
```

Related Commands

ntp client (169)
show ntp (170)

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.

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 2011
Polling                     : 1024 seconds
Current Mode                : unicast
```

```
NTP Status                 : Enabled
NTP Authenticate Status    : Enabled
Last Update NTP Server     : 192.168.0.88        Port: 123
Last Update Time           : Mar 12 02:41:01 2013 UTC
NTP Server 192.168.0.88 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#
```

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: 0-99 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 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 zone deviates from your regular time zone.

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)#
```

Related Commands

show sntp (166)

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 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 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 27: 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)#
```

Related Commands

show sntp (166)

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: 0-99 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 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 zone deviates from your regular time zone.

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 2
  saturday november 1 59 60
Console(config)#
```

Related Commands

show sntp (166)

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)#
```

Related Commands

show sntp (166)

clock timezone-predefined

This command uses predefined time zone configurations to set the time zone for the switch's internal clock. Use the **no** form to restore the default.

Syntax

clock timezone-predefined *offset-city*

no clock timezone-predefined

offset - Select the offset from GMT. (Range: GMT-0100 - GMT-1200; GMT-Greenwich-Mean-Time; GMT+0100 - GMT+1300) *city* - Select the city associated with the chosen GMT offset. After the offset has been entered, use the tab-complete function to display the available city options.

Default Setting

GMT-Greenwich-Mean-Time-Dublin,Edinburgh,Lisbon,London

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-predefined GMT-0930-Taiohae
Console(config)#
```

Related Commands

show sntp (166)

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, 2011.

```
Console#calendar set 15 12 34 1 February 2011
Console#
```

show calendar

This command displays the system clock.

Default Setting

None

Command Mode

Normal Exec, Privileged Exec

Example

```
Console#show calendar
 Current Time            : Mar 12 02:53:58 2013
 Time Zone               : UTC, 00:00
 Summer Time             : DEST, offset 60 minutes
                           Apr 1 2007 23:23 to Apr 23 2007 23:23
 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 28: 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 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)#
```

Related Commands

Access Control Lists (335)

absolute

This command sets the 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: 1-30 characters)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show time-range r&d
 Time-range r&d:
   absolute start 01:01 01 April 2009
   periodic    Daily 01:01 to    Daily 02:01
   periodic    Daily 02:01 to    Daily 03:01
Console#
```

5 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 29: 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 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 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
show snmp engine-id	Shows the SNMP engine ID	PE
show snmp group	Shows the SNMP groups	PE

Table 29: SNMP Commands (Continued)

Command	Function	Mode
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
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)
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
show memory	Shows memory utilization parameters	PE
show process cpu	Shows CPU utilization parameters	PE

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

- public - Read-only access. Authorized management stations are only able to retrieve MIB objects.
- private - Read/write access. Authorized management stations are able to both retrieve and modify MIB objects.

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)#
```

Related Commands

snmp-server location (184)

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)#
```

Related Commands

snmp-server contact (184)

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, counter information 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** | **ethernet cfm** | **mac-notification [interval** *seconds*]]

authentication - Keyword to issue authentication failure notifications.

ethernet cfm - Connectivity Fault Management traps. For more information on these traps, see "CFM Commands" on page 681.

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

Issues authentication and link-up-down 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 and link-up-down 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, link-up, and link-down 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.

Example

```
Console(config)#snmp-server enable traps link-up-down
Console(config)#
```

Related Commands

snmp-server host (187)

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 (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 182).
  2. Create a view with the required notification messages (page 194).
  3. Create a group that includes the required notify view (page 191).
  4. Allow the switch to send SNMP traps; i.e., notifications (page 186).
  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 182).
  2. Create a remote SNMPv3 user to use in the message exchange process (page 193).
  3. Create a view with the required notification messages (page 194).
  4. Create a group that includes the required notify view (page 191).
  5. Allow the switch to send SNMP traps; i.e., notifications (page 186).
  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)#
```

Related Commands

snmp-server enable traps (186)

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. (Range: Always 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-26)

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 - The Internet 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 193).

Example

```
Console(config)#snmp-server engine-id local 1234567890
Console(config)#snmp-server engineID remote 9876543210 192.168.1.19
Console(config)#
```

Related Commands

snmp-server host (187)

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: public[1] (read only), private[2] (read/write)
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 *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)#
```

[1] No view is defined.
[2] Maps to the defaultview.

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 three local users 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 - The Internet 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 group r&d v3 auth md5 greenpeace priv
  des56 einstien
Console(config)#snmp-server user mark group 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 this 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 EngineID                                         IP address
80000000030004e2b316c54321                                   192.168.1.19
Console#
```

Table 30: show snmp engine-id - display description

Field	Description
Local SNMP engineID	String identifying the engine ID.
Local SNMP engineBoots	The number of times that the engine has (re-)initialized since the snmp EngineID was last configured.
Remote SNMP engineID	String identifying an engine ID on a remote device.
IP address	IP address of the device containing the corresponding remote SNMP engine.

show snmp group

Four default groups are provided – SNMPv1 read-only access and read/write access, and SNMPv2c read-only access and read/write access.

Command Mode

Privileged Exec

Example

```
Console#show snmp group
Group Name: r&d
Security Model: v3
Read View: defaultview
Write View: daily
Notify View: none
Storage Type: permanent
Row Status: active

Group Name: public
Security Model: v1
Read View: defaultview
Write View: none
Notify View: none
Storage Type: volatile
Row Status: active

Group Name: public
Security Model: v2c
Read View: defaultview
Write View: none
Notify View: none
Storage Type: volatile
Row Status: active

Group Name: private
Security Model: v1
Read View: defaultview
Write View: defaultview
Notify View: none
Storage Type: volatile
Row Status: active
```

```
Group Name: private
Security Model: v2c
Read View: defaultview
Write View: defaultview
Notify View: none
Storage Type: volatile
Row Status: active

Console#
```

Table 31: show snmp group - display description

Field	Description
Group Name	Name of an SNMP group.
Security Model	The SNMP version.
Read View	The associated read view.
Write View	The associated write view.
Notify View	The associated notify view.
Storage Type	The storage type for this entry.
Row Status	The row status of this entry.

show snmp user

This command shows information on SNMP users.

Command Mode

Privileged Exec

Example

```
Console#show snmp user
Engine ID                : 80000103037072cfea1b710000
User Name                : steve
Group Name               : public
Security Model           : v3
Security Level           : Authentication and privacy
Authentication Protocol  : MD5
Privacy Protocol         : 3DES
Storage Type             : Nonvolatile
Row Status               : Active


SNMP remote user
Engine ID                : 1234567890
User Name                : bill
Group Name               : rd
Security Model           : v3
Security Level           : Authentication and privacy
Authentication Protocol  : MD5
Privacy Protocol         : 3DES
Storage Type             : Nonvolatile
Row Status               : Active

Console#
```

Table 32: show snmp user - display description

Field	Description
SNMP remote user	A user associated with an SNMP engine on a remote device.
Engine ID	String identifying the engine ID.
User Name	Name of user connecting to the SNMP agent.
Group Name	Name of an SNMP group.
Security Model	Shows the SNMP version 1, 2c or 3.
Security Level	Shows if authentication or privacy is used.
Authentication Protocol	The authentication protocol used with SNMPv3.
Privacy Protocol	The privacy protocol used with SNMPv3.
Storage Type	The storage type for this entry.
Row Status	The row status of this entry.

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#
```

Table 33: show snmp view - display description

Field	Description
View Name	Name of an SNMP view.
Subtree OID	A branch in the MIB tree.
View Type	Indicates if the view is included or excluded.
Storage Type	The storage type for this entry.
Row Status	The row status of this entry.

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

Enabled

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 - The Internet 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 be exceeding 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#
```

Related Commands

show memory (117)

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#
```

Related Commands

show process cpu (117)

6

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 34: 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 - 1.3.6.1.2.1.16.1.1.1.6.1-32/54
Taking delta samples every 30 seconds,
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 153).

trap – Sends a trap message to all configured trap managers (see “snmp-server host” on page 187).

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: 1-127 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: 1-65536)

seconds – The polling interval. (Range: 1-3600 seconds)

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 - 1.3.6.1.2.1.16.1.1.1.6.32/54
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 buckets 24
  interval 60 owner mike
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: 1-127 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
⋮
```

7 Authentication Commands

You can configure this switch to authenticate users logging into the system for management access using local or remote authentication methods.

Table 35: Authentication Commands

Command Group	Function
User Accounts	Configures the basic user names and passwords for management access
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
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

User Accounts

The basic commands required for management access are listed in this section. This switch also includes other options for password checking via the console or a Telnet connection (page 142), and user authentication via a remote authentication server (page 211).

Table 36: 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

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* - Level 15 for Privileged Exec. (Levels 0-14 are not used.)

{**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)#
```

Related Commands

enable (97)
authentication enable (214)

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 the user level.
The device has two predefined privilege levels:
0: Normal Exec, **15**: Privileged Exec.

Level 15 provides full access to all commands.

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 Normal Exec.
The factory defaults for the user names and passwords are:

Table 37: 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)#
```

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 38: 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.

Example

```
Console(config)#authentication enable radius
Console(config)#
```

Related Commands

enable password - sets the password for changing command modes (212)

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)#
```

Related Commands

username - for setting the local user names and passwords (213)

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 39: 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 retransmit	Sets the number of retries	GC
radius-server timeout	Sets the interval between sending authentication requests	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 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 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)#
```

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

Server 1:
 Server IP Address          : 192.168.1.1
 Authentication Port Number : 1812
 Accounting Port Number     : 1813
 Retransmit Times           : 2
 Request Timeout            : 5
```

```
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 40: 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 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)

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 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#
```

Web Server

This section describes commands used to configure web browser management access to the switch.

Table 41: Web Server Commands

Command	Function	Mode
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
ip http secure-port	Specifies the UDP port number for HTTPS	GC
ip http secure-server	Enables HTTPS (HTTP/SSL) for encrypted communications	GC

Note: Users are automatically logged off of the HTTP server or HTTPS server if no input is detected for 300 seconds.

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)#
```

Related Commands

ip http server (225)
show system (120)

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)#
```

Related Commands

ip http port (225)
show system (120)

ip http secure-port

This command specifies the UDP 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)#
```

Related Commands

ip http secure-server (226)
show system (120)

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 Internet Explorer 11, Mozilla Firefox 40, or Google Chrome 45, or more recent versions.

  The following web browsers and operating systems currently support HTTPS:

  #### Table 42: HTTPS System Support

Web Browser	Operating System
Internet Explorer 11 or later	Windows 7, 8, 10
Mozilla Firefox 40 or later	Windows 7, 8, 10, Linux
Google Chrome 45 or later	Windows 7, 8, 10

- 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)#
```

Related Commands

ip http secure-port (226)
copy tftp https-certificate (129)
show system (120)

Telnet Server

This section describes commands used to configure Telnet management access to the switch.

Table 43: 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
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 or 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)#
```

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: 4
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 both SSH Version 1.5 and 2.0 clients.

Table 44: 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 server-key size	Sets the SSH server key size	GC
ip ssh timeout	Specifies the authentication timeout for the SSH server	GC
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	Clear 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 15684995401867669259333946775054617325313674890836547254
   15020245593199868544358361651999923329781766065830956
   108259132128902337654680172627257141342876294130119619556678259566410486957427
   888146206519417467729848654686157177393901647793559423035774130980227370877945
   4524083971752646358058176716709574804776117
   ```

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
   134108168560989392104094492015542534763164192187295892114317388005553616163105
   177594083868631109291232226828519254374603100937187721199696317813662774141689
   851320491172048303392543241016379975923714490119380060902539484084827178194372
   2884025331159521348610229029789827213532671316294325328189150453063939166 43
   steve@192.168.1.19
   ```

4. Set the Optional Parameters – Set other optional parameters, including the authentication timeout, the number of retries, and the server key size.

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 v1.5 or 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 v1.5 Clients

a. The client sends its RSA public key to the switch.
b. The switch compares the client's public key to those stored in memory.
c. If a match is found, the switch uses its secret key to generate a random 256-bit string as a challenge, encrypts this string with the user's public key, and sends it to the client.
d. The client uses its private key to decrypt the challenge string, computes the MD5 checksum, and sends the checksum back to the switch.
e. The switch compares the checksum sent from the client against that computed for the original string it sent. If the two check sums match, this means that the client's private key corresponds to an authorized public key, and the client is authenticated.

Authenticating SSH v2 Clients

a. The client first queries the switch to determine if DSA 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 four 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)#
```

Related Commands

show ip ssh (238)

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 four client sessions. The maximum number of client sessions includes both current Telnet sessions and SSH sessions.

- The SSH server uses DSA or 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 DSA and RSA host keys before enabling the SSH server.

Example

```
Console#ip ssh crypto host-key generate dsa
Console#configure
Console(config)#ip ssh server
Console(config)#
```

Related Commands

ip ssh crypto host-key generate (236)
show ssh (239)

ip ssh server-key size

This command sets the SSH server key size. Use the **no** form to restore the default setting.

Syntax

ip ssh server-key size *key-size*

no ip ssh server-key size

key-size – The size of server key. (Range: 512-896 bits)

Default Setting

768 bits

Command Mode

Global Configuration

Command Usage

The server key is a private key that is never shared outside the switch. The host key is shared with the SSH client, and is fixed at 1024 bits.

Example

```
Console(config)#ip ssh server-key size 512
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

10 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)#
```

Related Commands

exec-timeout (144)
show ip ssh (238)

delete public-key

This command deletes the specified user's public key.

Syntax

delete public-key *username* [**dsa** | **rsa**]

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

dsa – DSA public key type.

rsa – RSA public key type.

Default Setting

Deletes both the DSA and RSA key.

Command Mode

Privileged Exec

Example

```
Console#delete public-key admin dsa
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 [**dsa** | **rsa**]

dsa – DSA (Version 2) key type.

rsa – RSA (Version 1) key type.

Default Setting

Generates both the DSA and RSA key pairs.

Command Mode

Privileged Exec

Command Usage

- The switch uses only RSA Version 1 for SSHv1.5 clients and DSA Version 2 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 dsa
Console#
```

Related Commands

ip ssh crypto zeroize (237)
ip ssh save host-key (237)

ip ssh crypto zeroize

This command clears the host key from memory (i.e. RAM).

Syntax

ip ssh crypto zeroize [**dsa** | **rsa**]

dsa – DSA key type.

rsa – RSA key type.

Default Setting

Clears both the DSA and 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 dsa
Console#
```

Related Commands

ip ssh crypto host-key generate (236)
ip ssh save host-key (237)
no ip ssh server (233)

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 both the DSA and RSA key.

Command Mode

Privileged Exec

Example

```
Console#ip ssh save host-key dsa
Console#
```

Related Commands

ip ssh crypto host-key generate (236)

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
Server Key Size     : 768 bits
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: 1-8 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.

- When an RSA key is displayed, the first field indicates the size of the host key (e.g., 1024), the second field is the encoded public exponent (e.g., 35), and the last string is the encoded modulus. When a DSA key is displayed, the first field indicates that the encryption method used by SSH is based on the Digital Signature Standard (DSS), and the last string is the encoded modulus.

Example

```
Console#show public-key host
Host:
RSA:
1024 65537 13236940658254764031382795526536375927835525327972629521130241
  071942106165575942459093923609695405036277525755625100386613098939383452310
  332802149888661921595568598879891919505883940181387440468908779160305837768
  1854900028313416250083487184495220874292122556916656552963281635169640408315
  5547660664151657116381
DSA:
ssh-dss AAAB3NzaC1kc3MAAACBAPWKZTPbsRIB8ydEXcxM3dyV/yrDbKStIlnzD/Dg0h2Hxc
  YV44sXZ2JXhamLK6P8bvuiyacWbUW/a4PAtp1KMSdqsKeh3hKoA3vRRSy1N2XFfAKxl5fwFfv
  JlPdOkFgzLGMinvSNYQwiQXbKTBH0Z4mUZpE85PWxDZMaCNBPjBrRAAAAFQChb4vsdfQGNIjwbv
  wrNLaQ77isiwAAAIEAsy5YWDC99ebYHNRj5kh47wY4i8cZvH+/p9cnrfwFTMU01VFDly3IR
  2G395NLy5Qd7ZDxfA9mCOfT/yyEfbobMJZi8oGCstSNOxrZZVnMqWrTYfdrKX7YKBw/Kjw6Bm
  iFq7O+jAhf1Dg45loAc27s6TLdtny1wRq/ow2eTCD5nekAAACBAJ8rMccXTxHLFAczWS7EjOy
  DbsloBfPuSAb4oAsyjKXKVYNLQkTLZfcFRu41bS2KV5LAwecsigF/+DjKGWtPNIQqabKgYCw2
  o/dVzX4Gg+yqdTlYmGA7fHGm8ARGeiG4ssFKy4Z6DmYPXFum1Yg0fhLwuHpOSKdxT3kk475S7
  w0W
Console#
```

show ssh

This command displays the current SSH server connections.

Command Mode

Privileged Exec

Example

```
Console#show ssh
Connection Version State               Username Encryption
  0          2.0   Session-Started      admin   ctos aes128-cbc-hmac-md5
                                                stoc aes128-cbc-hmac-md5
Console#
```

Table 45: show ssh - display description

Field	Description
Session	The session number. (Range: 0-3)
Version	The Secure Shell version number.
State	The authentication negotiation state. (Values: Negotiation-Started, Authentication-Started, Session-Started)
Username	The user name of the client.

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 46: 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
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

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

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

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)#
```

Related Commands

dot1x timeout re-authperiod (247)

dot1x timeout quiet-period

This command sets the time that a switch port waits after the maximum request count (see page 244) 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. (Range: 1)

port - Port number. (Range: 1-32/54)

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#
```

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. (Range: 1)

port - Port number. (Range: 1-32/54)

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 242).

- *Authenticator Parameters* – Shows whether or not EAPOL pass-through is enabled (page 241).

- *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 244).
  - Control Mode – Dot1x port control mode (page 245).
  - 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 246).
  - Reauth Period – Time after which a connected client must be re-authenticated (page 247).
  - Quiet Period – Time a port waits after Max Request Count is exceeded before attempting to acquire a new client (page 246).
  - TX Period – Time a port waits during authentication session before re-transmitting EAP packet (page 248).
  - 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 244).
  - 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 245).
  - Intrusion Action– Shows the port response to intrusion when authentication fails (page 243).
  - 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 1/51 Disabled      Single-Host    Force-Authorized   Yes
Eth 1/52 Enabled       Single-Host    Auto               Yes

802.1X Port Details

802.1X Authenticator is enabled on port 1/1
802.1X Supplicant is disabled on port 1/1
.
.
.
Console#show dot1x interface ethernet 1/28

802.1X Authenticator is enabled on port 28
Reauthentication     : Enabled
Reauth Period        : 3600
Quiet Period         : 60
TX Period            : 30
Supplicant Timeout   : 30
Server Timeout       : 10
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 47: 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#
```

8

General Security Measures

This switch provides port-based traffic segmentation to segregate traffic for clients attached to each of the data ports.

Table 48: General Security Commands

Command Group	Function
Port Security*	Configures secure addresses for a port
802.1X Port Authentication*	Configures host authentication on specific ports using 802.1X
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 IPv4 traffic on insecure ports for which the source address cannot be identified via DHCPv4 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
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 IP 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 49: Port Security 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
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)#
```

Related Commands

show interfaces status (376)

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 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
```

Related Commands

show interfaces status (376)
shutdown (364)
mac-address-table static (438)

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. (Range: 1)

port - Port number. (Range: 1-32/54)

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 Disabled      Secure/Down  None              0         2
 Eth 1/ 2 Enabled       Secure/Up    None              10        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
 .
 .
 .
```

Table 50: show port security - display description

Field	Description
Port Security	The configured status (enabled or disabled).
Port Status	The operational status: ◆ Secure/Down – Port security is disabled. ◆ Secure/Up – Port security is enabled. ◆ Shutdown – Port is shut down due to a response to a port security violation.
Intrusion Action	The configured intrusion response.
MaxMacCnt	The maximum number of addresses which can be stored in the address table for this interface (either dynamic or static).
CurrMacCnt	The current number of secure entries in the address table.

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 port-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 ~~ID~~                         : 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       : 2010/7/29 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 51: 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
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

Table 51: Network Access Commands (Continued)

Command	Function	Mode
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

[**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)

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 removed by the switch from the secure MAC table, and the switch will only perform the authentication process the next time it receives the MAC address packet.

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 52: 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: 0-1024; 0 for unlimited)

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, 802.1X, and port security cannot be configured together on the same port. Only one security mechanism can be applied.
- 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 untagged VLAN and "t" tagged VLAN. The "Tunnel-Type" attribute should be set to "VLAN," and the "Tunnel-Medium-Type" attribute set to "802."

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

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. (Range: 1)

port - Port number. (Range: 1-32/54)

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. (Range: 1)

port - Port number. (Range: 1-32/54)

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                           : Enabled

Port : 1/1
MAC Authentication                          : Disabled
MAC Authentication Intrusion Action         : Block traffic
MAC Authentication Maximum MAC Counts       : 1024
Maximum MAC Counts                          : 2048
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)

mask - Specifies a MAC address bit mask for filtering displayed addresses.

interface - Specifies a port interface.

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

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 214).

Note: Web authentication cannot be configured on trunk ports.

Table 53: 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. (Range: 1)

port - Port number. (Range: 1-32/54)

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. (Range: 1)

port - Port number. (Range: 1-32/54)

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 - This is unit 1.

port - Port number. (Range: 1-32/54)

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 54: 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, or MAC address, arbitrary string	GC
ip dhcp snooping information policy	Sets the information option policy for DHCP client packets that include Option 82 information	GC
ip dhcp snooping limit rate	Sets the maximum number of DHCP packets that can be trapped for DHCP snooping	GC
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	IC
ip dhcp snooping trust	Configures the specified interface as trusted	IC

Table 54: DHCP Snooping Commands (Continued)

Command	Function	Mode
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)#
```

Related Commands

ip dhcp snooping vlan (288)
ip dhcp snooping trust (290)

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, the **no** form with the **encode no-subtype** keyword to enable use of sub-type and sub-length in CID/RID fields, or the **no** form with the **remote-id** keyword to set the remote ID to the switch's MAC address encoded in hexadecimal.

Syntax

ip dhcp snooping information option
[**encode no-subtype**] [**remote-id** {**ip-address** [**encode** {**ascii** | **hex**}] | **mac-address** [**encode** {**ascii** | **hex**}] | **string** *string*}]

no ip dhcp snooping information option [**encode no-subtype**]
[**remote-id** [**ip-address encode**] | [**mac-address encode**]]

encode no-subtype - Disables use of sub-type and sub-length fields in circuit-ID (CID) and remote-ID (RID) in Option 82 information.

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: 1-32 characters)

Default Setting

Option 82: Disabled
CID/RID sub-type: Enabled
Remote ID: MAC address (hexadecimal)

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 packet.

Example

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

Enabled

Command Mode

Global Configuration

Command Usage

See the Command Usage section under the ip dhcp snooping information option circuit-id command for a description of how these fields are included in TR-101 syntax.

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, arbitrary string, or TR-101 compliant node identifier. 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**}] | **string**}

no ip dhcp snooping information option remote-id
[**ip-address encode**] | [**mac-address encode**]

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: 1-32 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 snooping information option remote-id tr101
  node-identifier ip
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 {**drop** | **keep** | **replace**}

no ip dhcp snooping information policy

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

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, or replace it with the switch's relay information.

Example

```
Console(config)#ip dhcp snooping information policy drop
Console(config)#
```

ip dhcp snooping limit rate

This command sets the maximum number of DHCP packets that can be trapped by the switch for DHCP snooping. Use the **no** form to restore the default setting.

Syntax

ip dhcp snooping limit rate *rate*

no dhcp snooping limit rate

rate - The maximum number of DHCP packets that may be trapped for DHCP snooping. (Range: 1-2048 packets/second)

Default Setting

Disabled

Command Mode

Global Configuration

Example

This example sets the DHCP snooping rate limit to 100 packets per second.

```
Console(config)#ip dhcp snooping limit rate 100
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 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)#
```

Related Commands

ip dhcp snooping (281)
ip dhcp snooping vlan (288)
ip dhcp snooping trust (290)

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)#
```

Related Commands

ip dhcp snooping (281)
ip dhcp snooping trust (290)

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*

no dhcp snooping information option circuit-id

string - An arbitrary string inserted into the circuit identifier field. (Range: 1-32 characters)

Default Setting

VLAN-Unit-Port

Command Mode

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 55: 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.

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 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)#
```

Related Commands

ip dhcp snooping (281)
ip dhcp snooping vlan (288)

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)

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 vlan 1
Console#
```

clear ip dhcp snooping database flash

This command removes all dynamically learned snooping entries from flash memory.

Command Mode

Privileged Exec

Example

```
Console#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#clear 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: disabled
DHCP Snooping Information Option Status: disabled
DHCP Snooping Information Option Sub-option Format: extra subtype included
DHCP Snooping Information Option Remote ID: MAC Address (hex encoded)
DHCP Snooping Information Policy: replace
DHCP Snooping is configured on the following VLANs:
1
Verify Source Mac-Address: enabled
DHCP Snooping rate limit: unlimited
Interface    Trusted      Circuit-ID Mode  Circuit-ID Value
----------   ----------   ---------------  ----------------------------------
Eth 1/1      No           VLAN-Unit-Port   ---
Eth 1/2      No           VLAN-Unit-Port   ---
Eth 1/3      No           VLAN-Unit-Port   ---
Eth 1/4      No           VLAN-Unit-Port   ---
Eth 1/5      No           VLAN-Unit-Port   ---
.
.
.
```

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 56: 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
ipv6 dhcp snooping option remote-id policy	Sets the information option policy for DHCPv6 client packets that include Option 37 information	GC
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
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)#
```

Related Commands

ipv6 dhcp snooping vlan (298)
ipv6 dhcp snooping trust (299)

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

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 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 {**drop** | **keep** | **replace**}

no ipv6 dhcp snooping option remote-id policy

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

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, 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 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)#
```

Related Commands

ipv6 dhcp snooping (293)
ipv6 dhcp snooping trust (299)

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)#
```

Related Commands

ipv6 dhcp snooping (293)
ipv6 dhcp snooping vlan (298)

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)

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 is configured on the following VLANs:
   1,
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 280). 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 57: 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

Table 57: IPv4 Source Guard Commands

Command	Function	Mode
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* **vlan** *vlan-id*

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: 1-28/52)

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 (page 308).

- 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-ab-cd-11-22-33 vlan 1 192.168.0.99
  interface ethernet 1/5
Console(config-if)#
```

Related Commands

ip source-guard (305)
ip dhcp snooping (281)
ip dhcp snooping vlan (288)

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 281), 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~~.

- 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)#
```

Related Commands

ip source-guard binding (303)
ip dhcp snooping (281)
ip dhcp snooping vlan (288)

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: 1-5 for ACL mode; 1-1024 for MAC mode)

Default Setting

Mode: ACL
Maximum Binding: 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 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 280)

static - Shows static entries configured with the ip source-guard binding command (see page 303).

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. (Range: 1)

port - Port number. (Range: 1-28/52)

Command Mode

Privileged Exec

Example

```
Console#show ip source-guard binding
MAC Address        IP Address       Lease(sec)  Type            VLAN      Interface
-----------------  ---------------  ----------  --------------  --------- ---------
11-22-33-44-55-66  192.168.0.99              0  Static          1         Eth 1/5

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 293). 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 58: 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* **vlan** *vlan-id*

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. (Range: 1)

port - Port number. (Range: 1-32/54)

Default Setting

No configured entries

Command Mode

Global Configuration

Command Usage

- Table entries include an associated MAC address, IPv6 global unicast address, ~~lease time,~~ entry type (Static-IP-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)#
```

Related Commands

ipv6 source-guard (312)

ipv6 dhcp snooping (293)
ipv6 dhcp snooping vlan (298)

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, ~~lease time,~~ 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)#
```

Related Commands

ipv6 source-guard binding (310)
ipv6 dhcp snooping (293)
ipv6 dhcp snooping vlan (298)

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
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 293)

static - Shows static entries configured with the ipv6 source-guard binding command.

Command Mode

Privileged Exec

Example

```
Console#show ipv6 source-guard binding
MAC Address    IPv6 Address                            VLAN Interface Type
-------------- --------------------------------------- ---- --------- ----
00AB-11CD-2345                                 2001::1    1  Eth 1/5   STA
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 293). 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 59: 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* **vlan** *vlan-id*

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. (Range: 1)

port - Port number. (Range: 1-32/54)

Default Setting

No configured entries

Command Mode

Global Configuration

Command Usage

- Table entries include an associated MAC address, IPv6 global unicast address, ~~lease time,~~ entry type (Static-IP-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)#
```

Related Commands

ipv6 source-guard (312)
ipv6 dhcp snooping (293)
ipv6 dhcp snooping vlan (298)

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, ~~lease time,~~ 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)#
```

Related Commands

ipv6 source-guard binding (310)
ipv6 dhcp snooping (293)
ipv6 dhcp snooping vlan (298)

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
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 293)

static - Shows static entries configured with the ipv6 source-guard binding command.

Command Mode

Privileged Exec

Example

```
Console#show 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 60: 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

Table 60: ARP Inspection Commands (Continued)

Command	Function	Mode
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.

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 ACL configuration commands are described under "ARP ACLs" on page 352.

- 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            : 10 s
Log Message Number              : 1
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. (Range: 1)

port - Port number. (Range: 1-32/54)

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

Example

```
Console#show ip arp inspection vlan 1

VLAN ID     DAI Status             ACL Name              ACL Status
--------   ---------------    --------------------    --------------------
1           disabled               sales                static
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 61: 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 62: 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 and clear the configuration settings for segmented groups.

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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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. Use the **no** form to restore the default.

Syntax

[**no**] **traffic-segmentation uplink-to-uplink** {**blocking** | **forwarding**}

blocking – Blocks traffic between uplink ports assigned to different sessions.

forwarding – Forwards traffic between uplink ports assigned to different sessions.

Default Setting

Blocking

Command Mode

Global Configuration

Example

This example enables forwarding of traffic between uplink ports assigned to different client sessions.

```
Console(config)#traffic-segmentation uplink-to-uplink forwarding
Console(config)#
```

show traffic-segmentation

This command displays the configured traffic segments.

Command Mode

Privileged Exec

Example

```
Console#show traffic-segmentation

 Private VLAN 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#
```

9

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, next header type, or flow label), 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 63: 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
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 64: 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 96 rules.

Example

```
Console(config)#access-list ip standard david
Console(config-std-acl)#
```

Related Commands

permit, deny (337)
ip access-group (340)
show ip access-list (341)

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)#
```

Related Commands

access-list ip (336)

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* | **udp**]
{**any** | *source address-bitmask* | **host** *source*}
{**any** | *destination address-bitmask* | **host** *destination*}
[**precedence** *precedence*] [**tos** *tos*] [**dscp** *dscp*]
[**source-port** *sport* [*bitmask*]]
[**destination-port** *dport* [*port-bitmask*]]
~~[**time-range** *time-range-name*]~~

no {**permit** | **deny**} [*protocol-number* | **udp**]
{**any** | *source address-bitmask* | **host** *source*}
{**any** | *destination address-bitmask* | **host** *destination*}
[**precedence** *precedence*] [**tos** *tos*] [**dscp** *dscp*]
[**source-port** *sport* [*bitmask*]]
[**destination-port** *dport* [*port-bitmask*]]

{**permit** | **deny**} **tcp**
{**any** | *source address-bitmask* | **host** *source*}
{**any** | *destination address-bitmask* | **host** *destination*}
[**precedence** *precedence*] [**tos** *tos*] [**dscp** *dscp*]
[**source-port** *sport* [*bitmask*]]
[**destination-port** *dport* [*port-bitmask*]]
[**control-flag** *control-flags flag-bitmask*]
[**time-range** *time-range-name*]

no {**permit** | **deny**} **tcp**
{**any** | *source address-bitmask* | **host** *source*}
{**any** | *destination address-bitmask* | **host** *destination*}
[**precedence** *precedence*] [**tos** *tos*] [**dscp** *dscp*]
[**source-port** *sport* [*bitmask*]]
[**destination-port** *dport* [*port-bitmask*]]
[**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.

precedence – IP precedence level. (Range: 0-7)

tos – Type of Service level. (Range: 0-15)

dscp – DSCP priority level. (Range: 0-63)

sport – Protocol[3] source port number. (Range: 0-65535)

[3] Includes TCP, UDP or other protocol types.

dport – Protocol[3] destination port number. (Range: 0-65535)

port-bitmask – Decimal number representing the port bits to match. (Range: 0-65535)

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 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.

- You can specify both Precedence and ToS in the same rule. However, if DSCP is used, then neither Precedence nor ToS can be specified.

- 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"

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 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)#
```

Related Commands

access-list ip (336)

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** | **out**}

acl-name – Name of the ACL. (Maximum length: 16 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

- Only one ACL can be bound to a port.
- 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)#
```

Related Commands

show ip access-list (341)
Time Range (177)

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#
```

Related Commands

ip access-group (340)

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#
```

Related Commands

permit, deny (337)
ip access-group (340)

IPv6 ACLs

The commands in this section configure ACLs based on IPv6 address, DSCP traffic class, next header type, or flow label. 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 65: 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 a specified criteria, including destination IPv6 address	IPv6- EXT-ACL
show ipv6 access-list	Displays the rules for configured IPv6 ACLs	PE
ipv6 access-group	Adds a port to an IPv6 ACL	IC
show ipv6 access-group	Shows port assignments for 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 96 rules.

Example

```
Console(config)#access-list ipv6 standard david
Console(config-std-ipv6-acl)#
```

Related Commands

permit, deny (Standard IPv6 ACL) (343)
permit, deny (Extended IPv6 ACL) (344)
ipv6 access-group (345)
show ipv6 access-list (346)

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)#
```

Related Commands

access-list ipv6 (342)
Time Range (177)

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 destination IP addresses, next header type, or flow label. Use the **no** form to remove a rule.

Syntax

{**permit** | **deny**} {**any** | **host** *destination-ipv6-address* | *destination-ipv6-address*[*/prefix-length*]} ~~[**time-range** *time-range-name*~~]

no {**permit** | **deny**} {**any** | **host** *destination-ipv6-address* | *destination-ipv6-address*[*/prefix-length*]}

any – Any IP address (an abbreviation for the IPv6 prefix ::/0).

host – Keyword followed by a specific destination IP address.

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.

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

Extended IPv6 ACL

Command Usage

- All new rules are appended to the end of the list.

Example

This example accepts any incoming packets if the destination address is 2009:DB9:2229::79/8.

```
Console(config-ext-ipv6-acl)#permit 2009:DB9:2229::79/8
Console(config-ext-ipv6-acl)#
```

Related Commands

access-list ipv6 (342)
Time Range (177)

ipv6 access-group

This command binds a port to an IPv6 ACL. 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: 16 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

- A port can only be bound to one ACL.
- 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)#
```

Related Commands

show ipv6 access-list (346)

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#
```

Related Commands

ipv6 access-group (345)

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#
```

Related Commands

permit, deny (Standard IPv6 ACL) (343)
permit, deny (Extended IPv6 ACL) (344)
ipv6 access-group (345)

MAC ACLs

The commands in this section configure ACLs based on hardware addresses, packet format, and Ethernet type. 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 66: 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	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 adds a MAC access list and 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. Use the **no** form to remove the specified ACL.

Syntax

[**no**] **access-list mac** *acl-name*

acl-name – Name of the ACL. (Maximum length: 16 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 96 rules.

Example

```
Console(config)#access-list mac jerry
Console(config-mac-acl)#
```

Related Commands

permit, deny (348)
mac access-group (350)
show mac access-list (351)

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. Use the **no** form to remove a rule.

Syntax

{**permit** | **deny**}
{**any** | **host** *source* | *source address-bitmask*}
{**any** | **host** *destination* | *destination address-bitmask*}
[**vid** *vid vid-bitmask*] [**ethertype** *protocol* [*protocol-bitmask*]]
~~[**time-range** *time-range-name*]~~

no {**permit** | **deny**}
{**any** | **host** *source* | *source address-bitmask*}
{**any** | **host** *destination* | *destination address-bitmask*}
[**vid** *vid vid-bitmask*] [**ethertype** *protocol* [*protocol-bitmask*]]

Note: The default is for Ethernet II packets.

{**permit** | **deny**} **tagged-eth2**
{**any** | **host** *source* | *source address-bitmask*}
{**any** | **host** *destination* | *destination address-bitmask*}
[**vid** *vid vid-bitmask*] [**ethertype** *protocol* [*protocol-bitmask*]]
~~[**time-range** *time-range-name*]~~

no {**permit** | **deny**} **tagged-eth2**
{**any** | **host** *source* | *source address-bitmask*}
{**any** | **host** *destination* | *destination address-bitmask*}
[**vid** *vid vid-bitmask*] [**ethertype** *protocol* [*protocol-bitmask*]]

{**permit** | **deny**} **untagged-eth2**
{**any** | **host** *source* | *source address-bitmask*}
{**any** | **host** *destination* | *destination address-bitmask*}
[**ethertype** *protocol* [*protocol-bitmask*]] ~~[**time-range** *time-range-name*]~~

no {**permit** | **deny**} **untagged-eth2**
{**any** | **host** *source* | *source address-bitmask*}
{**any** | **host** *destination* | *destination address-bitmask*}
[**ethertype** *protocol* [*protocol-bitmask*]]

{**permit** | **deny**} **tagged-802.3**
{**any** | **host** *source* | *source address-bitmask*}
{**any** | **host** *destination* | *destination address-bitmask*}
[**vid** *vid vid-bitmask*]

no {**permit** | **deny**} **tagged-802.3**
{**any** | **host** *source* | *source address-bitmask*}
{**any** | **host** *destination* | *destination address-bitmask*}
[**vid** *vid vid-bitmask*]

{**permit** | **deny**} **untagged-802.3**
{**any** | **host** *source* | *source address-bitmask*}
{**any** | **host** *destination* | *destination address-bitmask*}
~~[**time-range** *time-range-name*]~~

no {**permit** | **deny**} **untagged-802.3**
{**any** | **host** *source* | *source address-bitmask*}
{**any** | **host** *destination* | *destination address-bitmask*}

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 source or destination address.

host – A specific MAC address.

source – Source MAC address.

destination – Destination MAC address range with bitmask.

address-bitmask[4] – Bitmask for MAC address (in hexadecimal format).

vid – VLAN ID. (Range: 1-4094)

vid-bitmask[4] – VLAN bitmask. (Range: 1-4095)

protocol – A specific Ethernet protocol number. (Range: 0-ffff hex.)

protocol-bitmask[4] – Protocol bitmask. (Range: 0-ffff hex.)

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

Default Setting

None

Command Mode

MAC ACL

[4] For all bitmasks, “1” means relevant and “0” means ignore.

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

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)#
```

Related Commands

access-list mac (347)
Time Range (177)

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: 16 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

- Only one ACL can be bound to a port.

- 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)#
```

Related Commands

show mac access-list (351)
Time Range (177)

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#
```

Related Commands

mac access-group (350)

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#
```

Related Commands

permit, deny (348)
mac access-group (350)

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 67: 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
show arp access-list	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 96 rules.

Example

```
Console(config)#access-list arp factory
Console(config-arp-acl)#
```

Related Commands

permit, deny (353)
show arp access-list (354)

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*}
mac {**any** | **host** *source-mac* | *source-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*}
mac {**any** | **host** *source-mac* | *source-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[5] – IPv4 number representing the address bits to match.

source-mac – Source MAC address.

destination-mac – Destination MAC address range with bitmask.

mac-address-bitmask[5] – 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.

[5] For all bitmasks, binary “1” means care 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-mac-acl)#
```

Related Commands

access-list arp (352)

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#
```

Related Commands

permit, deny (353)

show arp access-list

This command displays the rules for configured ARP ACLs.

Syntax

show arp access-list [*acl-name*]

acl-name – Name of the ACL. (Maximum length: 32 characters)

Command Mode

Privileged Exec

Example

```
Console#show arp access-list
ARP access-list factory:
  permit response ip any 192.168.0.0 255.255.0.0 mac any any
Console#
```

Related Commands

permit, deny (353)

ACL Information

This section describes commands used to display ACL information.

Table 68: 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** | **out**} [**interface** *interface*]] |
[**interface** *interface*] | [**name** *acl-name*]

in – Clears counter for ingress rules.

out – Clears counter for egress rules.

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

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 1/2
 IP access-list david
 MAC access-list jerry
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.[6]

ip extended – Shows ingress rules for Extended IPv4 ACLs.

ip standard – Shows ingress rules for Standard IPv4 ACLs.

ipv6 extended – Shows ingress rules for Extended IPv6 ACLs.

ipv6 standard – Shows ingress rules for Standard IPv6 ACLs.

mac – Shows ingress 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 10.7.1.1 255.255.255.0 any
  permit 192.168.1.0 255.255.255.0 any destination-port 80 80
  permit 192.168.1.0 255.255.255.0 any protocol tcp control-code 2 2
```

[6] Due to a hardware limitation, this option only displays statistics for permit rules.

```
MAC access-list jerry:
  permit any host 00-30-29-94-34-de ethertype 800 800
IP extended access-list A6:
  deny tcp any any control-flag 2 2
  permit any any
Console#
```

10 Interface Commands

These commands are used to display or set communication parameters for an Ethernet port, aggregated link, or VLAN; or perform cable diagnostics on the specified interface.

Table 69: 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
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	Force module type	IC
shutdown	Disables an interface	IC
switchport mtu	Sets the maximum transfer unit for an interface	IC
clear counters	Clears statistics on an interface	PE
hardware profile portmode	Configures port settings for 40G operation	PE
show hardware profile portmode	Displays the configuration settings for 40G operation	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 statistical history for the specified interfaces	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
Transceiver Threshold Configuration		
transceiver-threshold-auto	Uses default threshold settings obtained from the transceiver to determine when an alarm or trap message should be sent	IC
transceiver-monitor	Sends a trap when any of the transceiver's operational values fall outside specified thresholds	IC
transceiver-threshold current	Sets thresholds for transceiver current which can be used to trigger an alarm or warning message	IC

Table 69: Interface Commands (Continued)

Command	Function	Mode
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
Cable Diagnostics		
test loop internal	Performs an 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.

Syntax

[**no**] **interface** *interface-list*

interface-list – One or more ports. Use a hyphen to indicate a consecutive list of ports or a comma between non-consecutive ports.

craft - Management port on the front panel.

ethernet *unit/port-list*

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: 1-32/54)

port-channel *channel-id* (Range: 1-27)

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

Default Setting

None

Command Mode

Global Configuration

Command Usage

The craft interface is provided as an out-of-band management connection which is isolated from all other ports on the switch. This interface must first be configured with an IPv4 or IPv6 address before a connection can be made through Telnet, SSH, or HTTP.

Example

To specify port 4, enter the following command:

```
Console(config)#interface ethernet 1/4
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: 1-64 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)#
```

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

- 10GBASE-SFP+ and 40GBASE-QSFP transceivers do not support auto-negotiation. Forced mode should always be used to establish a connection over any 10GBASE-SFP+ or 10GBASE-SFP+ port or trunk.

- 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: 1-32 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 statisical 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 module type. Use the **no** form to restore the default mode.

Syntax

media-type sfp-forced [*mode*]

no media-type

sfp-forced - Always uses the selected SFP module type (even if a module is not installed).

mode

1000sfp - Always uses the SFP+ port at 1000 Mbps, full duplex.

10gsfp - Always uses the SFP+ port at 10 Gbps, full duplex.

Default Setting

None

Command Mode

Interface Configuration (Ethernet)

Example

This forces the switch to use the built-in SFP slot for port 25.

```
Console(config)#interface ethernet 1/51
Console(config-if)#media-type sfp-forced 1000sfp
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)#
```

switchport mtu

This command configures the maximum transfer unit (MTU) allowed for layer 2 packets crossing a Gigabit, 10 Gigabit or 40 Gigabit Ethernet port or trunk. Use the **no** form to restore the default setting.

Syntax

switchport mtu *size*

no switchport mtu

size - Specifies the maximum transfer unit (or frame size) for a Gigabit, 10 Gigabit or 40 Gigabit Ethernet port or trunk. (Range: 1500-12288 bytes)

Default Setting

1518 bytes

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Use the jumbo frame command to enable or disable jumbo frames for all Gigabit, 10 Gigabit and 40 Gigabit Ethernet ports. To set the MTU for a specific interface, enable jumbo frames and use this command to specify the required size of the MTU.

- The comparison of packet size against the configured port MTU considers only the incoming packet size, and is not affected by the fact that an ingress port is a tagged port or a QinQ ingress port. In other words, any additional size (for example, a tagged field of 4 bytes added by the chip) will not be considered when comparing the egress packet's size against the configured MTU.

- When pinging the switch from an external device, information added for the Ethernet header can increase the packet size by at least 42 bytes for an untagged packet, and 46 bytes for a tagged packet. If the adjusted frame size exceeds the configured port MTU, the switch will not respond to the ping message.

- For other traffic types, calculation of overall frame size is basically the same, including the additional header fields SA(6) + DA(6) + Type(2) + VLAN-Tag(4) (for tagged packets, for untaqged packets, the 4-byte field will not be added by switch), and the payload. This should all be less than the configured port MTU, including the CRC at the end of the frame.

- For QinQ, the overall frame size is still calculated as described above, and does not add the length of the second tag to the frame.

- The port MTU size can be displayed with the show show interfaces status command.

Example

The following first enables jumbo frames for layer 2 packets, and then sets the MTU for port 1:

```
Console(config)#jumbo frame
Console(config)#interface ethernet 1/1
Console(config-if)#switchport mtu 9216
Console(config-if)#
```

Related Commands

jumbo frame (126)
show interfaces status (376)

clear counters

This command clears statistics on an interface.

Syntax

clear counters *interface*

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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 port settings for 40G operation.

Syntax

hardware profile portmode interface {**1x40g** | **4x10g** | **reset**}

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

1x40g - Configures the port as a single 40G port.

4x10g - Configures the port as four 10G ports.

reset - Configures port mode to the default setting.

Default Setting

AS6700-32X: 1x40g
AS6700-54X: The example under the show hardware profile portmode command shows the default settings for this switch.

Command Mode

Privileged Exec

Command Usage

- 40G ports can be configured as a single port connected with 40G QSFP fiber cable, 40G DAC (direct attach) cable, or breakout cable that connects a 40G port to four 10G ports. Refer to the *installation Guide* for more information on how to use these cable types.

- Four 10G ports can also be configured as a single 40G port using breakout cable. Refer to the *installation Guide* for more information on how to use this cabling option.

Example

This example is for the AS6700-32X, affecting only Port 1.

```
Console#hardware profile portmode ethernet 1/1 4x10g
Console#
```

show hardware profile portmode

This command displays the configuration settings for 40G operation.

Command Mode

Privileged Exec

Example

This example shows the default 40G settings for the AS6700-32X.

```
Console#show hardware profile portmode
40G         10G         Config  Oper
Interfaces  Interfaces  Mode    Mode
----------  ----------  ------  ------
1/1         1/33-36     -       1x40g
1/2         1/37-40     -       1x40g
1/3         1/41-44     -       1x40g
1/4         1/45-48     -       1x40g
1/5         1/49-52     -       1x40g
1/6         1/53-56     -       1x40g
1/7         1/57-60     -       1x40g
1/8         1/61-64     -       1x40g
1/9         1/65-68     -       1x40g
1/10        1/69-72     -       1x40g
1/11        1/73-76     -       1x40g
1/12        1/77-80     -       1x40g
1/13        1/81-84     -       1x40g
1/14        1/85-88     -       1x40g
1/15        1/89-92     -       1x40g
1/16        1/93-96     -       1x40g
1/17        1/97-100    -       1x40g
1/18        1/101-104   -       1x40g
1/19        1/105-108   -       1x40g
1/20        1/109-112   -       1x40g
1/21                    -       1x40g
1/22                    -       1x40g
⋮
```

This example shows the default 40G and 10G port settings for the AS6700-54X.

```
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
1/21        1/21-24     -       4x10g
1/25        1/25-28     -       4x10g
1/29        1/29-32     -       4x10g
1/33        1/33-36     -       4x10g
1/37        1/37-40     -       4x10g
1/41        1/41-44     -       4x10g
1/45        1/45-48     -       4x10g
1/49        1/55-58     -       1x40g
1/50        1/59-62     -       1x40g
1/51        1/63-66     -       1x40g
1/52        1/67-70     -       1x40g
1/53        1/71-74     -       1x40g
```

```
1/54        1/75-78     -       1x40g
Console#
```

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

Example

```
Console#show interfaces brief
Interface Name              Status    PVID Pri Speed/Duplex  Type         Trunk
--------- ----------------- --------- ---- --- ------------- ------------ -----
Eth 1/ 1                    Up           1   0 Auto-1000full 1000BASE SFP None
Eth 1/ 2                    Up           1   0 1000full      1000BASE SFP None
Eth 1/ 3                    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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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
                       0 Unknown Protocols Input
                       0 QLen Output
 ===== Extended Iftable Stats =====
                      23 Multi-cast Input
                    5525 Multi-cast Output
                     170 Broadcast Input
                      11 Broadcast Output
 ===== Ether-like Stats =====
                       0 Alignment Errors
                       0 FCS Errors
                       0 Single Collision Frames
                       0 Multiple Collision Frames
                       0 SQE Test Errors
                       0 Deferred Transmissions
                       0 Late Collisions
                       0 Excessive Collisions
                       0 Internal Mac Transmit Errors
                       0 Internal Mac Receive Errors
                       0 Frames Too Long
                       0 Carrier Sense Errors
                       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
                   21065 Packet Size <= 64 Octets
                    3805 Packet Size 65 to 127 Octets
                    2448 Packet Size 128 to 255 Octets
                     797 Packet Size 256 to 511 Octets
                    2941 Packet Size 512 to 1023 Octets
                    9187 Packet Size 1024 to 1518 Octets
 ===== Port Utilization =====
                     111 Octets Input per seconds
                       0 Packets Input per seconds
                    0.00 % Input Utilization
                     606 Octets Output per seconds
                       1 Packets Output per second
                    0.00 % Output Utilization
Console#
```

Table 70: show interfaces counters - display description

Parameter	Description
IF Table Stats	
Octets Input	The total number of octets received on the interface, including framing characters.

Table 70: show interfaces counters - display description (Continued)

Parameter	Description
Octets Output	The total number of octets transmitted out of the interface, including framing characters.
Unicast Input	The number of subnetwork-unicast packets delivered to a higher-layer protocol.
Unicast Output	The total number of packets that higher-level protocols requested be transmitted to a subnetwork-unicast address, including those that were discarded or not sent.
Discard Input	The number of inbound packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space.
Discard Output	The number of outbound packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. One possible reason for discarding such a packet could be to free up buffer space.
Error Input	The number of inbound packets that contained errors preventing them from being deliverable to a higher-layer protocol.
Error Output	The number of outbound packets that could not be transmitted because of errors.
Unknown Protocols Input	The number of packets received which were discarded because of an unknown or unsupported protocol.
QLen Output	The length of the output packet queue (in packets).
Extended IF Table Stats	
Multicast Input	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a multicast address at this sub-layer.
Multicast Output	The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a multicast address at this sub-layer, including those that were discarded or not sent.
Broadcast Input	The number of packets, delivered by this sub-layer to a higher (sub-)layer, which were addressed to a broadcast address at this sub-layer.
Broadcast Output	The total number of packets that higher-level protocols requested be transmitted, and which were addressed to a broadcast address at this sub-layer, including those that were discarded or not sent.
Etherlike Statistics	
Alignment Errors	The number of alignment errors (missynchronized data packets).
FCS Errors	A count of frames received on a particular interface that are an integral number of octets in length but do not pass the FCS check. This count does not include frames received with frame-too-long or frame-too-short error.
Single Collision Frames	The number of successfully transmitted frames for which transmission is inhibited by exactly one collision.
Multiple Collision Frames	A count of successfully transmitted frames for which transmission is inhibited by more than one collision.
SQE Test Errors	A count of times that the SQE TEST ERROR message is generated by the PLS sublayer for a particular interface.
Deferred Transmissions	A count of frames for which the first transmission attempt on a particular interface is delayed because the medium was busy.

Table 70: show interfaces counters - display description (Continued)

Parameter	Description
Late Collisions	The number of times that a collision is detected later than 512 bit-times into the transmission of a packet.
Excessive Collisions	A count of frames for which transmission on a particular interface fails due to excessive collisions. This counter does not increment when the interface is operating in full-duplex mode.
Internal MAC Transmit Errors	A count of frames for which transmission on a particular interface fails due to an internal MAC sublayer transmit error.
Internal MAC Receive Errors	A count of frames for which reception on a particular interface fails due to an internal MAC sublayer receive error.
Frames Too Long	A count of frames received on a particular interface that exceed the maximum permitted frame size.
Carrier Sense Errors	The number of times that the carrier sense condition was lost or never asserted when attempting to transmit a frame.
Symbol Errors	For an interface operating at 100 Mb/s, the number of times there was an invalid data symbol when a valid carrier was present. For an interface operating in half-duplex mode at 1000 Mb/s, the number of times the receiving media is non-idle (a carrier event) for a period of time equal to or greater than slotTime, and during which there was at least one occurrence of an event that causes the PHY to indicate 'Data reception error' or 'carrier extend error' on the GMII. For an interface operating in full-duplex mode at 1000 Mb/s, the number of times the receiving media is non-idle (a carrier event) for a period of time equal to or greater than minFrameSize, and during which there was at least one occurrence of an event that causes the PHY to indicate 'Data reception error' on the GMII
RMON Statistics	
Octets	Total number of octets of data received on the network. This statistic can be used as a reasonable indication of Ethernet utilization.
Packets	The total number of packets (bad, broadcast and multicast) received.
Broadcast Packets	The total number of good packets received that were directed to the broadcast address. Note that this does not include multicast packets.
Multicast Packets	The total number of good packets received that were directed to this multicast address.
Undersize Packets	The total number of packets received that were less than 64 octets long (excluding framing bits, but including FCS octets) and were otherwise well formed.
Oversize Packets	The total number of packets received that were longer than 1518 octets (excluding framing bits, but including FCS octets) and were otherwise well formed.
Fragments	The total number of frames received that were less than 64 octets in length (excluding framing bits, but including FCS octets) and had either an FCS or alignment error.
Jabbers	The total number of frames received that were longer than 1518 octets (excluding framing bits, but including FCS octets), and had either an FCS or alignment error.
CRC Align Errors	
Collisions	The best estimate of the total number of collisions on this Ethernet segment.

Table 70: show interfaces counters - display description (Continued)

Parameter	Description
64 Octets	The total number of packets (including bad packets) received and transmitted that were less than 64 octets in length (excluding framing bits but including FCS octets).
65-127 Octets 128-255 Octets 256-511 Octets 512-1023 Octets 1024-1518 Octets 1519-1536 Octets	The total number of packets (including bad packets) received and transmitted where the number of octets fall within the specified range (excluding framing bits but including FCS octets).
Utilization Statistics	
Octets input per second	Number of octets entering this interface in kbits per second.
Packets input per second	Number of packets entering this interface in packets per second.
Input utilization	The input utilization rate for this interface.
Octets output per second	Number of octets leaving this interface in kbits per second.
Packets output per second	Number of packets leaving this interface in packets per second.
Output utilization	The output utilization rate for this interface.

show interfaces history

This command displays statistical history for the specified interfaces.

show interfaces history [*interface* [*name* [**current** | **previous** *index count*] [**input** | **output**]]]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

name - Name of sample as defined in the history command. (Range: 1-32 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 historical statistics for all interfaces, intervals, ingress traffic, and egress traffic.

Command Mode

Privileged Exec

Command Usage

If no interface is specified, information on all interfaces is displayed.

Example

This example shows the statistics recorded for all named entries in the sampling table.

```
Console#show interfaces history ethernet 1/1
Interface         : Eth 1/ 1
Name              : 15min
Interval          : 900 second(s)
Buckets Requested : 96
Buckets Granted   : 7
Status            : Active

Current Entries

 Start Time   %      Octets Input    Unicast       Multicast     Broadcast
 ------------ ------ --------------- ------------- ------------- ------------
 00d 01:45:01   0.00          105421           688            30            8

              Discards      Errors        Unknown Proto
              ------------- ------------- -------------
                          0             0             0

              %      Octets Output   Unicast       Multicast     Broadcast
             ------ --------------- ------------- ------------- -------------
                0.00          859987           947           373            1

              Discards      Errors
              ------------- -------------
                          0             0

Interface         : Eth 1/ 1
Name              : 1day
Interval          : 86400 second(s)
Buckets Requested : 7
Buckets Granted   : 0
Status            : Active

Current Entries

 Start Time   %      Octets Input    Unicast       Multicast     Broadcast
 ------------ ------ --------------- ------------- ------------- ------------
 00d 00:00:00   0.00          969845          6548           237           82

              Discards      Errors        Unknown Proto
              ------------- ------------- -------------
                          7             0             0

              %      Octets Output   Unicast       Multicast     Broadcast
             ------ --------------- ------------- ------------- -------------
                0.00         8455699          9101          3146            3
              Discards      Errors
              ------------- -------------
                          0             0

Console#
```

This example shows the statistics recorded for a named entry in the sampling table.

```
Console#show interfaces history ethernet 1/1 1min
Interface         : Eth 1/ 1
Name              : 1min
Interval          : 60 second(s)
Buckets Requested : 10
Buckets Granted   : 1
Status            : Active

Current Entries

 Start Time   %      Octets Input    Unicast       Multicast     Broadcast
 ------------ ------ --------------- ------------- ------------- ------------
 00d 02:00:31   0.00           5856            39             1            0

              Discards      Errors        Unknown Proto
              ------------- ------------- -------------
                          0             0             0

              %      Octets Output   Unicast       Multicast     Broadcast
             ------ --------------- ------------- ------------- -------------
                0.00          48334            54            19            0

              Discards      Errors
              ------------- -------------
                          0             0

Previous Entries

 Start Time   Octets Input    Unicast       Multicast     Broadcast
 ------------ --------------- ------------- ------------- -------------
 00d 00:05:37         1400912          9381          1895            50
 00d 00:06:37         1566090         10660          2195            50
 00d 00:07:37         1754781         11786          2674            59

 Start Time   Octets Input    Discards      Errors        Unknown Proto
 ------------ --------------- ------------- ------------- -------------
 00d 00:05:37         1400912             0             0             0
 00d 00:06:37         1566090             0             0             0
 00d 00:07:37         1754781             0             0             0

 Start Time   Octets Output   Unicast       Multicast     Broadcast
 ------------ --------------- ------------- ------------- -------------
 00d 00:05:37         6827866         10563          2042            30
 00d 00:06:37         7572668         12040          2362            30
 00d 00:07:37         8548505         13380          2879            30

 Start Time   Octets Output   Discards      Errors
 ------------ --------------- ------------- -------------
 00d 00:05:37         6827866             0             0
 00d 00:06:37         7572668             0             0
 00d 00:07:37         8548505             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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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.

Example

```
Console#show interfaces status ethernet 1/1
Information of Eth 1/1
 Basic Information:
  Port Type              : 1000Base SFP
  MAC Address            : 00-00-0C-00-00-FE
 Configuration:
  Name                   :
  Port Admin             : Up
  Speed-duplex           : Auto
  Capabilities           : 1000full
  Broadcast Storm        : Enabled
  Broadcast Storm Limit  : 500 packets/second
  Multicast Storm        : Disabled
  Multicast Storm Limit  : 262143 packets/second
  Unknown Unicast Storm       : Disabled
  Unknown Unicast Storm Limit : 262143 packets/second
  Flow Control           : Disabled
  VLAN Trunking          : Disabled
  LACP                   : Disabled
  MAC-Learning           : Yes
  Media Type             : None
  MTU                    : 1518
 Current Status:
  Link Status            : Up
  Port Operation Status  : Up
  Operation Speed-duplex : 1000full
  Up Time                  : 0w 0d 1h 41m 8s (6068 seconds)
  Flow Control Type        : None
  Max Frame Size           : 1518 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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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            : Enabled, 500 packets/second
 Multicast Threshold            : Disabled
 Unknown Unicast Threshold      : Disabled
 LACP Status                    : Disabled
 VLAN Membership Mode           : Hybrid
 Ingress Rule                   : Disabled
 Acceptable Frame Type          : All frames
 Native VLAN                    : 1
 Priority for Untagged Traffic  : 0
 Allowed VLAN                   :     1(u)
 Forbidden VLAN                 :
Console#
```

Table 71: show interfaces switchport - display description

Field	Description
Broadcast Threshold	Shows if broadcast storm suppression is enabled or disabled; if enabled it also shows the threshold level (page 421).
Multicast Threshold	Shows if multicast storm suppression is enabled or disabled; if enabled it also shows the threshold level (page 421).
Unknown Unicast Threshold	Shows if unknown unicast storm suppression is enabled or disabled; if enabled it also shows the threshold level (page 421).
LACP Status	Shows if Link Aggregation Control Protocol has been enabled or disabled (page 393).
VLAN Membership Mode	Indicates membership mode as Trunk or Hybrid (page 479).
Ingress Rule	Shows if ingress filtering is enabled or disabled (page 478).
Acceptable Frame Type	Shows if acceptable VLAN frames include all types or tagged frames only (page 475).
Native VLAN	Indicates the default Port VLAN ID (page 480).
Priority for Untagged Traffic	Indicates the default priority for untagged frames (page 510).
Allowed VLAN	Shows the VLANs this interface has joined, where “(u)” indicates untagged and “(t)” indicates tagged (page 476).

Transceiver Threshold Configuration

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

transceiver-threshold-auto

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet)

Example

```
Console(config)interface ethernet 1/1
Console(config-if)#transceiver-threshold-auto
Console#
```

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

transceiver-monitor

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet)

Example

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

transceiver-threshold current

This command sets thresholds for transceiver current which can be used to trigger an alarm or warning message.

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: 100-25500 in units of 0.01 mA)

Default Setting

High Alarm: 100 mA
HIgh Warning: 90 mA
Low Warning: 7 mA
Low Alarm: 6 mA

Command Mode

Interface Configuration (Ethernet)

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.

Example

The following example sets alarm thresholds for the transceiver current at port 1.

```
Console(config)interface ethernet 1/1
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.

Syntax

transceiver-threshold rx-power {**high-alarm** | **high-warning** | **low-alarm** | **low-warning**} *threshold-value*

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: -9999 - 9999 in units of 0.01 dBm)

Default Setting

High Alarm: -3.00 dBm
HIgh Warning: -3.50 dBm
Low Warning: -21.00 dBm
Low Alarm: -21.50 dBm

Command Mode

Interface Configuration (Ethernet)

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.

Syntax

transceiver-threshold temperature {**high-alarm** | **high-warning** | **low-alarm** | **low-warning**} *threshold-value*

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: -20000 - 20000 in units of 0.01 Celsius)

Default Setting

High Alarm: 75.00 °C
HIgh Warning: 70.00 °C
Low Warning: 0.00 °C
Low Alarm: -123.00 °C

Command Mode

Interface Configuration (Ethernet)

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.

Syntax

transceiver-threshold tx-power {**high-alarm** | **high-warning** | **low-alarm** | **low-warning**} *threshold-value*

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: -9999 - 9999 in units of 0.01 dBm)

Default Setting

High Alarm: -9.00 dBm
HIgh Warning: -9.50 dBm
Low Warning: -11.50 dBm
Low Alarm: -12.00 dBm

Command Mode

Interface Configuration (Ethernet)

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 1.

```
Console(config)interface ethernet 1/1
Console(config-if)#transceiver-threshold tx-power low-alarm 8
Console(config-if)#transceiver-threshold tx-power high-alarm -3
Console#
```

transceiver-threshold voltage

This command sets thresholds for the transceiver voltage which can be used to trigger an alarm or warning message.

Syntax

transceiver-threshold voltage {**high-alarm** | **high-warning** | **low-alarm** | **low-warning**} *threshold-value*

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: 100-25500 in units of 0.01 Volt)

Default Setting

High Alarm: 3.50 Volts
HIgh Warning: 3.45 Volts
Low Warning: 3.15 Volts
Low Alarm: 3.10 Volts

Command Mode

Interface Configuration (Ethernet)

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 1.

```
Console(config)interface ethernet 1/1
Console(config-if)#transceiver-threshold voltage low-alarm 4
Console(config-if)#transceiver-threshold voltage high-alarm 2
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. (Range: 1)

port - Port number. (Range: 1-32/54)

Default Setting

Shows all SFP 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.

- When the measured value of a monitored DDM item meets the condition of a warning state or an alarm state, an exclamation mark (i.e., “!”) will be added behind the value of the warning threshold value or alarm threshold value.

- This switch does not support the detection of the Rx loss signal of an SFP transceiver, so the Rx loss status of an SFP transceiver is always treated as deasserted. The warning/alarm state of a monitored DDM item is therefore not related to the Rx loss status of an SFP transceiver

Example

```
Console#show interfaces transceiver ethernet 1/25
Information of Eth 1/7
 Connector Type        : LC
 Fiber Type            : Multimode 50um (M5), Multimode 62.5um (M6)
 Eth Compliance Codes  : 1000BASE-SX
 Baud Rate             : 2100 MBd
 Vendor OUI            : 00-90-65
 Vendor Name           : FINISAR CORP.
 Vendor PN             : FTLF8519P2BNL
 Vendor Rev            : A
 Vendor SN             : PFS4U5F
 Date Code             : 09-07-02
 DDM Info
   Temperature         : 11.54 degree C
   Vcc                 : 3.25 V
   Bias Current        : 7.21 mA
   RX Power            : -31.55 dBm
 DDM Thresholds
                            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
   RxPower(dBm)                -21.50!       -21.00!        -3.50         -3.00
Console#
```

The following example shows information for a 40G transceiver.

```
Console#show interfaces transceiver ethernet 1/54
Information of Eth 1/54
 Connector Type        : No Separable Connector
 Fiber Type            : Multimode Mode
 40G Eth Compliance    : 40GBASE-CR4
 Baud Rate             : 0 MBd
 Vendor OUI            : 41-50-48
 Vendor Name           : Amphenol
 Vendor PN             : 603020007
 Vendor Rev            : A
 Vendor SN             : APF12150073U30
 Date Code             : 12-04-21
 DDM Information
   Temperature         : 1.50 degree C
   Vcc                 : 0.00 V
   Bias Current(ch 1)  : 0.00 mA
   Bias Current(ch 2)  : 0.00 mA
   Bias Current(ch 3)  : 0.00 mA
   Bias Current(ch 4)  : 0.00 mA
   RX Power(ch1)       : -40.00 dBm
   RX Power(ch2)       : -40.00 dBm
   RX Power(ch3)       : -40.00 dBm
   RX Power(ch4)       : -40.00 dBm
 DDM Thresholds
                           Low Alarm  Low Warning  High Warning    High Alarm
   -----------          ------------  ------------  ------------  -----------
   Temperature(Celsius)        35.03          0.00          0.00        13.00
   Voltage(Volts)               0.20          2.88          1.67         0.00
   Current(mA)                  5.15         36.01          0.00        33.34
   RxPower(dBm)                -0.85         -0.85         -0.85         1.50
Console#
```

show interfaces transceiver-threshold

This command Displays the alarm/warning thresholds for temperature, voltage, bias current, transmit power, and receive power. **Syntax**

Syntax

show interfaces transceiver-threshold [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

Default Setting

Shows all SFP 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.

- Note that this command will not add an exclamation mark (i.e., “!”) behind the value of the warning threshold value or an alarm threshold value.

Example

```
Console#show interfaces transceiver-threshold ethernet 1/25
Information of Eth 1/25
 DDM Thresholds
                            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#
```

Cable 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. (Range: 1)

port - Port number. (Range: 1-32/54)

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. (Range: 1)

port - Port number. (Range: 1-32/54)

Command Mode

Privileged Exec

Example

```
Console#show loop internal interface ethernet 1/1

 Port       Test Result     Last Update
 --------   --------------  --------------------
 Eth 1/1         Succeeded  2013-04-15 15:26:56
Console#
```

11 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. This switch supports up to 27/16 trunks on the AOS5700-54X and AOS6700-32X respectively. For example, a trunk consisting of two 1000 Mbps ports can support an aggregate bandwidth of 4 Gbps when operating at full duplex.

Table 72: 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 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 peer-link	Configures the MLAG domain peer link	GC
mlag group member	Configures MLAG domain member ports	GC

Table 72: Link Aggregation Commands (Continued)

Command	Function	Mode
show mlag	Shows MLAG configuration settings	PE
show mlag domain	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 on the AS6700-32X can have up to 32 ports, and up to 54 ports on the AS5700-54X.
- 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.
- Trunk groups are limited to either all 10G ports or all 40G ports. When using an LAG composed of all 10G ports, different transceiver types may be used as long as the speed of each member port is the same.
- 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), this key is set to the same value as the port admin key (lacp admin key - Ethernet Interface) used by the interfaces that joined the group.
- 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-ip

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 (Range: 1-16/27)

Default Setting

The current port will be added to this 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 10-12:

```
Console(config)#interface port-channel 1
Console(config-if)#exit
Console(config)#interface ethernet 1/10-12
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, either by forced mode or auto-negotiation.

- 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 1/1-3
Console(config-if)#lacp
Console(config-if)#end
Console#show interfaces status port-channel 1
Information of Trunk 1
 Basic Information:
  Port Type                : 1000Base SFP
  MAC Address              : 12-34-12-34-12-3F
Configuration:
  Name                     :
  Port Admin               : Up
  Speed-duplex             : 1000full
  Capabilities             : 1000full
  Broadcast Storm          : Enabled
  Broadcast Storm Limit    : 262143 packets/second
  Multicast Storm          : Disabled
  Multicast Storm Limit    : 262143 Kbits/second
  Unknown Unicast Storm       : Disabled
  Unknown Unicast Storm Limit : 262143 Kbits/second
  Flow Control             : Disabled
  VLAN Trunking            : Disabled
  MAC Learning             : Enabled
  MTU                      : 1518
 Current status:
  Created By               : LACP
  Link Status              : Up
  Port Operation Status    : Up
  Operation speed-duplex   : 1000full
  Up Time                  : 0w 0d 0h 14s (14 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
Console#
```

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

Actor: 1, 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), this key is set to the same value as the port admin key (**lacp admin key** - Ethernet Interface) used by the interfaces that joined the group.

- 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.

- By default, the actor's operational key is determined by port's link speed (1000f - 4, 100f - 3, 10f - 2), and copied to the admin key.

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 string. 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

0

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), this key is set to the same value as the port admin key (lacp admin key - Ethernet Interface) used by the interfaces that joined the group. Note that when the LAG is no longer used, the port channel admin key is reset to 0.
- If the port channel admin key is set to a non-default value, the operational key is based upon LACP PDUs received from the partner, and the channel admin key is reset to the default value. The trunk identifier will also be changed by this process.

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). Use the no form to restore the default setting.

Syntax

lacp timeout {**long** | **short**}

no lacp timeout

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** | **sys-id**}

port-channel - Local identifier for a link aggregation group. (Range: 1-16/27)

counters - Statistics for LACP protocol messages.

internal - Configuration settings and operational state for local side.

neighbors - Configuration settings and operational state for remote side.

sysid - Summary of system priority and MAC address for all channel groups.

Default Setting

Port Channel: all

Command Mode

Privileged Exec

Example

```
Console#show lacp 1 counters
Port Channel : 1
 -----------------------------------------------------------
 Member Port                 : Eth 1/1
 LACPDU Sent                 : 63
 LACPDU Received             : 62
 MarkerPDU Sent              : 0
 MarkerPDU Received          : 0
 MarkerResponsePDU Sent      : 0
 MarkerResponsePDU Received  : 0
 Unknown Packet Received     : 0
 Illegal Packet Received     : 0

  LACPDUs Sent          : 12
  LACPDUs Received      : 6
  Marker Sent           : 0
  Marker Received       : 0
  LACPDUs Unknown Pkts  : 0
  LACPDUs Illegal Pkts  : 0
⋮
```

Table 73: show lacp counters - display description

Field	Description
Port Channel	Local identifier for a link aggregation group.
Member Port	The ports active in this link aggregation group.
LACPDU Sent	Number of valid LACPDUs transmitted from this channel group.
LACPDU Received	Number of valid LACPDUs received on this channel group.
Marker Sent	Number of valid Marker PDUs transmitted from this channel group.

Table 73: show lacp counters - display description (Continued)

Field	Description
Marker Received	Number of valid Marker PDUs received by this channel group.
MarkerResponsePDU Sent	Number of valid Marker Response PDUs transmitted from this channel group.
MarkerResponsePDU Received	Number of valid Marker Response PDUs received at this channel group.
LACPDUs Unknown Pkts	Number of frames received that either (1) Carry the Slow Protocols Ethernet Type value, but contain an unknown PDU, or (2) are addressed to the Slow Protocols group MAC Address, but do not carry the Slow Protocols Ethernet Type.
LACPDUs Illegal Pkts	Number of frames that carry the Slow Protocols Ethernet Type value, but contain a badly formed PDU or an illegal value of Protocol Subtype.

```
Console#show lacp 1 internal
Port Channel : 1
Admin Key    : 0
Oper Key     : 4
Timeout      : Long
 ------------------------------------------------------------
 Member Port     : Eth 1/1
 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
⋮
```

Table 74: show lacp internal - display description

Field	Description
Port Channel	Local identifier for a link aggregation group.
Admin Key	Current administrative value of the key for the aggregation port.
Oper Key	Current operational value of the key for the aggregation port.
Timeout	The timeout to wait for the next LACP data unit (LACPDU)
Member Port	The ports active in this link aggregation group.
Periodic Time	Number of seconds before invalidating received LACPDU information.
System Priority	LACP system priority assigned to this port channel.
Port Priority	LACP port priority assigned to this interface within the channel group.
LACPDUs Internal	Number of seconds before invalidating received LACPDU information.

Table 74: show lacp internal - display description (Continued)

Field	Description
Admin State, Oper State	Administrative or operational values of the actor’s state parameters: - Expired – The actor’s receive machine is in the expired state; - Defaulted – The actor’s receive machine is using defaulted operational partner information, administratively configured for the partner. - Distributing – If false, distribution of outgoing frames on this link is disabled; i.e., distribution is currently disabled and is not expected to be enabled in the absence of administrative changes or changes in received protocol information. - Collecting – Collection of incoming frames on this link is enabled; i.e., collection is currently enabled and is not expected to be disabled in the absence of administrative changes or changes in received protocol information. - Synchronization – The System considers this link to be IN_SYNC; i.e., it has been allocated to the correct Link Aggregation Group, the group has been associated with a compatible Aggregator, and the identity of the Link Aggregation Group is consistent with the System ID and operational Key information transmitted. - Aggregation – The system considers this link to be aggregatable; i.e., a potential candidate for aggregation. - Long timeout – Periodic transmission of LACPDUs uses a slow transmission rate. - LACP-Activity – Activity control value with regard to this link. (0: Passive; 1: Active)

```
Console#show lacp 1 neighbors
Port Channel : 1
 ------------------------------------------------------------
 Member Port             : Eth 1/1
 Partner Admin System ID : 32768, 00-00-00-00-00-00
 Partner Oper System ID  : 32768, 70-72-CF-9D-73-54
 Partner Admin Port ID   : 32768, 1
 Partner Oper Port ID    : 128, 1
 Partner Admin Key       : 0
 Partner Oper Key        : 82
 Partner Admin State     : Defaulted, Distributing, Collecting,
                           Synchronization, Long Timeout, Passive LACP
 Partner Oper State      : Distributing, Collecting, Synchronization,
                           Aggregatable, Long Timeout, Actvie LACP

  Partner Admin System ID   : 32768, 00-00-00-00-00-00
  Partner Oper System ID    : 32768, 00-12-CF-61-24-2F
  Partner Admin Port Number : 1
  Partner Oper Port Number  : 1
  Port Admin Priority       : 32768
  Port Oper Priority        : 32768
  Admin Key                 : 0
  Oper Key                  : 3
  Admin State:               defaulted, distributing, collecting,
                             synchronization, long timeout,
  Oper State:                distributing, collecting, synchronization,
                             aggregation, long timeout, LACP-activity
⋮
```

Table 75: show lacp neighbors - display description

Field	Description
Port Channel	Local identifier for a link aggregation group.
Member Port	The ports active in this link aggregation group.
Partner Admin System ID	LAG partner's system ID assigned by the user.
Partner Oper System ID	LAG partner's system ID assigned by the LACP protocol.
Partner Admin Port ID	Current administrative value of the port priority and the port number for the protocol partner.
Partner Oper Port ID	Operational port priority and the port number assigned to this aggregation port by the port's protocol partner.
Partner Admin Key	Current administrative value of the Key for the protocol partner.
Partner Oper Key	Current operational value of the Key for the protocol partner.
Admin State	Administrative values of the partner's state parameters. (See preceding table.)
Partner Oper State	Operational values of the partner's state parameters. (See preceding table.)

```
 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
⋮
```

Table 76: show lacp sysid - display description

Field	Description
Channel group	A link aggregation group configured on this switch.
System Priority*	LACP system priority for this channel group.
System MAC Address*	System MAC address.

* The LACP system priority and system MAC address are concatenated to form the LAG system ID.

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

Operational Concept

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 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

Disabled

Command Mode

Global Configuration

Example

```
Console(config)#mlag
Console(config)#
```

mlag peer-link

This command configures the MLAG domain peer link. 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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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.
- The peer link may 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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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 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 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#
```

12 Port Mirroring Commands

Data can be mirrored from a local port on the same switch for analysis at the target port using software monitoring tools or a hardware probe. This switch supports the following mirroring modes.

Table 77: 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 78: 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**]

no port monitor *interface*

interface - **ethernet** *unit*/*port* (source port)

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

rx - Mirror received packets.

tx - Mirror transmitted packets.

both - Mirror both received and transmitted packets.

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.
- Note that Spanning Tree BPDU packets are not mirrored to the target port.
- 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.

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)#
```

show port monitor

This command displays mirror information.

Syntax

show port monitor [*interface*]

interface - **ethernet** *unit/port* (source port)

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

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):Eth1/5
 Source Port (monitored port)  :Eth1/6
 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 79: 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.

- *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.

  Only two mirror sessions are allowed. Both sessions can be allocated to remote mirroring, unless local mirroring is enabled (which is limited to a single session).

- *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* [**rx** | **tx** | **both**]

session-id – A number identifying this RSPAN session. (Range: 1-2)

Only two mirror sessions are allowed, including both local and remote mirroring. If local mirroring is enabled with the port monitor command, then there is only one session available for RSPAN.

interface

ethernet *unit/port-list*

unit - Unit identifier. (Range: 1)

port-list - One or more source ports. Use a hyphen to indicate a consecutive list of ports or a comma between non-consecutive ports. (Range: 1-32/54)

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.
- 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 rx
Console(config)#rspan session 1 source interface ethernet 1/3 rx
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: 1-2)

Only two mirror sessions are allowed, including both local and remote mirroring. If local mirroring is enabled with the port monitor command, then there is only one session available for RSPAN.

interface - **ethernet** *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

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 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 1/4
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: 1-2)

Only two mirror sessions are allowed, including both local and remote mirroring. If local mirroring is enabled with the port monitor command, then there is only one session available for RSPAN.

vlan-id - ID of configured RSPAN VLAN. (Range: 2-4092)
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. (Range: 1)

port - Port number. (Range: 1-32/54)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- 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: 1-2)

Only two mirror sessions are allowed, including both local and remote mirroring. If local mirroring is enabled with the port monitor command, then there is only one session available for RSPAN.

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: 1-2)

Only two mirror sessions are allowed, including both local and remote mirroring. If local mirroring is enabled with the port monitor command, then there is only one session available for RSPAN.

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#
```

13

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 80: 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.

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 81: 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 - 10,000,000 Kbits per second for 10G Ethernet ports;
64 - 40,000,000 Kbits per second for 40G Ethernet ports)

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- If the rate limit is enabled without entering a specific rate, it will be set to the maximum possible rate for that interface.
- 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)#
```

Related Command

show interfaces switchport (377)

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 82: 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** | **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., packets per second.
(Range: 500-59520000 pps)

Default Setting

Broadcast Storm Control: Enabled, 500 pps
Multicast Storm Control: Disabled
Unknown Unicast Storm Control: 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 kilobits per second:

```
Console(config)#interface ethernet 1/5
Console(config-if)#switchport broadcast packet-rate 600
Console(config-if)#
```

14

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 83: 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.

- General loopback detection provided by the commands described in this section and loopback detection provided by the spanning tree protocol cannot both be enabled at the same time. If loopback detection is enabled for the spanning tree protocol, general loopback detection cannot be enabled on the same interface.

- 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

Disabled

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.

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)#no spanning-tree loopback-detection
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 {**block** | **none** | **shutdown**}

no loopback-detection action

block - When a loopback is detected on a port which a member of a specific VLAN, packets belonging to that VLAN are dropped at the offending port.

none - No action is taken.

shutdown - Shuts down the interface.

Default Setting

Shutdown

Command Mode

Global Configuration

Command Usage

- When the response to a detected loopback condition is set to block user traffic, loopback detection control frames may be untagged or tagged depending on the port's VLAN membership type.

- When the response to a detected loopback condition is set to block user traffic, ingress filtering for the port is enabled automatically if not already enabled by the switchport ingress-filtering command. The port's original setting for ingress filtering will be restored when loopback detection is disabled.

- When a port receives a control frame sent by itself, this means that the port is in looped state, and the VLAN in the frame payload is also in looped state with the wrong VLAN tag. 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.

- When the loopback detection response is changed, any ports placed in shutdown state by the loopback detection process will be immediately restored to operation regardless of the remaining recover time.

Example

This example sets the loopback detection mode to block user traffic.

```
Console(config)#loopback-detection action block
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

- When the loopback detection mode is changed, any ports placed in shutdown state by the loopback detection process will be immediately restored to operation regardless of the remaining recover time.

- 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(config)#
```

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. (Range: 1-8)

port - Port number. (Range: 1-52)

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     Disabled
 Eth 1/ 3  Disabled     Disabled
⋮
Console#show loopback-detection ethernet 1/1
Loopback Detection Information of Eth 1/1
 Admin State  : Enabled
 Oper State   : Normal
 Looped VLAN : None
Console#
```

15

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 84: 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 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 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 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

7 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 15
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. (Range: 1-8)

port - Port number. (Range: 1-32/54)

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#
```

Table 85: show udld - display description

Field	Description
Message Interval	The interval between UDLD probe messages for ports in advertisement phase
Detection Interval	The period the switch remains in detection state after discovering a neighbor
Recovery	Shows if automatic recovery from UDLD disabled port state is enabled

Table 85: show udld - display description (Continued)

Field	Description
Recovery Interval	Shows the period after which to recover from UDLD disabled port state if automatic recovery is enabled
UDLD	Shows if UDLD is enabled or disabled on a port
Mode	Shows if UDLD is functioning in Normal or Aggressive mode
Oper State	Shows the UDLD operational state (Disabled, Link down, Link up, Advertisement, Detection, Disabled port, Advertisement - Single neighbor, Advertisement - Multiple neighbors)
Port State	Shows the UDLD port state (Unknown, Bidirectional, Unidirectional, Transmit-to-receive loop, Mismatch with neighbor state reported, Neighbor's echo is empty) The state is Unknown if the link is down or not connected to a UDLD-capable device. The state is Bidirectional if the link has a normal two-way connection to a UDLD-capable device. All other states indicate mis-wiring.
Msg Invl	The interval between UDLD probe messages used for the indicated operational state
Det Invl	The period the switch remains in detection state after discovering a neighbor
Timeout	The time that UDLD waits for echoes from a neighbor device during the detection window

16 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 86: Address Table Commands

Command	Function	Mode
mac-address-table aging-time	Sets the aging time of the 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

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: 10-1000000 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 static

This command maps a static address to a port in a VLAN, and optionally designates the address as permanent, or to be deleted on reset. 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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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.

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#clear mac-address-table dynamic
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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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
 Flag: * - VXLAN VNID
 Interface MAC Address       VLAN/VXLAN Type     Life Time
 --------- ----------------- ---------- -------- -----------------
  CPU      70-72-CF-EA-1B-71          1 CPU      Delete on Reset
  Eth 1/ 1 14-DA-E9-CF-40-04          1 Learn    Delete on Timeout
  Eth 1/ 1 14-DA-E9-CF-40-03          3 Config   Permanent
  Eth 1/ 2 00-10-B5-A7-74-F5          1 Learn    Delete on Timeout
  Eth 1/ 2 00-00-00-00-BB-BB *     1002 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 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*

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Default Setting

None

Command Mode

Privileged Exec

Example

```
Console#show mac-address-table count interface ethernet 1/1
MAC Entries for Eth 1/2
Total Address Count       :0
Static Address Count      :0
Dynamic Address Count     :0
Console#
```

17

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 87: Spanning Tree Commands

Command	Function	Mode
spanning-tree	Enables the spanning tree protocol	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 pathcost method	Configures the path cost method for RSTP/MSTP	GC
spanning-tree priority	Configures the spanning tree bridge priority	GC
spanning-tree mst configuration	Changes to MSTP configuration mode	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 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 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

Table 87: Spanning Tree Commands (Continued)

Command	Function	Mode
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 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

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 enabled.

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 forward-time

This command configures the spanning tree bridge forward time globally for this switch. Use the **no** form to restore the default.

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) the root device 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)#
```

Related Commands

spanning-tree forward-time (445)
spanning-tree max-age (446)

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)#
```

Related Commands

spanning-tree forward-time (445)
spanning-tree hello-time (445)

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 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 802.1 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 456) takes precedence over port priority (page 461).

- 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 40000
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)#
```

Related Commands

mst vlan (452)
mst priority (451)
name (453)
revision (454)
max-hops (451)

spanning-tree system-bpdu-flooding

This command configures the system to flood BPDUs to all other ports on the switch or just to all other ports in the same VLAN when spanning tree is disabled globally on the switch or disabled on a specific port. 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 ports on the switch.

to-vlan - Floods BPDUs to all other ports within the receiving port's native VLAN (i.e., as determined by port's PVID).

Default Setting

Floods to all other ports in the same VLAN.

Command Mode

Global Configuration

Example

```
Console(config)#spanning-tree system-bpdu-flooding
Console(config)#
```

spanning-tree transmission-limit

This command configures the minimum interval between the transmission of consecutive RSTP/MSTP BPDUs. Use the **no** form to restore the default.

Syntax

spanning-tree transmission-limit *count*

no spanning-tree transmission-limit

count - The transmission limit in seconds. (Range: 1-10)

Default Setting

3

Command Mode

Global Configuration

Command Usage

This command limits the maximum transmission rate for BPDUs.

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 to restore the default.

Syntax

max-hops *hop-number*

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 33 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 453) 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 to clear the name.

Syntax

name *name*

name - Name of the spanning tree.

Default Setting

Switch's MAC address

Command Mode

MST Configuration

Command Usage

The MST region name and revision number (page 454) 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)#
```

Related Commands

revision (454)

revision

This command configures the revision number for this multiple spanning tree configuration of this switch. Use the **no** form to restore the default.

Syntax

revision *number*

number - Revision number of the spanning tree. (Range: 0-65535)

Default Setting

0

Command Mode

MST Configuration

Command Usage

The MST region name (page 453) 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)#
```

Related Commands

name (453)

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)#
```

Related Commands

spanning-tree edge-port (457)

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 spanning-tree spanning-disabled 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)#
```

Related Commands

spanning-tree edge-port (457)

spanning-tree spanning-disabled (462)

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[7], 1-200,000,000 for long path cost method)

Table 88: 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
Gigabit Ethernet	3-10	2,000-200,000
10G Ethernet	1-5	200-20,000
40G Ethernet	1-65535[1]	20-2,000[1]

[1] Undefined in standard.

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.

[7] 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 89: Default STA Path Costs

Port Type	Short Path Cost (IEEE 802.1D-1998)	Long Path Cost (802.1D-2004)
Ethernet	65,535	1,000,000
Fast Ethernet	65,535	100,000
Gigabit Ethernet	10,000	10,000
10G Ethernet	1,000	1,000
40G Ethernet	65535[1]	2,000,000[2]

[1] Undefined in standard, but recommended setting is 250.

[2] Code does not support 40G path cost, and therefore defaults to 10M half duplex cost.

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 448) 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 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[8], 1-200,000,000 for long path cost method)

The recommended path cost range is listed in Table 88 on page 456.

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. The default path costs are listed in Table 89 on page 457.

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.

[8] Use the spanning-tree pathcost method command to set the path cost method.

- 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)#
```

Related Commands

spanning-tree mst port-priority (460)

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)#
```

Related Commands

spanning-tree mst cost (459)

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
```

Related Commands

spanning-tree cost (456)

spanning-tree root-guard

This command prevents a designated port 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 edge-port
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**

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

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). Use the **no** form to allow propagation of TCN 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 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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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 eth 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*]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-27)

instance-id - Instance identifier of the multiple spanning tree. (Range: 0-4094, no leading zeroes)

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
---------------------------------------------------------------
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
.
.
.
```

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#
```

18

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 90: 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, PVID, and GVRP
Displaying VLAN Information	Displays VLAN groups, status, port members, and MAC addresses
Configuring IEEE 802.1Q Tunneling	Configures 802.1Q Tunneling (QinQ Tunneling)
Configuring L2CP Tunneling	Configures Layer 2 Control Protocol (L2CP) tunneling, either by discarding, processing, or transparently passing control packets across a QinQ tunnel
Configuring VXLAN Tunneling	Configures Virtual Extensible LAN (VXLAN) tunneling

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 91: 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)#
```

Related Commands

show garp timer (470)

~~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)

Example

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

~~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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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#
```

Related Commands

garp timer (469)

~~show gvrp configuration~~

This command shows if GVRP is enabled.

Syntax

show gvrp configuration [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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 92: 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)#
```

Related Commands

show vlan (482)

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**}]

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 411.

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)#
```

Related Commands

show vlan (482)

Configuring VLAN Interfaces

Table 93: 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 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
switchport priority default	Sets a port priority for incoming untagged frames	IC
vlan-trunking	Allows unknown VLANs to cross the switch	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)#
```

Related Commands

shutdown (364)
interface (360)
vlan (473)

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 default 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)#
```

Related Commands

switchport mode (479)

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**] | **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 a untagged member if switchport mode is set to access. Packets are sent as are (that is, with or without tags) if switchport mode is set to trunk or hybrid.

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.

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

All ports are assigned to VLAN 1 by default.
The default frame type is untagged.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- A port, or a trunk with switchport mode set to **hybrid**, must be assigned to at least one VLAN as untagged.
- If a trunk has switchport mode set to **trunk** (i.e., 1Q Trunk), then you can only assign an 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.

- 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.

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 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~~.

- 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.

- 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 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

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Ingress filtering only affects tagged frames.
- If ingress filtering is disabled and a port receives frames tagged for VLANs for which it is not a member, these frames will be flooded to all other ports (except for those VLANs explicitly forbidden on this port).
- If ingress filtering is enabled and a port receives frames tagged for 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.

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)

Command Usage

Access mode is mutually exclusive with VLAN trunking (see the vlan-trunking command). If VLAN trunking is enabled on an interface, then that interface cannot be set to access mode, and vice versa.

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)#
```

Related Commands

switchport acceptable-frame-types (475)

switchport native vlan

This command configures the PVID (i.e., default 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 using Access mode, and an interface is assigned to a new VLAN, its PVID is automatically set to the identifier for that VLAN. When using Hybrid mode, the PVID for an interface can be set to any VLAN for which it is an untagged member.
- If acceptable frame types is set to **all** or switchport mode is set to **hybrid**, the PVID will be inserted into all untagged frames entering the ingress port.

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

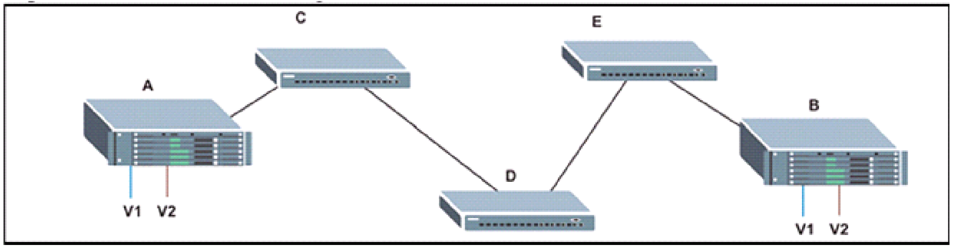
Interface Configuration (Ethernet, Port Channel)

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 3: 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.

- 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).

- 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.

- 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 9 and 10 to establish a path across the switch for unknown VLAN groups:

```
Console(config)#interface ethernet 1/9
Console(config-if)#vlan-trunking
Console(config-if)#interface ethernet 1/10
Console(config-if)#vlan-trunking
Console(config-if)#
```

Displaying VLAN Information

This section describes commands used to display VLAN information.

Table 94: 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) Eth1/19(S) Eth1/20(S)
                      Eth1/21(S) Eth1/22(S) Eth1/23(S) Eth1/24(S) Eth1/25(S)
                      Eth1/26(S) Eth1/27(S) Eth1/28(S) Eth1/29(S) Eth1/30(S)
                      Eth1/31(S) Eth1/32(S) Eth1/33(S) Eth1/34(S) Eth1/35(S)
                      Eth1/36(S) Eth1/37(S) Eth1/38(S) Eth1/39(S) Eth1/40(S)
                      Eth1/41(S) Eth1/42(S) Eth1/43(S) Eth1/44(S) Eth1/45(S)
                      Eth1/46(S) Eth1/47(S) Eth1/48(S) Eth1/49(S) Eth1/50(S)
                      Eth1/51(S) Eth1/52(S) Eth1/53(S) Eth1/54(S)
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 commands used to configure QinQ tunneling.

Table 95: 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	Sets the Tag Protocol Identifier (TPID) value of a tunnel port	IC
switchport dot1q-tunnel mode	Configures an interface as a QinQ tunnel port	IC
switchport dot1q-tunnel priority map	Copies inner tag priority to outer tag priority	IC
switchport dot1q-tunnel service default match all	Specifies how to handle traffic that does not match any other dot1q-tunnel service settings	IC
switchport dot1q-tunnel service match cvid	Creates a CVLAN to SPVLAN mapping entry	IC
show dot1q-tunnel	Displays the configuration of QinQ tunnel ports	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 (dot1q-tunnel tpid).
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)#
```

Related Commands

show dot1q-tunnel (490)
show interfaces switchport (377)

dot1q-tunnel tpid

This command sets the Tag Protocol Identifier (TPID) value of a tunnel port. Use the **no** form to restore the default setting.

Syntax

dot1q-tunnel tpid *tpid*

no dot1q-tunnel tpid

tpid – Sets the ethertype value for 802.1Q encapsulation. This identifier is used to select a nonstandard 2-byte ethertype to identify 802.1Q tagged frames. The standard ethertype value is 0x8100. (Range: 0800-FFFF hexadecimal)

Default Setting

0x8100

Command Mode

Global Configuration

Command Usage

- Use the **switchport dot1q-tunnel tpid** command to set a custom 802.1Q ethertype value on the switch. 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, 0x1234 is set as the custom 802.1Q ethertype on a trunk port, incoming frames containing that ethertype are assigned to the VLAN contained in the tag following the ethertype field, as they would be with a standard 802.1Q trunk. Frames arriving on the port containing any other ethertype are looked upon as untagged frames, and assigned to the native VLAN of that 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, the TPID is always 8100. If the port is in Access mode, received packets are processes as untagged packets.

- Avoid using well-known ethertypes for the TPID unless you can eliminate all side effects. For example, setting the TPID to 0800 hexadecimal (which is used for IPv4) will interfere with management access through the web interface.

Example

```
Console(config)#dot1q-tunnel tpid 9100
Console(config)#
```

Related Commands

show interfaces switchport (377)

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)#
```

Related Commands

show dot1q-tunnel (490)
show interfaces switchport (377)

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 default match all

This command specifies how to handle traffic that does not match any other dot1q-tunnel service settings. Use the **no** form to restore the default setting.

Syntax

switchport dot1q-tunnel service *svid* **match all {discard** | **remove-ctag**}

no switchport dot1q-tunnel service default [**match all**]

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)

discard - Drops all traffic that does not match any other dot1q-tunnel service settings

remove-ctag - Removes the customer's VLAN tag.

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

switchport dot1q-tunnel service match cvid

This command creates a CVLAN to SPVLAN mapping entry. Use the **no** form to delete a VLAN mapping entry.

Syntax

switchport dot1q-tunnel service *svid* **match 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)

remove-ctag - Removes the customer's VLAN tag.

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 switchport dot1q-tunnel mode uplink command to set an interface to access or uplink mode.
- 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.

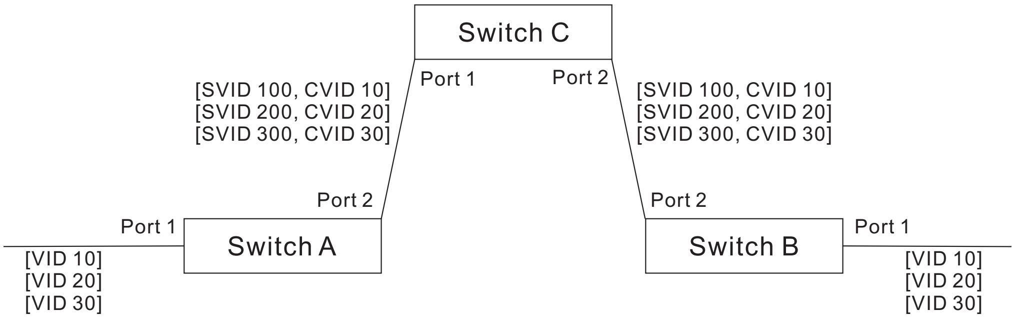
Example

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 4: 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 Remove C-Tag
 -------- ----------- ----- ------------
 Eth 1/ 1          10   100 Disabled
 Eth 1/ 1          20   200 Disabled
 Eth 1/ 1          30   300 Disabled

Default Service

 Port     Discard  Remove C-Tag
 -------- -------- ------------
 Eth 1/ 1 Enabled  Disabled
```

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
```

show dot1q-tunnel

This command displays information about QinQ tunnel ports. $$$

Syntax

show dot1q-tunnel [**interface** *interface* [**service** *svid*] | **service** [*svid*]]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

svid - VLAN ID for the outer VLAN tag (SPVID). (Range: 1-4094)

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

Port     Mode   TPID (Hex) Priority Mapping $$$
-------- ------ ---------- ----------------
Eth 1/ 1 Access       8100 Disabled
Eth 1/ 2 Uplink       8100 Disabled
Eth 1/ 3 Normal       8100 Disabled
:
Console#show dot1q-tunnel interface ethernet 1/5
802.1Q Tunnel Service Subscriptions

 Port     Match C-VID S-VID Remove C-Tag
 -------- ----------- ----- ------------
 Eth 1/ 5           1   100 Disabled

  Default Service

   Port     Discard  Remove C-Tag
   -------- -------- ------------
   Eth 1/ 1 Enabled  Disabled


Console#show dot1q-tunnel service 100
802.1Q Tunnel Service Subscriptions

 Port     Match C-VID S-VID Remove C-Tag
 -------- ----------- ----- ------------
 Eth 1/ 5           1   100 Disabled
 Eth 1/ 6           1   100 Enabled

Console#
```

Related Commands

switchport dot1q-tunnel mode (486)

Configuring L2CP Tunneling

This section describes the commands used to configure Layer 2 Protocol Tunneling (L2PT).

Table 96: L2 Protocol Tunnel Commands

Command	Function	Mode
l2protocol-tunnel custom-pdu	Configures the PDU format and pattern used for custom PDUs	GC
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 custom-pdu

This command configures the PDU format and pattern used for custom PDUs.

Syntax

l2protocol-tunnel custom-pdu *index destination-mac* {**bpdu** *protocol-id* **eth2** *ethertype* **snap** *oui protocol-id*}

index – PDU identifier. (Range: 1-16)

destination-mac – Destination MAC address. (Format: xx-xx-xx-xx-xx-xx or xxxxxxxxxxxx; for example, 01-23-45-00-00-00)

bpdu – IEEE 802.3 BPDU with logical link control (LLC) data communication protocol layer 42-42-03.

protocol-id – Range: 0-ffff hexadecimal

eth2 – Ethernet II packets.

ethertype – A two-octet field in an Ethernet frame. It is used to indicate which protocol is encapsulated in the payload of an Ethernet Frame. (Range: 600-ffff hexadecimal)

snap – The Subnetwork Access Protocol is an extension of the IEEE 802.2 Logical Link Control (LLC) udrf to distinguish many more protocols of the higher layer.

oui – A 24-bit number that uniquely identifies a vendor, manufacturer, or other organization. (Range: xxxxxx hexadecimal)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Use this command to configure user-defined PDUs. Then use the switchport l2protocol-tunnel command to assign these PDUs to an interface.
- 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 uplink mode using the switchport dot1q-tunnel mode command.

Example

This example sets the protocol ID for a custom PDU to FDDI.

```
Console(config)#l2protocol-tunnel custom-pdu 1 01-00-0c-cd-cd-d0 bpdu 0010
Console(config-if)#
```

Related Commands

switchport l2protocol-tunnel (496)

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*

mac-address – The switch rewrites the destination MAC address in all upstream L2PT protocol packets (e.g., 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.

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 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[9] 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.
  - 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:

[9] Access ports in this context are 802.1Q trunk ports.

    (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 uplink mode using the switchport dot1q-tunnel mode 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

switchport l2protocol-tunnel {**cdp** | **custom-pdu** *index* | **lldp** | **pvst+** | **spanning-tree** | **vtp**}

cdp - Cisco Discovery Protocol

custom-pdu - User defined PDU

index - Identifies a custom PDU defined with the l2protocol-tunnel custom-pdu command. (Range: 1-16)

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 uplink mode using the switchport dot1q-tunnel mode 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)#
```

Related Commands

l2protocol-tunnel custom-pdu (492)

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 VXLAN Tunneling

This section describes the commands used to configure Virtual Extensible LAN (VXLAN) tunneling.

VXLAN is a networking scheme that encapsulates MAC-based Layer 2 Ethernet frames within Layer 3 UDP packets to aggregate and tunnel multiple layer 2 networks across a Layer 3 infrastructure. VXLAN scales up to 16 million logical networks and supports Layer 2 adjacency for isolated tenants across IP networks. Multicast transmission is used for broadcast, multicast, and unknown unicast traffic. In this implementation, broadcast, multicast and unknown unicast traffic can also use unicast tunneling.

When a packet enters a switch port, the switch determines if the VLAN to which this port belongs is associated with a VXLAN ID. If a VLAN to VXLAN mapping is found, it then searches the bridge table for the destination port. If the egress port is found, the packet is encapsulated with a VXLAN header and sent on to the corresponding VTEP. If the egress port is not found, the packet is flooded to all VTEPs on this VXLAN ID. The flooded packet may encapsulated as a unicast packet or multicast packet according to the configured setting as described in RFC 7348.

Unicast VM-to-VM Communication

Consider a VM within a VXLAN overlay network. To communicate with a VM on a different host, it sends a MAC frame destined to the target as it normally would. The VTEP on the physical host looks up the VNI to which this VM is associated. It then determines if the destination MAC is on the same segment and if there is a mapping of the destination MAC address to the remote VTEP. If so, an outer header comprising an outer MAC, outer IP header, and VXLAN header are prepended to the original MAC frame. The encapsulated packet is forwarded towards the remote VTEP. Upon reception, the remote VTEP verifies the validity of the VNI and whether or not there is a VM on that VNI using a MAC address that matches the inner destination MAC address. If so, the packet is stripped of its encapsulating headers and passed on to the destination VM.

In addition to forwarding the packet to the destination VM, the remote VTEP learns the mapping from inner source MAC to outer source IP address. It stores this mapping in the bridge lookup table so that when the destination VM sends a response packet, there is no need for "unknown destination" flooding of the response packet.

Determining the MAC address of a destination VM prior to transmission by the source VM is performed as with non-VXLAN environments. Broadcast frames are used but are encapsulated within a multicast packet.

Broadcast Communication and Mapping to Multicast

Consider the VM on the source host attempting to communicate with the destination VM using IP as it normally would. Assuming that they are both on the same subnet, the VM sends out an ARP broadcast frame. In this non-VXLAN environment, this frame would be sent out using MAC broadcast across all switches carrying that VLAN.

With VXLAN, a header including the VXLAN VNI is inserted at the beginning of the packet along with the outer IP header and outer UDP header. However, this broadcast packet is sent out to the IP multicast group on which that VXLAN overlay network is realized.

To effect this, we need to have a mapping between the VXLAN VNI and the IP multicast group that it will use. (This information must be configured using the vxlan flood command.) Using this mapping, the VTEP can provide IGMP membership reports to the upstream switch/router to join/leave the VXLAN-related IP multicast groups as needed. This will enable pruning of the leaf nodes for specific multicast traffic addresses based on whether a member is available on this host using the specific multicast address. In addition, use of multicast routing protocols like Protocol Independent Multicast - Sparse Mode (PIM-SM) will provide efficient multicast trees within the Layer 3 network

The destination VM sends a standard ARP response using IP unicast. This frame is encapsulated and sent back to the VTEP connecting to the originating VM using IP unicast VXLAN encapsulation. This is possible since the mapping of the ARP response's destination MAC to the VXLAN tunnel end point IP was learned earlier through the ARP request.

Note that multicast frames and "unknown MAC destination" frames are also sent using the multicast tree, similar to the broadcast frames.

Table 97: VxLAN Tunneling Commands

Command	Function	Mode
vxlan udp-dst-port	Configures the VXLAN UDP destination port	GC
vxlan flood	Configures remote VXLAN tunnel endpoint (VTEP) when received packet fails bridge table lookup	GC
vxlan vlan vni	Associates a VLAN ID with a virtual network identifier (VNI)	GC
debug vxlan	Enables specified debug flag	PE
show mac-address-table	Shows MAC address entries for VXLAN VNI	PE

Table 97: VxLAN Tunneling Commands (Continued)

Command	Function	Mode
show vxlan udp-dst-port	Shows the VXLAN UDP destination port	PE
show vxlan vtep	Shows the remote VXLAN tunnel endpoint (VTEP)	PE
show vxlan flood	Shows the remote VXLAN tunnel endpoint (VTEP) used when received packet fails bridge table lookup	PE
show vxlan vlan-vni	Shows the VLAN ID associated with a virtual network identifier (VNI)	PE
show debug vxlan	Shows the VXLAN debug settings	PE

vxlan udp-dst-port

This command configures the VXLAN UDP destination port. Use the **no** form to restore the default setting.

Syntax

vxlan udp-dst-port *udp-port*

no vxlan udp-dst-port

udp-port - UDP port used for the VXLAN destination port.

Default Setting

4789

Command Mode

Global Configuration

Command Usage

The VXLAN header inserts a VNI at the beginning of the packet along with the IP header and UDP header. The UDP port defined by this command is used in the outer UDP header.

The outer UDP header includes a source port provided by the VTEP and the destination port being a well-known UDP port. IANA[10] has assigned the value 4789 for the VXLAN UDP port. This value should be used by default as the destination UDP port. Some early implementations of VXLAN have used other values for the destination port. This command is therefore provided to enable interoperability with these implementations.

Example

```
Console(config)#vxlan udp-dst-port 4933
Console(config)#end
Console#show vxlan udp-dst-port
  VXLAN UDP Destination Port: 4933
Console#
```

[10] Internet Assigned Numbers Authority

vxlan flood

This command configures remote VXLAN tunnel endpoint (VTEP) when the received packet fails bridge table lookup. Use the **no** form to restore the default setting.

Syntax

vxlan [**vni** *vni-id*] **flood** { **r-vtep** *ip-address* | **multicast** *ipv4-address* **vlan** *vid* *interface* }

no vxlan [**vni** *vni-id*] **flood** { **r-vtep** *ip-address* | **multicast** }

vni-id - A 24-bit segment ID used to identify each VXLAN segment, termed the VXLAN Network Identifier. The VNI is used in an outer header that encapsulates the inner MAC frame originated by a virtual machine (VM).

ip-address - The IPv4/v6 address assigned to a remote VTEP. If the egress port is not found, the packet is encapsulated as a unicast packet and flooded to all VTEPs on this VNI.

multicast - Multicast is used for carrying unknown destination, broadcast, and multicast frames.

ipv4-address - Each VTEP VNI joins this multicast group as an IP host through the IGMP. IGMP joins are used to trigger PIM joins for this group.

vid - The VLAN assigned to this VNI.

interface - The port assigned to this VNI.

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- VTEPs communicate with one another through flooding or multicast within the specified multicast group.

- When a VNI is configured to flood by multicasting, all unknown unicast, multicast and broadcast packets are transmitted by encapsulating them in multicast packets.

- Each VNI can be assigned to only one VLAN (using the vxlan vlan vni command); and each VLAN can be assigned a maximum of one VNI. Multiple remote VTEPs can be configured to flood packets on the same VNI.

- If a VNI is already configured to flood by multicast, you can still add a remote VTEP. If a VNI is already configured to flood to a remote VTEP, you can still configure it to flood by multicast.

Example

```
Console(config)#vxlan vni 16777 flood r-vtep 10.1.2.3
Console(config)#end
Console#show vxlan flood
  VNI       Remote VTEP IP address
  --------  ----------------------
       100  3.3.3.3
       101  11.1.1.1
       101  11.2.2.2
       102  11.1.1.1
       102  224.1.1.1
Console#
```

vxlan vlan vni

This command associates a VLAN ID with a virtual network identifier (VNI). Use the **no** form to remove the specfied VLAN-VNI association.

Syntax

[**no**] **vxlan vlan** *vid* **vni** *vni-id*

vid - The VLAN associated with this VNI.

vni-id - A 24-bit segment ID used to identify each VXLAN segment, termed the VXLAN Network Identifier. The VNI is used in an outer header that encapsulates the inner MAC frame originated by the virtual machine (VM).

Default Setting

None

Command Mode

Global Configuration

Command Usage

- The VLAN associated with the VNI is used for carrying the VXLAN transport traffic across the network.

- Each VNI can be assigned to only one VLAN; and each VLAN can be assigned a maximum of one VNI.

- The specified VLAN must be configured as a Layer 3 interface, IGMP snooping enabled on the switch, IGMP querier enabled on the associated VLAN, and the MTU set to a sufficiently large size to prevent fragmented packets from being recieved at the VTEP.

Example

```
Console(config)#vxlan vlan 1 vni 16777
Console(config)#end
```

```
Console#show vxlan vlan-vni
  VLAN  VNI
  ----  --------
     1     16777
Console#
```

debug vxlan

This command enables the specified debug flag. Use the **no** form to disable the specified flag.

Syntax

[**no**] **debug vxlan** {**database** | **event** | **vni** | **vtep** | **all**}

database - Enables database debugging.

event - Enables event debugging.

vni - Enables VNI debugging.

vtep - Enables VTEP debugging.

all - Enables all VXLAN debugging flags.

Default Setting

Disabled

Command Mode

Privileged Exec

Example

This example shows the type of debug information that would be displayed for tracing a callback event.

```
Console#debug vxlan event
Console#con
Console(config)#vlan database
Console(config-vlan)#vlan 2 media ethernet

23:14:22: VXLAN: (510) VLAN create,  vid_ifindex[1002]
Console(config-vlan)#exit
Console(config)#int ethernet 1/2
Console(config-if)#switchport allowed vlan 2

23:16:38: VXLAN: (618) Add VLAN member, vid_ifindex[1002], lport_ifindex[2]

23:16:38: VXLAN: (689) Delete VLAN member, vid_ifindex [1001],
  lport_ifindex[2]
Console(config-if)#
```

This example shows the type of debug information that would be displayed for an error on a VNI.

```
Console#debug vxlan vni
Console#con
```

```
Console(config)#vxlan vlan 2 vni 1001
Console(config)#vxlan vlan 2 vni 1002

23:19:2: VXLAN: (1805) VLAN 2 is assigned to VNI 1001
Failed to associate VLAN 2 with VNI 1002.
Console(config)#
```

This example shows the type of debug information that would be to trace internal VXLAN information on VTEP.

```
Console#debug vxlan vtep
Console#con
Console(config)#vxlan vni 1001 flood r-vtep 192.168.2.13

23:24:34: VXLAN: (2176) set rvtep ip[192.168.2.13]
 l_vtep_ip[192.168.2.1]
 dst_vid_ifindex [1003], dst_inet_addr[192.168.2.13]
 vfi  [28672], e_vlan[3], l3_if[6], lport[0], udp_port[4789]
 mac[00:00:00:00:00:00]

23:24:34: VXLAN: (2398) vfi_id [0x7000], bcast_group[0xc000001], l3_if[6]
 e_vlan[3], lport[0], udp_port[4789]
 r_mac[00:00:00:00:00:00]
l_vtep[192.168.2.1], r_vtep[192.168.2.13], nexthop[192.168.2.13]
Console(config)#
```

show vxlan udp-dst-port

This command shows the VXLAN UDP destination port.

Syntax

show vxlan udp-dst-port

Command Mode

Privileged Exec

Example

```
Console#show vxlan udp-dst-port
  VXLAN UDP Destination Port: 4789
Console#
```

show vxlan vtep

This command shows the remote VXLAN tunnel endpoint (VTEP).

Syntax

show vxlan vtep

Command Mode

Privileged Exec

Example

```
Console#show vxlan vtep
    VNI      SIP             R-VTEP          Port
  -------- --------------- --------------- --------
  12345678 101.101.101.101 202.202.202.202 Eth 1/11
         3 101.101.202.202 201.201.201.201 Eth 1/22
Console#
```

show vxlan flood

This command Shows the remote VXLAN tunnel endpoint (VTEP) used when a received packet fails bridge table lookup.

Syntax

show vxlan flood [**vni** *vni-id*]

vni-id - A 24-bit segment ID used to identify each VXLAN segment, termed the VXLAN Network Identifier. The VNI is used in an outer header that encapsulates the inner MAC frame originated by a virtual machine (VM).

Command Mode

Privileged Exec

Example

```
Console#show vxlan flood
  VNI       Remote VTEP IP address
  --------  ----------------------
       100              3.3.3.3
       101              11.1.1.1
       101              11.2.2.2
       102              11.1.1.1
       102              224.1.1.1

Console#show vxlan flood vni 100
  VNI       Remote VTEP IP address
  --------  ----------------------
       100              3.3.3.3
Console#
```

show vxlan vlan-vni

This command shows the VLAN ID associated with a virtual network identifier (VNI).

Syntax

show vxlan vlan-vni [*vid*]

vid - The VLAN associated with this VNI.

Command Mode

Privileged Exec

Example

```
Console#show vxlan vlan-vni
  VLAN  VNI
  ----  --------
     1        10
     2       200
     3       123

Console#show vxlan vlan-vni 3
  VLAN  VNI
  ----  --------
     3       123
Console#
```

show debug vxlan

This command shows the VXLAN debug settings.

Syntax

show debug vxlan

Command Mode

Privileged Exec

Example

```
Console#show debug vxlan
VXLAN:
 VXLAN event debugging is disabled
 VXLAN database debugging is disabled
 VXLAN VNI debugging is disabled
 VXLAN VTEP debugging is disabled
Console#
```

19

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 98: 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 99: 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	IC
queue weight	Assigns round-robin weights to the priority queues	IC
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

Interface Configuration (Ethernet, Port Channel)

Command Usage

- The switch can be set to service the port queues based on strict priority, WRR, or a combination of strict and weighted queueing.
- 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)#
```

Related Commands

queue weight (509)
show queue mode (511)

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: 1-15)

Default Setting

Weights 1, 2, 4, 6, 8, 10, 12, 14 are assigned to queues 0 - 7 respectively.

Command Mode

Interface Configuration (Ethernet)

Command Usage

- This command shares bandwidth at the egress port by defining scheduling weights for WRR, or for the queuing mode that uses a combination of strict and weighted queuing (page 508).

- 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 - 4 to the CoS priority queues 0 - 7.

```
Console(config)#queue weight 1 2 3 4 5 6 7 8
Console(config)#
```

Related Commands

queue mode (508)
show queue weight (511)

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, Port Channel)

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)#
```

Related Commands

show interfaces switchport (377)

show queue mode

This command shows the current 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.

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 100: Priority Commands (Layer 3 and 4)

Command	Function	Mode
qos map phb-queue	Maps internal per-hop behavior values to hardware queues	GC
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 default-drop-precedence	Maps the per-hop behavior to default drop precedence	IC
qos map dscp-cos	Maps internal per-hop behavior and drop precedence value pairs to CoS values used in tagged egress packets on a Layer 2 interface	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-port-dscp	Maps the destination TCP/UDP port 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 map default-drop-precedence	Shows the per-hop behavior to default drop precedence	PE
show map dscp-cos	Shows internal DSCP to egress CoS map	PE
show qos map dscp-mutation	Shows ingress DSCP to internal DSCP map	PE
show qos map ip-port-dscp	Shows destination TCP/UDP port 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 101: 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

Global Configuration

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 102: Default Mapping of CoS/CFI to Internal PHB/Drop Precedence

CFI	0	1
CoS		
0	(0,0)	(0,1)
1	(1,0)	(1,1)
2	(2,0)	(2,1)
3	(3,0)	(3,1)
4	(4,0)	(4,1)
5	(5,0)	(5,1)
6	(6,0)	(6,1)
7	(7,0)	(7,1)

Command Mode

Interface Configuration (Port, Static Aggregation)

Command Usage

- The default mapping of CoS to PHB values shown in Table 102 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 default-drop-precedence

This command maps the internal per-hop behavior (based on packet priority) to a default drop precedence for internal processing of untagged packets. Use the **no** form to restore the default settings.

Syntax

qos map default-drop-precedence *drop-precedence* **from** *phb0 ... phb7*

no map default-drop-precedence *phb0 ... phb7*

drop-precedence - Drop precedence used for controlling traffic congestion. (Range: 0 - Green, 3 - Yellow, 1 - Red)

phb - Per-hop behavior, or the priority used for this router hop. (Range: 0-7)

Default Setting.

Table 103: Mapping Per-hop Behavior to Drop Precedence

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 a drop precedence, followed by the keyword “from” and then up to four per-hop behavior values separated by spaces.
- This command only applies to Layer 2 untagged ingress packets. The drop precedence for any priority tagged ingress packets will be based on the other corresponding QoS mapping schemes described in those sections.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#qos map default-drop-precedence 1 from 0 1 2
Console(config-if)#qos map default-drop-precedence 3 from 3 4 5
Console(config-if)#qos map default-drop-precedence 0 from 6 7
Console(config-if)#
```

qos map dscp-cos

This command maps internal per-hop behavior and drop precedence value pairs to CoS/CFI values used in tagged egress packets on a Layer 2 interface. Use the **no** form to restore the default settings.

Syntax

qos map dscp-cos *cos-value cfi-value* **from** *phb0 drop-precedence0* ... *phb7 drop-precedence7*

no map ip dscp *phb0 drop-precedence0* ... *phb7 drop-precedence7*

cos-value - CoS value in ingress packets. (Range: 0-7)

cfi-value - 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)

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 104: Mapping Internal PHB/Drop Precedence to CoS/CFI Values

Drop Precedence Per-hop Behavior	0 (green)	1 (red)	3 (yellow)
0	(0,0)	(0,1)	(0,1)
1	(1,0)	(1,1)	(1,1)
2	(2,0)	(2,1)	(2,1)
3	(3,0)	(3,1)	(3,1)
4	(4,0)	(4,1)	(4,1)
5	(5,0)	(5,1)	(5,1)
6	(6,0)	(6,1)	(6,1)
7	(7,0)	(7,1)	(7,1)

Command Mode

Interface Configuration (Port, Static Aggregation)

Command Usage

- Enter a CoS/CFI value pair, followed by the keyword "from" and then four internal per-hop behavior and drop precedence value pairs separated by spaces.
- If the packet is forwarded with an 8021.Q tag, the priority value in the egress packet is modified based on the table shown above, or on similar values as modified by this command.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#qos map dscp-cos 1 0 from 1 2
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 105: Default Mapping of DSCP Values to Internal PHB/Drop Values

ingress-dscp1	0	1	2	3	4	5	6	7	8	9
ingress-dscp10										
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 105, 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-port-dscp

This command maps the destination TCP/UDP destination port in incoming packets to per-hop behavior and drop precedence values for priority processing. Use the **no** form to remove the mapped values for a TCP/UDP port.

Syntax

qos map ip-port-dscp {**tcp** | **udp**} *port-number* **to** *phb drop-precedence*

no qos map cos-dscp {**tcp** | **udp**} *port-number*

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)

tcp - Transport Control Protocol

udp - User Datagram Protocol

port-number - 16-bit TCP/UDP destination port number. (Range: 0-65535)

Default Setting

None

Command Mode

Interface Configuration (Port, Static Aggregation)

Command Usage

- This mapping table is only used if the protocol type of the arriving packet is TCP or UDP.

Example

```
Console(config)#interface ethernet 1/5
Console(config-if)#qos map ip-port-dscp tcp 21 to 1 0
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 106: 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** | **ip-prec**}

no qos map trust-mode

cos - Sets the QoS mapping mode to CoS.

dscp - Sets the QoS mapping mode to DSCP.

ip-prec - Sets the QoS mapping mode to IP Precedence.

Default Setting

CoS

Command Mode

Interface Configuration (Port, Static Aggregation)

Command Usage

- If the QoS mapping mode is set to IP Precedence with this command, and the ingress packet type is IPv4, then priority processing will be based on the IP Precedence value in the ingress packet.

- 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 either IP Precedence or 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 510) 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 510) 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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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)       (0,1)
  1            (1,0)       (1,1)
  2            (2,0)       (2,1)
  3            (3,0)       (3,1)
  4            (4,0)       (4,1)
  5            (5,0)       (5,1)
  6            (6,0)       (6,1)
  7            (7,0)       (7,1)
Console#
```

show map default-drop-precedence

This command shows the per-hop behavior to default drop precedence for untagged ingress packets.

Syntax

show qos map default-drop-precedence interface *interface*

interface

ethernet *unit/port*

unit - Stack unit. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Example

```
Console#show qos map default-drop-precedence interface ethernet 1/5
Information of Eth 1/5
 default-drop-precedence map:
 phb:       0     1     2     3     4     5     6     7
 -------------------------------------------------------
 color:     0     0     0     0     0     0     0     0
Console#
```

show map dscp-cos

This command shows the internal DSCP to egress CoS map, which converts internal PHB/Drop Precedence to CoS values.

Syntax

show qos map dscp-cos interface *interface*

interface

ethernet *unit/port*

unit - Stack unit. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Command Usage

This map is only used if the packet is forwarded with a 8021.Q tag.

Example

```
Console#show qos map dscp-cos interface ethernet 1/5
Information of Eth 1/5
 dscp-cos map:
 phb:  drop precedence   0(green)   1(red)     3(yellow)
 -------------------------------------------------------
 0  :                     (0,0)       (0,1)       (0,1)
 1  :                     (1,0)       (1,1)       (1,1)
 2  :                     (2,0)       (2,1)       (2,1)
 3  :                     (3,0)       (3,1)       (3,1)
 4  :                     (4,0)       (4,1)       (4,1)
 5  :                     (5,0)       (5,1)       (5,1)
 6  :                     (6,0)       (6,1)       (6,1)
 7  :                     (7,0)       (7,1)       (7,1)
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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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-port-dscp

This command shows the ingress TCP/UDP port to internal DSCP map.

Syntax

show qos map ip-port-dscp interface *interface*

interface

ethernet *unit/port*

unit - Stack unit. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Command Usage

The IP Port-to-DSCP mapping table is only used if the protocol type of the arriving packet is TCP or UDP.

Example

```
Console#show qos map ip-port-dscp interface ethernet 1/5
Information of Eth 1/5
 ip-port-dscp map:
 (ip protocol,destination port) :  phb     drop precedence
 -----------------------------------------------------------
 (TCP, 21)    :                    0       0
 (UDP, 12)    :                    1       0
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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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#
```

20 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 107: 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 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 command to modify the per-hop behavior, the class of service value in the VLAN tag 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

[**no**] **class-map** *class-map-name* **match-any**

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 531). The policy map is then bound by a service policy to an interface (page 541). A service policy defines packet classification, service tagging, and bandwidth policing. Once a policy map has been bound to an interface, no additional class maps may be added to the policy map, nor any changes made to the assigned class maps with the match or **set** commands.

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)#
```

Related Commands

show class-map (541)

description

This command specifies the description of a class map or policy map.

Syntax

description *string*

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 531) 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: 0-40000000 kbps or maximum port speed, whichever is lower)

committed-burst - Committed burst size (BC) in bytes. (Range: 1000-128000000 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: 0-40000000 kbps or maximum port speed, whichever is lower)

committed-burst - Committed burst size (BC) in bytes.
(Range: 0-524288 bytes)

excess-burst - Excess burst size (BE) in bytes. (Range: 1000-128000000 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: 0-40000000 kbps or maximum port speed, whichever is lower)

committed-burst - Committed burst size (BC) in bytes. (Range: 1000-128000000 bytes)

peak-rate - Peak information rate (PIR) in kilobits per second. (Range: 0-40000000 kbps or maximum port speed, whichever is lower)

peak-burst - Peak burst size (BP) in bytes. (Range: 1000-128000000 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 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 102, "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 or egress 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, Port Channel)

Command Usage

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.

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** | **output**}

interface

unit/port

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

input - Apply to the input traffic.

output - Apply to the output traffic.

Command Mode

Privileged Exec

Example

```
Console#show policy-map interface 1/5 input
Service-policy rd-policy
Console#
```

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Data Center Bridging Commands

Fibre Channel was developed as a dedicated fabric that loses little to no packets, and was not designed to work on an unreliable network. For this reason, a set of standards termed Data Center Bridging (DCB) have been developed to increase the reliability of Ethernet-based networks in the data center. DCB consists of four different technologies: DCB Exchange (DCBX), Priority-based Flow Control (PFC), Enhanced Transmission Selection (ETS), and Congestion Notification (CN). Openflow allows the switch to be managed by a centralized controller using multi-flow tables to provision forwarding behavior. These standards provide an effective method of speeding traffic through the data center.

Table 108: Data Center Bridging Commands

Command	Function
DCB Exchange	Provides the mechanism which allows peers to exchange configuration information via LLDP TLVs about ETS and PFC settings and their willingness to accept ETS configuration recommendations.
Priority-based Flow Control	Adds fields to the standard PAUSE frame that allow a device to inhibit the transmission of frames for certain priorities as opposed to inhibiting all frame transmissions.
Enhanced Transmission Selection	Allows the priorities used for services with similar bandwidth requirements to be combined into a traffic class group, and a minimum bandwidth set for each group.
Congestion Notification	CN is a mechanism to transmit congestion information on an end-to-end basis per traffic flow back to the edge of the network where the flow that causes the congestion can be easily isolated and rate limited.
Openflow	This feature allows the switch to be managed by a centralized Openflow controller, giving access to the forwarding plane of a network switch or router over the network.

DCB Exchange Commands

This section describes the commands used by DCB devices to exchange configuration information with directly-connected peers. These commands are also used to detect misconfiguration of the peer devices and, where accepted, to configured peer DCB devices.

Table 109: DCB Exchange Commands

Command	Function	Mode
dcbx	Enables DCBX on the selected interface	IC
dcbx mode	Configures DCBX mode used for message exchange	IC
show dcbx	Shows the DCBX configuration settings	PE

dcbx

This command enables DCBX on the selected interface. Use the **no** form to disable DCBX.

Syntax

[no] dcbx

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- DCBX is normally deployed in FCoE topologies to support lossless operation for FCoE traffic. In these scenarios, all network elements are DCBX enabled. LLDP is also enabled on any port configured to use DCBX.

- DCBX uses LLDP to exchange attributes between two link peers. DCBX does this by exchanging LLDP TLVs with peer devices to discover DCB capabilities supported by a peer port, detect misconfiguration of a DCB feature between the peers on a link, and perform configuration of DCB features on its peer port if the peer port is willing to accept configuration settings. The configurable attributes include ETS recommendation, ETS Configuration, and PFC.

- DCBX operates over a point to point link. If multiple LLDP peer ports running DCBX are detected on an interface, then DCBX shall behave as if the peer port's DCBX TLVs are not present until the multiple LLDP peer port condition is no longer present.

Example

The following example enables DCBX on port 5:

```
Console(config)#interface ethernet 1/5
Console(config-if)#dcbx
Console(config-if)#
```

dcbx mode

This command configures the DCBX mode used for message exchange. Use the **no** form to restore the default setting.

Syntax

dcbx mode {**auto-down** | **auto-up** | **configuration-source** | **manual**}

no dcbx mode

auto-down – In auto-downstream mode, the port advertises a configuration but is not willing to accept one from the link partner. However, it will accept a configuration propagated internally from the configuration source. Selection of a port based upon compatibility of the received configuration is suppressed.

auto-up – In auto-upstream mode, the port advertises a configuration, but it is also willing to accept a configuration from the link-partner and propagate it internally to the auto-downstream ports, as well as receive a configuration propagated internally by other auto-upstream ports.

configuration-source – In configuration-source mode, the port is manually selected as the configuration source. A configuration received over this port is propagated to the other auto-downstream and auto-upstream ports.

manual – In manual mode, the port does not accept a configuration from peer devices, nor does it accept any internally propagated configuration. The operational mode, traffic classes, and bandwidth information must be specified by the operator. These ports will advertise their configuration to a peer if DCBX is enabled on that port.

Default Setting

Manual

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Auto-downstream ports have the recommendation TLV parameter enabled. If these ports receive internally propagated information, they will utilize this information and ignore their local configuration.

- On auto-upstream ports, a recommendation TLV is sent to its peer, and processed if received locally. Auto-upstream ports that receive internally propagated information utilize this information and ignore their local configuration. The first auto-upstream port to successfully accept a compatible configuration becomes the configuration source.

Peer configurations received on auto-upstream ports other than the configuration source are accepted if compatible with the configuration source, and the DCBX client is set to operationally active on the auto-upstream port. If the configuration is not compatible with the configuration source, a message is logged indicating an incompatible configuration, an error counter incremented, and the DCBX client operationally disabled on the port.

- On a port set to configuration-source mode, automatic election of a new configuration source port is not allowed. Events that would cause selection of a new configuration source are ignored. The configuration received over the configuration source port is maintained until it is cleared by setting the port to the manual mode. Only the configuration source is allowed to propagate its configuration to other ports internally.

  If no port is set to configuration-source mode, then the first auto-upstream port to accept a compatible configuration becomes the configuration source.

- On a port set to manual mode, only locally configured settings are used to construct DCBX TLVs. On these ports, the operational mode, traffic classes, and bandwidth information must be specified by the operator. These ports advertise their configuration to their peer if DCBX is enabled on that port. Any incompatible peer configurations received on these ports are logged and an error counter incremented.

Example

The following example sets DCBX mode to auto-upstream on port 5:

```
Console(config)#interface ethernet 1/5
Console(config-if)#dcbx mode auto-up
Console(config-if)#
```

show dcbx

This command shows the DCBX configuration settings and status of the LLDP TLV willing bits.

Syntax

show dcbx [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Default Setting

Shows DCBX configuration settings for all ports.

Command Mode

Privileged Exec

Example

This example displays the DCBX administrative status, operational mode, and the status of the LLDP TLV willing bit for ETS and PFC.

```
Console#show dcbx ethernet 1/5
 DCBX Port Configuration
  Port     Status   Mode                ETS Willing PFC Willing
  -------- -------- ------------------- ----------- -----------
  Eth 1/5  Enabled  AutoUpstream        No          No

Console#
```

Priority-based Flow Control Commands

Priority-based Flow Control (PFC) is used to reduce frame loss due to congestion by inhibiting the transmission of frames based on individual traffic classes. PFC can pause high priority traffic only when necessary to avoid dropping frames, while allowing traditional traffic assigned other priorities to continue flowing through an interface.

Traffic classes are specified in the priority field of the 802.1Q VLAN header, which identifies an 802.1p priority value. However, a VLAN unaware end station can also use PFC by sending traffic as priority-tagged and ignoring the VLAN ID in received frames. Note that some frames, such as BPDUs, are sent untagged and can bypass the output queues, it is strongly recommended that the default priority for a port not have PFC enabled.

PFC can reduce the number of frames discarded due to congestion for loss-sensitive protocols. However, PFC can cause congestion to spread, and is therefore intended for use on networks of limited extent, such as within a data center. When PFC is used, deployment of Congestion Notification (CN) can reduce the frequency at which PFC is invoked.

Table 110: Priority-based Flow Control Commands

Command	Function	Mode
pfc mode	Sets the PFC mode to negotiate capability through DCBX or by forcing it to on state	IC
pfc priority	Enables PFC for specified priorities	IC

Table 110: Priority-based Flow Control Commands (Continued)

Command	Function	Mode
clear pfc statistics	Clears PFC statistics	PE
show pfc	Shows PFC configuration settings	PE
show pfc statistics	Shows PFC statistics for the number of PFC frames received and transmitted for each priority	PE

Configuration Guidelines

Take the following steps to configure PFC:

1. Ensure that tagging is enabled on the interfaces using PFC so that the 802.1p priority values are carried through the network (using the switchport allowed vlan command).

2. Use the pfc mode command to enable priority-based flow control on the interface.

3. Use the pfc priority command to specify the CoS values that should be paused (i.e., not dropped) due to greater loss sensitivity.

pfc mode

Use this command to sets the PFC mode to negotiate capability through DCBX or by forcing it to on state. Use the **no** form to disable this feature.

Syntax

pfc mode {**auto** | **on**}

no pfc mode

auto – Negotiates PFC capability using DCBX. The operational capability of PFC depends on the result of DCBX negotiations.

on – Forces PFC to enabled state

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Operator configuration of PFC is used only when the port is configured in DCBX manual mode. When interoperating with other equipment in manual mode, the peer equipment must be configured with identical PFC priorities and VLAN assignments. Ports configured in auto-upstream or auto-downstream DCBX roles receive their PFC configuration from the configuration source and ignore any manually configured information. Interfaces not enabled for PFC ignore received PFC frames.

- PFC is configurable on full duplex interfaces only. To enable PFC on a LAG, the member interfaces must have the same configuration.

- When PFC is enabled on an interface, it will be automatically disabled for IEEE 802.3 flow control. Any flow control frames received on a PFC enabled interface are ignored. When PFC is disabled on an interface, it defaults to IEEE 802.3 flow control.

Example

The following example sets port 5 to use PFC auto-negotiation mode.

```
Console(config)#interface ethernet 1/5
Console(config-if)#pfc mode auto
Console(config-if)#
```

pfc priority

Use this command to enable PFC for specified priorities. Use the **no** form to disable PFC for specified priorities.

Syntax

[**no**] **pfc priority enable** *priority-list*

priority-list – Priority identifier, specified as a single number, a range of consecutive numbers separated by a hyphen, or multiple numbers separated by commas. (Range: 0-7)

Default Setting

Enabled for CoS value 3

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- If a priority list has already been created by this command, then any priorities specified by subsequent commands are added the existing list.

- When PFC is enabled, the interface will not pause any CoS priority frames unless there is at least one pause priority set by this command.

- Each priority is configured as drop (PFC disabled) or no-drop (PFC enabled). If a priority designated as no-drop is congested, that priority is paused. The same no-drop priorities must be configured across the network in order to ensure end-to-end lossless behavior. VLAN tagging also needs to be turned on in order to carry the PFC priority settings through the network.

Example

The following example configures port 5 to enable PFC for priorities 3 and 5:

```
Console(config)#interface ethernet 1/5
Console(config-if)#pfc priority enable 3,5
Console(config-if)#
```

clear pfc statistics

Use this command to clear PFC statistics.

Syntax

clear pfc statistics [**interface** *interface*]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Default Setting

None

Command Mode

Privileged Exec

Example

This example clears PFC statistics on all interfaces.

```
Console#clear pfc statistics
Console#
```

show pfc

Use this command to show PFC configuration settings.

Syntax

show pfc [**interface** *interface*]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Example

This example displays the PFC administrative status, operational mode, and the priority bits for frames to pause (instead of drop) when congestion occurs in the specified priority buffers.

```
Console#show pfc interface ethernet 1/5
Interface Admin    Oper     Admin           Oper
          Mode     Mode     Enabled Pri     Enabled Pri
--------- -------- -------- --------------- ---------------
Eth 1/ 5  Auto     Enabled  3               3
Console#
```

show pfc statistics

Use this command to how PFC statistics for the number of PFC frames received and transmitted for each priority.

Syntax

show pfc statistics [**interface** *interface*]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Example

This example shows the number of received and transmitted PFC frames for each priority class used for Port 5.

```
Console#show pfc statistics interface ethernet 1/5
Interface Pri Rx PFC Frames          Tx PFC Frames
--------- --- -------------------- --------------------
Eth 1/ 5    0                    0                    0
Eth 1/ 5    1                    0                    0
Eth 1/ 5    2                    0                    0
Eth 1/ 5    3                    0                    0
Eth 1/ 5    4                    0                    0
Eth 1/ 5    5                    0                    0
Eth 1/ 5    6                    0                    0
Eth 1/ 5    7                    0                    0

Console#
```

Enhanced Transmission Selection Commands

Enhanced Transmission Selection (ETS) provides a means to allocate link bandwidth to different priority groups as a percentage of total bandwidth. These settings are then advertised to other devices in a data center network through DCBX ETS TLVs. Peer devices accept ETS traffic class group and bandwidth information TLVs from auto-upstream devices and propagate it to auto-downstream devices.

The priority of a packet arriving at an interface is grouped into a TCG at the first level of scheduling, ensuring that the minimum bandwidth is provided. The packet is then steered into the appropriate outbound CoS queue through a mapping table by a second level scheduler. Using ETS, the required bandwidth is provided to each TCG. Within each TCG, multiple traffic classes share the bandwidth of the group.

Table 111: ETS Commands

Command	Function	Mode
ets mode	Sets the ETS mode to negotiate capability through DCBX or by forcing it to on state	IC
traffic-class algo	Sets the queue scheduling algorithm assigned to a traffic class group	IC
traffic-class map	Maps a given priority to a traffic class group	IC
traffic-class weight	Configures the bandwidth allocation for all TCGs	IC
show ets mapping	Displays priority to TCG mapping	PE
show ets weight	Displays the bandwidth allocation for selected TCGs	PE

Configuration Guidelines

Take the following steps to configure ETS:

1. Map CoS queues to TCGs for the egress ports using the traffic-class map command.
2. Configure the bandwidth allocation for all TCGs using the traffic-class weight command.
3. Enable the required scheduling algorithm for each TCG using the traffic-class algo command.
4. Ensure that the 802.1p priority present in the frames entering the ingress ports is set to be trusted using the qos map trust-mode command.
5. Set the ETS mode to auto-negotiation through DCBX or force it into on state using the ets mode command.

ets mode

Use this command to set the ETS mode to negotiate capability through DCBX or by forcing it to on state. Use the no form to restore the default setting.

Syntax

ets mode {**auto** | **on**}

no ets mode

auto – Negotiates ETS capability using DCBX. The operational capability of ETS depends on the result of DCBX negotiations.

on – Forces ETS to enabled state.

Default Setting

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- Operator configuration of ETS is used only when the port is configured in DCBX manual mode. When interoperating with other equipment in manual mode, the peer equipment must be configured with identical ETS TCG queuing algorithm, priority queue mapping, and minimum bandwidth requirements. Ports configured in auto-upstream or auto-downstream DCBX roles receive their ETS configuration from the configuration source and ignore any manually configured information. Interfaces not enabled for ETS ignore received ETS frames.

- ETS is configurable on full duplex interfaces only. To enable ETS on a LAG, the member interfaces must have the same configuration.

Example

The following example sets port 5 to use ETX auto-negotiation mode.

```
Console(config)#interface ethernet 1/5
Console(config-if)#ets mode auto
Console(config-if)#
```

traffic-class algo

Use this command to set the queue scheduling algorithm assigned to a traffic class group. Use the **no** form to restore the default setting.

Syntax

traffic-class algo {**strict** | **ets**}

no traffic-class algo

strict - Processes all packets entering this interface using strict priority.

ets - Processes packets with priority values specified for a TCG using Weighted Deficit Round Robin (WDRR).

Default Setting

strict

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Packets with priority values not specified for a TCG use strict priority and therefore are processed ahead of the packets in the weighted queues.

Example

The following example sets the traffic-class algorithm for port 5 to use ETS.

```
Console(config)#interface ethernet 1/5
Console(config-if)#traffic-class algo ets
Console(config-if)#
```

traffic-class map

Use this command to map a given priority to a traffic class group (TCG). Use the **no** form to restore the default mapping for a priority value.

Syntax

traffic-class map *priority traffic-class-group*

no traffic-class algo *priority*

priority - 802.1p priority value in ingress packets. (Range: 0-7)

traffic-class-group - The TCG to which packets with specified priorities are assigned. (Range: 0-2)

Default Setting

All priorities are mapped to TCG 0.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- One or more priorities may be assigned to a TCG using multiple commands.

- Interfaces where ETS is not enabled discard any received ETS TLVs.

Example

The following example maps priority 2 and 3 to TCG 0 for port 5.

```
Console(config)#interface ethernet 1/5
Console(config-if)#traffic-class map 2 1
Console(config-if)#traffic-class map 3 1
Console(config-if)#
```

traffic-class weight

Use this command to configure the bandwidth allocation for all TCGs on an interface. Use the **no** form to restore the default settings.

Syntax

traffic-class weight *weight1 weight2 weight3*

no traffic-class weight

weight1~3 - The percentage of bandwidth assigned to each TCG. (Range: 0-100)

Default Setting

0

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

- The cumulative weight for all three TCGs must be 100.
- The weight assigned by the **traffic-class weight** command must be 0 for any TCG set to strict mode with the traffic-class algo command.
- The weight for up to three TCGs may be defined. The bandwidth available to the TCGs is the maximum percentage of available link bandwidth after all of the packets with priorities configured for strict mode have been serviced. Once these have been processed, a TCG may only use available bandwidth up to the maximum percentage allocated by the **traffic-class weight** command. However, the unused bandwidth of any TCG may be shared by other TCGs.

Example

The following example sets the maximum bandwidth for TCGs 0-3 on port 5 to 25, 35, and 40 percent, respectively.

```
Console(config)#interface ethernet 1/5
Console(config-if)#traffic-class weight 25 35 40
Console(config-if)#
```

show ets mapping

Use this command to display mapping from IEEE 802.1p priorities to the traffic class group (TCGs).

Syntax

show ets mapping [**interface** *interface*]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Example

This example shows both the locally configured settings, and current operational settings.

```
Console#show ets mapping interface ethernet 1/5
 Configuration:
 ETS Mode: Auto
 Priority Traffic Class
 -------- -------------
        0             0
        1             0
        2             0
        3             0
        4             0
        5             0
        6             0
        7             0

 Operational:
 ETS Mode: On
 Priority Traffic Class
 -------- -------------
        0             0
        1             0
        2             0
        3             0
        4             0
        5             0
        6             0
        7             0

Console#
```

show ets weight

Use this command to display the bandwidth allocation for selected TCGs.

Syntax

show ets mapping [**interface** *interface*]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Example

This example shows both the locally configured settings, and current operational settings.

```
Console#show ets weight interface ethernet 1/5
 Configuration:
 ETS Mode: Auto
 Traffic Class Tx Selection Mode Weight%
 ------------- ---------------- -------
             0 Strict                 0
             1 Strict                 0
             2 Strict                 0

 Operational:
 ETS Mode: On
 Traffic Class Tx Selection Mode Weight%
 ------------- ---------------- -------
             0 Strict                 0
             1 Strict                 0
             2 Strict                 0

Console#
```

Congestion Notification Commands

Overview

If congestion is left uncontrolled, it can cause head-of-line blocking, and spread congestion across the network. Congestion Notification (CN) is a mechanism used to transmit congestion information on an end-to-end basis per traffic flow back to the edge of the network where the flow that causes the congestion can be easily isolated and rate limited.

When congestion notification is used, a congested switch (CP – Congestion Point) sends messages toward the source of the congestion (RP – Reaction Point) to signal its congested state and that the rate of the flow entering the network should be reduced.

Upon receiving the CN messages, rate limiting is initiated as close as possible to the source of the congestion. This alleviates the congestion at the network core and stops it from spreading through the network.

Congestion Notification is different from PFC in that CN messages are propagated all the way toward the source of the congestion, while the PFC Pause is a hop-by-hop process, and normally takes longer to slow down the congestion caused by a specific flow.

The rate limiter parameters prompted by CN notifications are dynamically adjusted based on feedback coming from the CPs. CN functions at Layer 2 and therefore applies to all traffic types, using exponential decrease in traffic rates when congestion occurs, and a linear increase when bandwidth is available.

Congestion Notification Domains

Congestion notification depends on the formation of a cooperating set of network devices including VLAN-aware bridges and end stations to reduce frame loss. By partitioning the bridges' and end stations' resources, frames sourced or sunk by non-cooperating bridges or end stations can be carried across the network with minimal contention with Congestion Controlled Flows (CCFs) for those resources.

Operational Concept

In order for CN to successfully control congestion in a Virtual Bridged Network, the bridges and end stations in that network have to be configured with CN values that are appropriate to the characteristics of the CCFs generated by the applications that expect congestion controlled services. For example:

1. If frames that were not originated from an RP can enter a CP experiencing congestion, then the CNMs generated by that CP upon receipt of those frames cannot correct the problem.
2. Congestion notification cannot operate correctly if a CP's configuration is inappropriate for the CCFs passing through it, or if priority values are regenerated in a manner that moves frames in and out of CNPVs.
3. Frames transmitted from an end station with a CN-TAG cannot be understood by an end station that is not congestion aware.

Congestion aware bridges are therefore used to construct a Congestion Notification Domain (CND), within which a particular Congestion Notification Priority Value (CNPV) is supported. A CND is a connected subset of the bridges and end stations in a Virtual Bridged LAN that are configured to serve a particular CNPV. CNDs can be created by configuring the bridges and end stations in a network, or they can be created automatically, using an additional TLV element, the Congestion Notification TLV.

The QCN algorithm is composed of the following two parts:

1. Congestion Point (CP) Algorithm: This is the mechanism by which a congested bridge or end station buffer samples outgoing frames and generates a feedback message (CNM – Congestion Notification Message) addressed to the source of the sampled frame. The feedback message contains information about the extent of congestion at the CP.
2. Reaction Point (RP) Algorithm: This is the mechanism by which a Rate Limiter associated with a source decreases its sending rate based on feedback received from the CP, and increases its rate unilaterally (without further feedback) to recover lost bandwidth and probe for extra available bandwidth.

Table 112: CN Commands

Command	Function	Mode
cn	Enables congestion notification	GC
cn cnm-transmit-priority	Configures the dot1p priority used for transmitting any Congestion Notification Message (CNM)	GC
cn cnpv	Sets a dot1p priority to be a Congestion Notification Priority Value (CNPV)	GC
cn cnpv alternate-priority	Configures the alternate priority used to remark a received frame when its dot1p priority is equal to the CNPV when the defense mode is other than auto	GC
cn cnpv defense-mode	Configures the defense mode for a CNPV, determining whether CN is enabled or not, and if enabled, whether the port remarks the CNPV to a non-CNPV value on input, and whether the port removes CN-tags on output	GC
cn cnpv alternate-priority	Configures the alternate priority used to remark a received frame when its dot1p priority is equal to the CNPV when the defense mode is other than auto	IC
cn cnpv defense-mode	Configures the defense mode for a CNPV, determining whether CN is enabled or not, and if enabled, whether the port remarks the CNPV to a non-CNPV value on input, and whether the port removes CN-tags on output	IC
show cn	Shows the global CN status	PE
show cn cnpv	Shows CNPV information, including defense mode and alternate priority	PE
show cn cp	Shows functional settings and status for the specified CP	PE

cn

Use this command to enable congestion notification for all ports on the switch. Use the **no** form to disabled congestion notification on the switch.

Syntax

[**no**] **cn**

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

When CN is enabled, the system recognizes the CN-TAG in received frames, the Connection Point (CP) algorithm and Reaction Points (RP) algorithm runs on the configured CPs and Congestion Notification Messages (CNMs) are transmitted if congestion is detected on a CP.

Example

The following example enables CN for all ports.

```
Console(config)#interface ethernet 1/5
Console(config-if)#traffic-class map 2 1
Console(config-if)#traffic-class map 3 1
Console(config-if)#
```

cn cnm-transmit-priority

Use this command to configure the dot1p priority used for transmitting any Congestion Notification Message (CNM). Use the **no** form to restore the default setting.

Syntax

cn cnm-transmit-priority *priority*

no cn cnm-transmit-priority

priority - dot1p priority used to transmit any CNM. (Range: 0-7)

Default Setting

0

Command Mode

Global Configuration

Command Usage

The specified priority should not be equal to any existing Congestion Notification Priority Value (CNPV).

Example

The following example sets the CNM transmit priority to 1.

```
Console(config)#cn cnm-transmit-priority 1
Console(config)#
```

cn cnpv

Use this command to set a dot1p priority to be a Congestion Notification Priority Value (CNPV). Use the **no** form to change a CNPV back to a dot1p priority value.

Syntax

[**no**] **cn cnpv** *cnpv-priority*

cnpv-priority - CNPV assigned to Congestion Control Flows (CFF) on this port. (Range: 0-7)

Default Setting

None

Command Mode

Global Configuration

Command Usage

- Up to 7 CNPVs can be set for the system.

- When a CNPV is changed to be non-CNPV using the **no** form of this command, other CNPVs which are not administratively disabled on a port may be operationally enabled if the operational defense mode is still disabled.

- When the number of CPs reaches the maximum for a port, the operational defense mode for related CNPVs on that port is disabled.

Example

The following example sets a CNPV to 2.

```
Console(config)#cn cnpv 2
Console(config)#
```

cn cnpv alternate-priority (Global Configuration)

Use this command to configure the alternate priority used to remark a received frame when its dot1p priority is equal to the CNPV when the defense mode is other than auto. Use the **no** form restore the default setting.

Syntax

cn cnpv *cnpv-priority* **alternate-priority** *priority*

no cn cnpv *cnpv-priority* **alternate-priority**

cnpv-priority - CN priority value. (Range: 0-7)

priority - Remarked priority value. (Range: 0-7)

Default Setting

Alternate Priority: 0

Command Mode

Global Configuration

Command Usage

- Use the alternate priority to steer away traffic that comes from congestion unaware sources. Traffic from CN unaware sources should be remarked when entering the CN domain so that resources assigned to the CN-enabled queues are not exhausted with traffic from CN unaware sources. Frames coming from non-CN sources do not have a CN-TAG. If these frames are mapped to the CN-enabled queue, then they may contribute to the congestion and trigger generation of CNMs. These messages are not useful to sources that are CN unaware.

- If a port's neighbor is known to be configured for a particular CNPV, the entry in the port's priority regeneration table for that CNPV is ignored, and the priority is never changed on input.

- If a port's neighbor is known to not be configured for a particular CNPV configured on this port, the entry in the port's priority regeneration table for that CNPV shall be overridden to translate the CNPV to an alternate non-CNPV value.

- If a CNPV is configured on any port, then on that port, the port's priority regeneration table shall be overridden to prevent any other priority value from being remapped into that CNPV.

Example

The following example maps CNPV 2 to alternate priority 5.

```
Console(config)#cn cnpv 2 alternate-priority 5
Console(config)#
```

cn cnpv defense-mode (Global Configuration)

Use this command to configure the defense mode for a CNPV, determining whether CN is enabled or not, and if enabled, whether the port remarks the CNPV to a non-CNPV value on input, and whether the port removes CN-tags on output. Use the **no** form to restore the default settings.

Syntax

cn cnpv *cnpv-priority* **defense-mode** {**auto** | **disabled** | **edge** | **interior** | **interior-ready**}

no cn cnpv *cnpv-priority* **defense-mode**

cnpv-priority - CN priority value. (Range: 0-7)

auto - Defense mode and alternate priority is chosen automatically as determined by the LLDP Congestion Notification TLV.

disabled - CN capability is administratively disabled.

edge - CNPV is remapped to non-CNPV and CN-TAG is removed.

interior - Priority remapping is inhibited and CN-TAG is removed.

interior-ready - Priority remapping is inhibited and CN-TAG is retained.

Default Setting

auto

Command Mode

Global Configuration

Command Usage

- Under the **auto** option, the defense mode is determined by the LLDP CN TLV, and may be set to edge, interior, or interior-ready.

  The alternate priority is also determined by the LLDP CN TLV. If CN is enabled and the CND defense mode of the port is Edge, then the CNPV to which an incoming frame can be mapped is the next lower priority value which is not mapped as a CNPV, or the next higher non-CNPV, if all lower values are CNPVs.

- Under the **disabled** option, the congestion notification capability is administratively disabled for this priority value and port. The priority regeneration table controls the remapping of input frames on this port to or from this priority. CN-TAGs are not stripped by the switch.

- Under the **edge** option, on this port and for this CNPV, the priority parameters of input frames are remapped to an alternate (non-CNPV) value, and no priority value is remapped to this CNPV regardless of the priority regeneration table. CN-TAGs are removed from frames before being output by the switch.

- Under the **interior** option, on this port and for this CNPV, the priority parameters of input frames are not remapped to another value, and no priority value is remapped to this CNPV, regardless of the priority regeneration table. CN-TAGs are removed from frames before being output by the switch.

- Under the **interior-ready** option, on this port and for this CNPV, the priority parameters of input frames are not remapped to another value, and no priority value is remapped to this CNPV, regardless of the priority regeneration table. CN-TAGs are not removed from frames by the switch.

Example

The following example sets the defense mode to edge for CNPV 2.

```
Console(config)#cn cnpv 2 defense-mode edge
Console(config)#
```

cn cnpv alternate-priority (Interface Configuration)

Use this command to configure the alternate priority used to remark a received frame when its dot1p priority is equal to the CNPV when the defense mode is other than auto. Use the **no** form to use the global setting for the CNPV.

Syntax

cn cnpv *cnpv-priority* **alternate-priority** *priority*

no cn cnpv *cnpv-priority* **alternate-priority**

cnpv-priority - CN priority value. (Range: 0-7)

priority - Remarked priority value. (Range: 0-7)

Default Setting

The CNPV to alternate priority mapping is based on the global setting configured by the cn cnpv alternate-priority (Global Configuration) command.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Refer to the Command Usage section under the cn cnpv alternate-priority (Global Configuration) command for more information on this command.

Example

The following example maps CNPV 2 to alternate priority 5.

```
Console(config)#cn cnpv 2 alternate-priority 5
Console(config)#
```

cn cnpv defense-mode (Interface Configuration)

Use this command to configure the defense mode for a CNPV, determining whether CN is enabled or not, and if enabled, whether the port remarks the CNPV to a non-CNPV value on input, and whether the port removes CN-tags on output. Use the **no** form to restore the default settings.

Syntax

cn cnpv *cnpv-priority* **defense-mode** {**auto** | **disabled** | **edge** | **interior** | **interior-ready**}

no cn cnpv *cnpv-priority* **defense-mode**

cnpv-priority - CN priority value. (Range: 0-7)

auto - Defense mode and alternate priority is chosen automatically as determined by the LLDP Congestion Notification TLV.

disabled - CN capability is administratively disabled.

edge - CNPV is remapped to non-CNPV and CN-TAG is removed.

interior - Priority remapping is inhibited and CN-TAG is removed.

interior-ready - Priority remapping is inhibited and CN-TAG is retained.

Default Setting

The CNPV to alternate priority mapping is based on the global setting configured by the cn cnpv defense-mode (Global Configuration) command.

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Refer to the Command Usage section under the cn cnpv defense-mode (Global Configuration) command for more information on this command.

Example

The following example sets the defense mode to edge for CNPV 2.

```
Console(config)#cn cnpv 2 defense-mode edge
Console(config)#
```

show cn

Use this command to show the global CN status.

Syntax

show cn

Command Mode

Privileged Exec

Example

This example shows the global settings for congestion notification, and the number of discarded frames.

```
Console#show cn
Congestion Notification Global Information
 Admin Status            : Enabled
 Oper Status             : Enabled
 CNM Transmit Priority   : 1
 Total Discarded Frames : 0

Console#
```

show cn cnpv

Use this command to show CNPV information, including the defense mode and alternate priority.

Syntax

show cn cnpv [*cnpv*-priority [*interface*]]

cnpv-priority - CN priority value. (Range: 0-7)

interface

ethernet *unit*/*port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Example

This example shows information for CNPV 0 on port 5.

```
Console#show cn cnpv 0 ethernet 1/5
Congestion Notification Per-CNPV Port Information
 CNPV                        : 0
 Port                        : Eth 1/5
 Admin Defense Mode          : By-Global
 Oper Defense Mode           : Edge
 Admin Alternate Priority : By-Global
 Oper Alternate Priority   : 1

Console#
```

show cn cp

Use this command to show functional settings and status for the specified CP.

Syntax

show cn cp *interface* **index** *index*

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

index - Congestion Point index. (Range: 0-1)

Command Mode

Privileged Exec

Example

This example shows information for CP 0 on port 5.

```
Console#show cn cp ethernet 1/5 index 0
Congestion Notification Per-Port Per-CP Information
 Port                 : Eth 1/5
 CP Index             : 0
 CPID                 : 0012CF0105000500
 Queue                : 2
 Managed CNPVs        : 0
 MAC Address          : 70-72-CF-8C-2F-EF
 Set Point            : 26000
 Feedback Weight      : 2
 Minimum Sample Base  : 150000 bytes
 Discarded Frames     : 0
 Transmitted Frames   : 0
 Transmitted CNMs     : 0

Console#
```

Table 113: show cn cp - display description

Field	Description
Port	Port identifier.
CP Index	This index is used to distinguish between unique flows since more than one Congestion Notification Priority Value (CNPV) can flow through a single CP.
CPID	A number that, along with the source address and VLAN identifier of a CNM PDU, uniquely identifies a CP in a Virtual Bridged Network
Queue	The priority queue assigned to this CNPV.
Managed CNPVs	The number of CNPVs assigned to this congestion point. (Range: 0-2)
MAC Address	MAC address, belonging to the system transmitting the CNM PDU, used as the source address of Congestion Notification Messages (CNMs) sent from this CP.

Table 113: show cn cp - display description (Continued)

Field	Description
Set Point	The set-point for the queue. This is the target number of octets in the CP's queue. (Default: 26000)
Feedback Weight	Variable used in calculation or Quantized Feedback and New Sample Base. If the queue length is moving toward the set point, the feedback weight will be closer to 0 than if the queue length is moving away from the set point.
Minimum Sample Base	The minimum number of octets to enqueue in the CP's queue between CNM PDU transmissions. (Default: 150,000 bytes)
Discarded Frames	The number of frames offered to this CP that were discarded because of a full output queue.
Transmitted Frames	The number of data frames enqueued for transmission on this CP's output queue.
Transmitted CNMs	The number of CNMs transmitted by this CP.

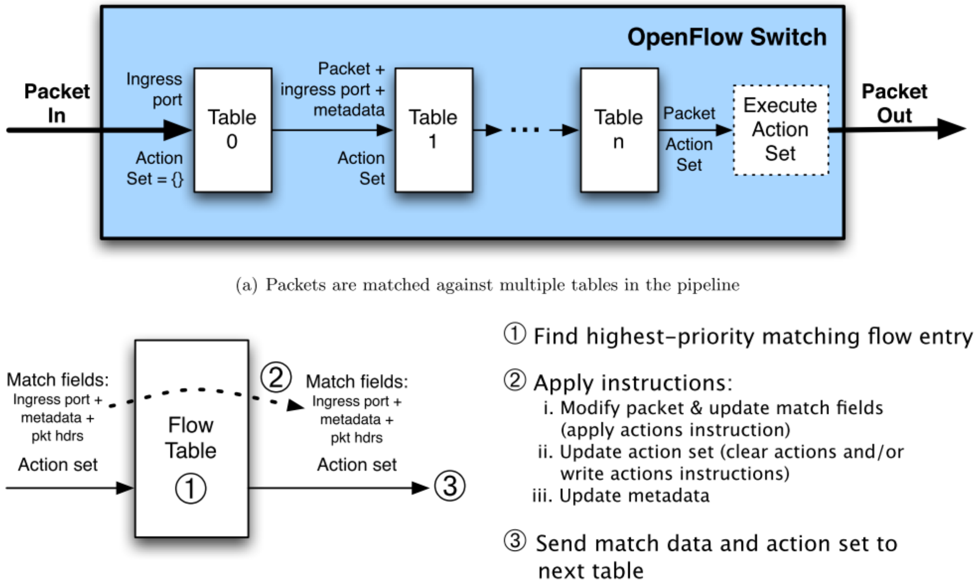
Openflow Commands

OpenFlow enables remote controllers to determine the path of network packets through the network of switches. This separation of the control from the forwarding allows for more sophisticated traffic management than is feasible using access control lists and routing protocols.

OpenFlow allows remote administration of a switch's packet forwarding tables, by adding, modifying and removing packet matching rules and actions. This way, routing decisions can be made periodically or ad hoc by the controller and translated into rules and actions with a configurable lifespan, which are then deployed to a switch's flow table, leaving the actual forwarding of matched packets to the switch at wire speed for the duration of those rules. Packets which are unmatched by the switch can be forwarded to the controller. The controller can then decide to modify existing flow table rules on one or more switches or to deploy new rules, to prevent a structural flow of traffic between the switch and controller. It could even decide to forward the traffic itself, provided that it has told the switch to forward entire packets.

The following table is from the Openflow standard. It illustrates how flow decisions are made at each table, and then passed on to the next table for subsequent processing. To ensure no looping occurs in the flow process, a table with a lower ID cannot pass control data onto a table with a larger ID.

Figure 5: Openflow Process


OpenFlow Switch
Packet In
Ingress port
Action Set = {}
Table 0
Packet + ingress port + metadata
Action Set
Table 1
Table n
Packet
Action Set
Execute Action Set
Packet Out
Match fields:
Ingress port + metadata + pkt hdrs
Action set
Flow Table ①
②
Match fields:
Ingress port + metadata + pkt hdrs
Action set
③
① Find highest-priority matching flow entry
② Apply instructions:
i. Modify packet & update match fields (apply actions instruction)
ii. Update action set (clear actions and/or write actions instructions)
iii. Update metadata
③ Send match data and action set to next table

(a) Packets are matched against multiple tables in the pipeline

Note: The storm control function will be invalid if an Openflow flow rule is added to the switch. Due to a chip-specific behavior, storm control is detected and limited in the DA lookup stage. ACL flow is implemented by Filter Processor (FP) rules, of which the FP rule is near the last stage of ingress pipeline, and is capable of changing packet behavior.

ingress port -> VLAN logic -> L2 logic (SA learing, DA lookup ...) -> L3 logic -> ... -> FP logic -> MMU -> egress port

For example, some packets will be marked as discard in DA lookup because of storm control, but ACL flow in the FP stage will change these packets to forwarding state. That means the final state for these packets will be forwarding.

The following commands are supported by Openflow. Openflow is enabled by default when the switch is booted and set to Hybrid mode. (See "Selecting Legacy or Hybrid Operation Mode" on page 57 and "Legacy and Hybrid Operating Mode Feature Set Differences" on page 1073.)

Table 114: Openflow Commands

Command	Function	Mode
controller Configuration Commands		
of-agent controller	Sets the address for the OpenFlow controller	GC
of-agent datapath-desc	Configures the data path description	GC
Openflow Clear and Show Commands		
clear of-agent	Clears all flow and group settings	PE
show of-agent controller	Displays controller address and port settings	PE

Table 114: Openflow Commands (Continued)

Command	Function	Mode
show of-agent flow	Displays all flow table settings	PE
show of-agent group	Displays all group settings	PE

of-agent controller

This command sets the address for the OpenFlow controller. Use the **no** form to deleted the controller address.

Syntax

[**no**] **of-agent controller** *ip-address* [*port*]

ip-address - IPv4 address of controller.

port - TCP port. (Range: 1-65535)

Default Setting

TCP Port: 6633

Command Mode

Global Configuration

Command Usage

- Confiugre up to two IP addresses to which the switch can establish a connection to the OF controller. When the interface with the assigned address goes offline, the switch will select another active interface if one is available. The OpenFlow feature becomes operationally disabled and re-enabled when a new IP address is selected. The OpenFlow feature becomes operational only when a switch interface with the matching IP address becomes active.

- The switch must have an operational IP interface with the specified address in order for the static IP address to be used for the OpenFlow feature. If the system does not have an interface with a matching IP address then the OpenFlow feature is operationally disabled. If the OpenFlow feature is enabled when this command is issued and the specified static IP address is not the same as the IP address already in use by the OpenFlow feature, then the feature is automatically disabled and re-enabled.

Example

```
Console(config)#of-agent controller 192.168.1.2 6633
Console(config)#
```

of-agent datapath-desc

This command configures the data path description. Use the no form to remove the data path descriptor.

Syntax

of-agent datapath-desc *description*

no of-agent datapath-desc

description - A unique description or identifier for the flow forwarding behaviour implemented by the data path. (Range: 1-100 characters)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#through_boa
Console(config)#
```

clear of-agent

This command clears all agent flow and group settings.

Syntax

clear of-agent

Command Mode

Privileged Exec

Example

```
Console#clear of-agent
Console#
```

show of-agent controller

This command displays controller address and port settings.

Syntax

show of-agent controller

Command Mode

Privileged Exec

Example

```
Console#show of-agent controller
Controllers:
192.168.1.2:6633
192.168.1.3:6633
Console#
```

show of-agent flow

This command displays all flow table settings.

Syntax

show of-agent flow [**table-id** {*table-id* | **ingress-port** | **vlan** | **termination-mac** | **unicast-routing** | **multicast-routing** | **bridging** | **acl-policy**}]

table-id - Flow table identifier. (Range: 0-60)

ingress-port - Ingress port flow table

vlan - VLAN flow table.

termination-mac - VxLAN termination MAC flow table.

unicast-routing - Unicast routing flow table.

multicast-routing - Multicast routing flow table.

bridging - Bridging flow table.

acl-policy - ACL Policy flow table.

Command Mode

Privileged Exec

Example

```
Console#show of-agent flow table-id 0
Flow 1:
  Table ID: 0 [Ingress Port table]
  Priority: 1, cookie: 7
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    In port: 0/0xFFFF0000
  Instruction:
    Goto table: 10 [VLAN table]

No more flow from ofagent
Console#show of-agent flow table-id 10
Flow 1:
  Table ID: 10 [VLAN table]
  Priority: 101, cookie: 16
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    In port: 3
    VLAN: 0x1002/0x1FFF
  Instruction:
    Goto table: 20 [Termination MAC table]
```

```
Flow 2:
  Table ID: 10 [VLAN table]
  Priority: 101, cookie: 8
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    In port: 45
    VLAN: 0x1002/0x1FFF
  Instruction:
    Goto table: 20 [Termination MAC table]

No more flow from ofagent
Console#show of-agent flow table-id 20
Flow 1:
  Table ID: 20 [Termination MAC table]
  Priority: 201, cookie: 12
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    EtherType: 0x0800
    VLAN: 0x2/0xFFF
    Dest MAC: 01-00-5E-00-00-00
    Dest MAC MASK: FF-FF-FF-80-00-00
  Instruction:
    Goto table: 40 [Multicast Routing table]

Flow 2:
  Table ID: 20 [Termination MAC table]
  Priority: 201, cookie: 14
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    EtherType: 0x86DD
    VLAN: 0x2/0xFFF
    Dest MAC: 33-33-00-00-00-00
    Dest MAC MASK: FF-FF-00-00-00-00
  Instruction:
    Goto table: 40 [Multicast Routing table]

Flow 3:
  Table ID: 20 [Termination MAC table]
  Priority: 201, cookie: 3
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    In port: 45/0xFFFFFFFF
    EtherType: 0x0800
    VLAN: 0x2/0xFFF
    Dest MAC: 70-72-CF-7C-F3-A4
    Dest MAC MASK: FF-FF-FF-FF-FF-FF
  Instruction:
    Goto table: 30 [Unicast Routing table]

Flow 4:
  Table ID: 20 [Termination MAC table]
  Priority: 201, cookie: 9
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    In port: 45/0xFFFFFFFF
    EtherType: 0x86DD
    VLAN: 0x2/0xFFF
    Dest MAC: 70-72-CF-7C-F3-A4
    Dest MAC MASK: FF-FF-FF-FF-FF-FF
  Instruction:
    Goto table: 30 [Unicast Routing table]

No more flow from ofagent
```

```
Console#show of-agent flow table-id 30
Flow 1:
  Table ID: 30 [Unicast Routing table]
  Priority: 401, cookie: 4
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    EtherType: 0x0800
    Dest IPv4: 192.168.2.0
    Dest IPv4 Mask: 255.255.255.0
  Instruction:
    Group: 0x20000003 [L3 Unicast]
    Goto table: 60 [ACL table]

Flow 2:
  Table ID: 30 [Unicast Routing table]
  Priority: 401, cookie: 10
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    EtherType: 0x86DD
    Dest IPv6: 2014:0000:0000:0000:0000:0000:0000:0000
    Dest IPv6 Mask: FFFF:FFFF:FFFF:FFFF:0000:0000:0000:0000
  Instruction:
    Group: 0x20000003 [L3 Unicast]
    Goto table: 60 [ACL table]

No more flow from ofagent
Console#show of-agent flow table-id 40
Flow 1:
  Table ID: 40 [Multicast Routing table]
  Priority: 501, cookie: 13
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    EtherType: 0x0800
    VLAN: 0x2
    SRC IPv4: 192.168.2.2
    SRC IPv4 Mask: 255.255.255.255
    Dest IPv4: 224.0.2.2
  Instruction:
    Group: 0x60030001 [L3 Multicast]
    Goto table: 60 [ACL table]

Flow 2:
  Table ID: 40 [Multicast Routing table]
  Priority: 501, cookie: 15
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    EtherType: 0x86DD
    VLAN: 0x2
    Dest IPv6: FF01:0000:0000:0000:0000:0000:0000:0002
  Instruction:
    Group: 0x60020001 [L3 Multicast]
    Goto table: 60 [ACL table]

No more flow from ofagent
Console#show of-agent flow table-id 50
Flow 1:
  Table ID: 50 [Bridging table]
  Priority: 601, cookie: 20
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    VLAN: 0x2
  Instruction:
    Group: 0x40020001 [L2 Flood]
    Goto table: 60 [ACL table]
```

```
Flow 2:
  Table ID: 50 [Bridging table]
  Priority: 501, cookie: 18
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    VLAN: 0x2
    Dest MAC: 00-00-00-11-22-33
    Dest MAC MASK: FF-FF-FF-FF-FF-FF
  Instruction:
    Group: 0x2002D [L2 Interface]
    Goto table: 60 [ACL table]

No more flow from ofagent
Console#show of-agent flow table-id 60
Flow 1:
  Table ID: 60 [ACL table]
  Priority: 601, cookie: 6
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    EtherType: 0x0800
    In port: 45/0xFFFFFFFF
  Instruction:
    Set VLAN PCP: 3
    Group: 0x30001 [L2 Interface]

Flow 2:
  Table ID: 60 [ACL table]
  Priority: 601, cookie: 11
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    EtherType: 0x86DD
    In port: 45/0xFFFFFFFF
  Instruction:
    Set VLAN PCP: 5
    Group: 0x10000001 [L2 Rewrite]

No more flow from ofagent
Console#show of-agent flow table-id 10 vlan
Flow 1:
  Table ID: 10 [VLAN table]
  Priority: 101, cookie: 16
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    In port: 3
    VLAN: 0x1002/0x1FFF
  Instruction:
    Goto table: 20 [Termination MAC table]

Flow 2:
  Table ID: 10 [VLAN table]
  Priority: 101, cookie: 8
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    In port: 45
    VLAN: 0x1002/0x1FFF
  Instruction:
    Goto table: 20 [Termination MAC table]

No more flow from ofagent

Console#show of-agent flow
Flow 1:
  Table ID: 0 [Ingress Port table]
  Priority: 1, cookie: 7
  Hard Timeout: 0, Idle Timeout: 0
  Match:
    In port: 0/0xFFFF0000
  Instruction:
    Goto table: 10 [VLAN table]

No more flow from ofagent
Console#
```

show of-agent group

This command displays all group settings.

Syntax

show of-agent group [**type** {*group-type* | **l2-interface** | **l2-rewrite** | **l3-unicast** | **l2-multicast** | **l2-flood** | **l3-interface** | **l3-multicast** | **l3-ecmp** | **l2-overlay**}]

group-type - Specifies group type. (Range: 0-8)

l2-interface - Specifies L2 interface group.

l2-rewrite - Specifies L2 rewrite group.

l3-unicast - Specifies L3 unicast group.

l2-multicast - Specifies L2 multicast group.

l2-flood - Specifies L2 flood group.

l3-interface - Specifies L3 interface group.

l3-ecmp - Specifies L3 ECMP group.

l2-overlay - Specifies L2 overlay group.

Command Mode

Privileged Exec

Example

```
Console#show of-agent group
Group 0x20001 [L2 Interface] VID: 2, Port: 1
  Bucket Index: 0
    Output: 1

Group 0x20003 [L2 Interface] VID: 2, Port: 3
  Bucket Index: 0
    Pop VLAN
    Output: 3

Group 0x2002D [L2 Interface] VID: 2, Port: 45
  Bucket Index: 0
    Pop VLAN
    Output: 45

Group 0x30001 [L2 Interface] VID: 3, Port: 1
  Bucket Index: 0
    Output: 1

Group 0x30003 [L2 Interface] VID: 3, Port: 3
  Bucket Index: 0
```

```
    Output: 3

Group 0x10000001 [L2 Rewrite]
  Bucket Index: 0
    New Source MAC: 00-00-62-22-33-55
    New Dest MAC: 00-00-62-22-44-66
    New VID: 3
    Reference Group: 0x30001 [L2 Interface]

Group 0x20000001 [L3 Unicast]
  Bucket Index: 0
    New Source MAC: 00-00-63-22-33-55
    New Dest MAC: 00-00-63-22-44-66
    New VID: 2
    Reference Group: 0x20001 [L2 Interface]

Group 0x20000003 [L3 Unicast]
  Bucket Index: 0
    New Source MAC: 00-00-04-22-33-55
    New Dest MAC: 00-00-04-22-44-66
    New VID: 3
    Reference Group: 0x30001 [L2 Interface]

Group 0x30020001 [L2 Multicast] VID: 2
  Bucket Index: 0
    Reference Group: 0x20001 [L2 Interface]
  Bucket Index: 1
    Reference Group: 0x20003 [L2 Interface]

Group 0x40020001 [L2 Flood] VID: 2
  Bucket Index: 0
    Reference Group: 0x20001 [L2 Interface]
  Bucket Index: 1
    Reference Group: 0x20003 [L2 Interface]

Group 0x50000003 [L3 Interface]
  Bucket Index: 0
    New Source MAC: 00-00-05-22-33-99
    New VID: 3
    Reference Group: 0x30003 [L2 Interface]

Group 0x60020001 [L3 Multicast] VID: 2
  Bucket Index: 0
    Reference Group: 0x20001 [L2 Interface]
  Bucket Index: 1
    Reference Group: 0x50000003 [L3 Interface]

Group 0x60030001 [L3 Multicast] VID: 3
  Bucket Index: 0
    Reference Group: 0x30001 [L2 Interface]
No more group from ofagent

Console#show of-agent group type l2-interface
Group 0x20001 [L2 Interface] VID: 2, Port: 1
  Bucket Index: 0
    Output: 1

Group 0x20003 [L2 Interface] VID: 2, Port: 3
  Bucket Index: 0
    Pop VLAN
    Output: 3

Group 0x2002D [L2 Interface] VID: 2, Port: 45
  Bucket Index: 0
    Pop VLAN
    Output: 45

Group 0x30001 [L2 Interface] VID: 3, Port: 1
  Bucket Index: 0
    Output: 1

Group 0x30003 [L2 Interface] VID: 3, Port: 3
  Bucket Index: 0
    Output: 3
No more group from ofagent
Console#show of-agent group type l3-interface
Group 0x50000003 [L3 Interface]
  Bucket Index: 0
    New Source MAC: 00-00-05-22-33-99
    New VID: 3
    Reference Group: 0x30003 [L2 Interface]
No more group from ofagent

Console#show of-agent group type 7
Group 0x70000001 [L3 ECMP]
  Bucket Index: 0
    Reference Group: 0x20000001 [L3 Unicast]
No more group from ofagent
Console#
```

22

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.

Note that IGMP query can be enabled globally at Layer 2, or enabled for specific VLAN interfaces at Layer 3. (Layer 2 query is disabled if Layer 3 query is enabled.)

Table 115: 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
IGMP (Layer 3)	Configures the IGMP protocol used with multicast routing in IPv4 networks
IGMP Proxy Routing	Collects and sends multicast group membership information onto the upstream interface based on IGMP messages monitored on downstream interfaces, and forwards multicast traffic based on that information
MLD (Layer 3)	Configures the MLD protocol used with multicast routing in IPv6 networks
MLD Proxy Routing	Collects and sends multicast group membership information onto the upstream interface based on MLD messages monitored on downstream interfaces, and forwards multicast traffic based on that information

IGMP Snooping

This section describes commands used to configure IGMP snooping on the switch.

Table 116: 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
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

Table 116: IGMP Snooping Commands (Continued)

Command	Function	Mode
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
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

Disabled

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)#
```

Related Commands

show ip igmp snooping (600)

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: Enabled
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

Enabled

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 version-exclusive

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 585).

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: Using Global Status

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

[**no**] **ip igmp snooping vlan** *vlan-id* **immediate-leave** [**by-host-ip**]

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 Last Member Query Interval (fixed at one second) * Robustness Variable (fixed at 2) as defined in RFC 2236.).

- 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 585).

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 585).

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 585), or as a proxy host when IGMP snooping proxy reporting is enabled (page 585).

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 585), or as a proxy host when IGMP snooping proxy reporting is enabled (page 585).

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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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

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                        : Enabled
 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 (1/10s)
 Last Member Query Count                : 2
 General Query Suppression              : Disabled
 Query Interval                         : 125
 Query Response Interval                : 100 (1/10s)
 Proxy Query Address                    : 0.0.0.0
 Proxy Reporting                        : Using global status (Enabled)
 Multicast Router Discovery             : Enabled

 VLAN Static Group    Port
 ---- --------------- --------
 1    235.0.0.0       Eth 1/ 5
⋮
```

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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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 1/1             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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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
 Interface Report   Leave    G Query  G(-S)-S Query Drop     Join Succ Group
 --------- -------- -------- -------- ------------- -------- --------- ------
 Eth 1/ 1        23       11        4            10        5        14      5
Console#
```

Table 117: show ip igmp snooping statistics input - display description

Field	Description
Interface	Shows interface.
Report	The number of IGMP membership reports received on this interface.
Leave	The number of leave messages received on this interface.
G Query	The number of general query messages received on this interface.
G(-S)-S Query	The number of group specific or group-and-source specific query messages received on this interface.
Drop	The number of times a report, leave or query was dropped. Packets may be dropped due to invalid format, rate limiting, or packet content not allowed.
Join Succ	The number of times a multicast group was successfully joined.
Group	The number of multicast groups active on this interface.

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#
```

Table 118: show ip igmp snooping statistics output - display description

Field	Description
Interface	Shows interface.
Report	The number of IGMP membership reports sent from this interface.
Leave	The number of leave messages sent from this interface.
G Query	The number of general query messages sent from this interface.
G(-S)-S Query	The number of group specific or group-and-source specific query messages sent from this interface.
Drop	The number of times a report, leave or query was dropped. Packets may be dropped due to invalid format, rate limiting, or packet content not allowed.
Group	The number of multicast groups active on this interface.

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                 : 192.168.2.4
 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#
```

Table 119: show ip igmp snooping statistics vlan query - display description

Field	Description
Other Querier	IP address of remote querier on this interface.
Other Querier Expire	Time after which remote querier is assumed to have expired.
Other Querier Uptime	Time remote querier has been up.
Self Querier	IP address of local querier on this interface.
Self Querier Expire	Time after which local querier is assumed to have expired.
Self Querier Uptime	Time local querier has been up.
General Query Received	The number of general queries received on this interface.
General Query Sent	The number of general queries sent from this interface.
Specific Query Received	The number of specific queries received on this interface.
Specific Query Sent	The number of specific queries sent from this interface.

Table 119: show ip igmp snooping statistics vlan query - display description

Field	Description
Warn Rate Limit	The rate at which received query messages of the wrong version type cause the Vx warning count to increment. Note that "0 sec" means that the Vx warning count is incremented for each wrong message version received.
V1 Warning Count	The number of times the query version received (Version 1) does not match the version configured for this interface.
V2 Warning Count	The number of times the query version received (Version 2) does not match the version configured for this interface.
V3 Warning Count	The number of times the query version received (Version 3) does not match the version configured for this interface.

Static Multicast Routing

This section describes commands used to configure static multicast routing on the switch.

Table 120: 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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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 121: 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
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

Table 121: IGMP Filtering and Throttling Commands (Continued)

Command	Function	Mode
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

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 122: 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

Table 122: IGMP Authentication RADIUS Attribute Value Pairs (Continued)

Attribute Name	AVP Type	Entry
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 1/1-28
Console(config-if)#ip igmp authentication
Console#
```

Related Commands

show ip igmp authentication

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: 0-1024)

Default Setting

1024

Command Mode

Interface Configuration (Ethernet)

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." 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)

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)

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)#
```

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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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#
```

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 123: MLD Snooping Commands

Command	Function	Mode
ipv6 mld snooping	Enables MLD Snooping globally	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 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
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

Table 123: MLD Snooping Commands (Continued)

Command	Function	Mode
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

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 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 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 2

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

[**no**] **ipv6 mld snooping vlan** *vlan-id* **immediate-leave**

vlan-id - A VLAN identification number. (Range: 1-4094)

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.

Example

The following shows how to enable MLD immediate leave.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 mld snooping immediate-leave
Console(config-if)#
```

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. (Range: 1)

port - Port number. (Range: 1-52)

port-channel *channel-id* (Range: 1-26)

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. (Range: 1)

port - Port number. (Range: 1-52)

port-channel *channel-id* (Range: 1-26)

Default Setting

None

Command Mode

Global Configuration

Example

```
Console(config)#ipv6 mld snooping vlan 1 static ff05:0:1:2:3:4:5:6 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. (Range: 1)

port - Port number. (Range: 1-28/52)

port-channel *channel-id* (Range: 1-16)

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

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 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

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

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
Type                        : MLD Snooping
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#
```

IGMP (Layer 3)

This section describes commands used to configure Layer 3 Internet Group Management Protocol (IGMP) on the switch.

Table 124: 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 robustval	Configures the expected packet loss	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 - Dense Mode, 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#
```

Related Commands

ip igmp snooping (583)
show ip igmp snooping (600)

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: 0-255 tenths of a second)

Default Setting

100 (10 seconds)

Command Mode

Interface Configuration (VLAN)

Command Usage

- IGMPv1 does not support a configurable maximum response time for query messages. It is fixed at 10 seconds for IGMPv1.

- 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 631).

Example

The following shows how to configure the maximum response time to 20 seconds.

```
Console(config-if)#ip igmp query-max-response-time 200
Console(config-if)#
```

Related Commands

ip igmp version (633)
ip igmp query-interval (631)

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 1, the designated router is elected according to the multicast routing protocol that runs on the LAN. But 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)#
```

Related Commands

ip igmp max-resp-interval (630)

ip igmp robustval

This command specifies the robustness (expected packet loss) for this interface. Use the **no** form of this command to restore the default value.

Syntax

ip igmp robustval *robust-value*

no ip igmp robustval

robust-value - The robustness of this interface. (Range: 1-255)

Default Setting

2

Command Mode

Interface Configuration (VLAN)

Command Usage

- The robustness value is used in calculating the appropriate range for other IGMP variables, such as the Group Membership Interval, as well as the Other Querier Present Interval, and the Startup Query Count (RFC 3376).

- Routers adopt the robustness value from the most recently received query. If the querier's robustness variable (QRV) is zero, indicating that the QRV field does not contain a declared robustness value, the switch will set the robustness variable to the value statically configured by this command. If the QRV exceeds 7, the maximum value of the QRV field, the robustness value is set to zero, meaning that this device will not advertise a QRV in any query messages it subsequently sends.

Example

```
Console(config-if)#ip igmp robustness-variable 3
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 {**1** | **2** | **3**}

no ip igmp version

1 - IGMP Version 1

2 - IGMP Version 2

3 - IGMP Version 3

Default Setting

IGMP Version 2

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 1 - 3.
- If the switch receives an IGMP Version 1 Membership Report, it sets a timer to note that there are Version 1 hosts which are members of the group for which it heard the report.

  If there are Version 1 hosts present for a particular group, the switch will ignore any Leave Group messages that it receives for that group.

Example

```
Console(config-if)#ip igmp version 1
Console(config-if)#
```

clear ip igmp group

This command deletes entries from the IGMP cache.

Syntax

clear ip igmp group [*group-address* | **interface** *interface*]

group-address - IP address of the multicast group.

interface

vlan *vlan-id* - VLAN ID. (Range: 1-4094)

Default Setting

Deletes all entries in the cache if no options are selected.

Command Mode

Privileged Exec

Command Usage

Enter the address for a multicast group to delete all entries for the specified group. Enter the interface option to delete all multicast groups for the specified interface. Enter no options to clear all multicast groups from the cache.

Example

The following example clears all multicast group entries for VLAN 1.

```
Console#clear ip igmp interface vlan1
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#
```

Table 125: show ip igmp groups - display description

Field	Description
Group Address	IP multicast group address with subscribers directly attached or downstream from the switch.
Interface VLAN	The interface on the switch that has received traffic directed to the multicast group address.
Last Reporter	The IP address of the source of the last membership report received for this multicast group address on this interface.
Uptime	The time elapsed since this entry was created.
Expire	The time remaining before this entry will be aged out. (The default is 260 seconds.) This field displays "stopped" if the Group Mode is INCLUDE.
V1 Timer	The time remaining until the switch assumes that there are no longer any IGMP Version 1 members on the IP subnet attached to this interface. ◆ If the switch receives an IGMP Version 1 Membership Report, it sets a timer to note that there are Version 1 hosts present which are members of the group for which it heard the report. ◆ If there are Version 1 hosts present for a particular group, the switch will ignore any Leave Group messages that it receives for that group.

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#
```

Table 126: show ip igmp groups detail - display description

Field	Description
Interface	The interface on the switch that has received traffic directed to the multicast group address.
Group	IP multicast group address with subscribers directly attached or downstream from the switch, or a static multicast group assigned to this interface.
Uptime	The time elapsed since this entry was created.

Table 126: show ip igmp groups detail - display description (Continued)

Field	Description
`Group mode`	In INCLUDE mode, reception of packets sent to the specified multicast address is requested only from those IP source addresses listed in the source-list parameter. In EXCLUDE mode, reception of packets sent to the given multicast address is requested from all IP source addresses except for those listed in the source-list parameter, and where the source timer status has expired. Note that EXCLUDE mode does not apply to SSM addresses.
`Last Reporter`	The IP address of the source of the last membership report received for this multicast group address on this interface.
`Group Source List`	A list of zero or more IP unicast addresses from which multicast reception is desired or not desired, depending on the filter mode.
`Source Address`	The address of one of the multicast servers transmitting traffic to the specified group.
`Uptime`	The time elapsed since this entry was created.
`v3 Exp`	The time remaining before this entry will be aged out. The V3 label indicates that the expire time is only provided for sources learned through IGMP Version 3. (The default is 260 seconds.)
`Fwd`	Indicates whether or not traffic will be forwarded from the multicast source.

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)

Default Setting

None

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                      : 2
  IGMP Proxy                        : Enabled
  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#
```

IGMP Proxy Routing

This section describes commands used to configure IGMP Proxy Routing on the switch.

Table 127: IGMP Proxy Commands

Command	Function	Mode
ip igmp proxy	Enables IGMP proxy service for multicast routing	IC
ip igmp proxy unsolicited-report-interval	Specifies how often the upstream interface should transmit unsolicited IGMP reports	IC
show ip igmp interface	Displays multicast information for the specified interface	PE

To enable IGMP proxy service, follow these steps:

1. Use the ip multicast-routing command to enable IP multicasting globally on the router.

2. Use the ip igmp proxy command to enable IGMP proxy on the upstream interface that is attached to an upstream multicast router.

3. Use the ip igmp command to enable IGMP on the downstream interfaces from which to forward IGMP membership reports.

4. Optional – Use the ip igmp proxy unsolicited-report-interval command to indicate how often the system will send unsolicited reports to the upstream router.

ip igmp proxy

This command enables IGMP proxy service for multicast routing, forwarding IGMP membership information monitored on downstream interfaces onto the upstream interface in a summarized report. Use the **no** form to disable proxy service.

Syntax

[**no**] **ip igmp proxy**

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- When IGMP proxy is enabled on an interface, that interface is known as the upstream or host interface. This interface performs only the host portion of IGMP by sending IGMP membership reports, and automatically disables IGMP router functions.
- Interfaces with IGMP enabled, but not located in the direction of the multicast tree root are known as downstream or router interfaces. These interfaces perform the standard IGMP router functions by maintaining a database of all IGMP subscriptions on the downstream interface. IGMP must therefore be enabled on all downstream interfaces which require proxy multicast service.
- When changes occur in the downstream IGMP groups, a IGMP state change report is created and sent to the upstream router.
- If there is an IGMPv1 or IGMPv2 querier on the upstream network, then the proxy device will act as an IGMPv1 or IGMPv2 host on the upstream interface accordingly. Otherwise, it will act as an IGMPv3 host.
- Multicast routing protocols are not supported on interfaces where IGMP proxy service is enabled.
- Only one upstream interface is supported on the system.
- A maximum of 1024 multicast streams are supported.

Example

The following example enables multicast routing globally on the switch, configures VLAN 2 as a downstream interface, and then VLAN 1 as the upstream interface.

```
Console(config)#ip multicast-routing
Console(config)#interface vlan2
Console(config-if)#ip igmp
Console(config-if)#exit
Console(config)#interface vlan1
Console(config-if)#ip igmp proxy
Console(config-if)#
```

ip igmp proxy unsolicited-report-interval

This command specifies how often the upstream interface should transmit unsolicited IGMP reports. Use the **no** form to restore the default value.

Syntax

ip igmp proxy unsolicited-report-interval *seconds*

no ip igmp proxy unsolicited-report-interval

seconds - The interval at which to issue unsolicited reports. (Range: 1-65535 seconds)

Default Setting

400 seconds

Command Mode

Interface Configuration (VLAN)

Example

The following example sets the interval for sending unsolicited IGMP reports to 5 seconds.

```
Console(config)#interface vlan
Console(config-if)#ip igmp proxy unsolicited-report-interval 5
Console(config)#
```

MLD (Layer 3)

This section describes commands used to configure Layer 3 Multicast Listener Discovery (MLD) on the switch.

Table 128: MLD Commands (Layer 3)

Command	Function	Mode
ipv6 mld	Enables MLD for the specified interface	IC
ipv6 mld last-member-query-response-interval	Configures the frequency at which to send query messages in response to receiving a leave message	IC
ipv6 mld max-resp-interval	Configures the maximum host response time	IC
ipv6 mld query-interval	Configures frequency for sending host query messages	IC
ipv6 mld robustval	Configures the expected packet loss	IC
ipv6 mld static-group	Statically binds multicast groups to a VLAN interface	IC
ipv6 mld version	Configures MLD version used on an interface	IC
clear ipv6 mld group	Deletes entries from the MLD cache	PE
show ipv6 mld groups	Displays information for MLD groups	PE
show ip igmp interface	Displays multicast information for an interface	PE

ipv6 mld

This command enables MLD on a VLAN interface. Use the **no** form of this command to disable MLD on the selected interface.

Syntax

[**no**] **ipv6 mld**

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

MLD (including query functions) can be enabled for specific VLAN interfaces at Layer 3 through the **ipv6 mld** command.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 mld
Console(config-if)#end
Console#show ipv6 mld interface
VLAN 1 : Up
  MLD                             : Enabled
  MLD Version                     : 2
  MLD Proxy                       : Disabled
  MLD Unsolicited Report Interval : 400 sec
  Robustness Variable             : 2
  Query Interval                  : 125 sec
  Query Max Response Time         : 10  sec
  Last Member Query Interval      : 1   sec
  Querier                         : ::
  Joined Groups :
  Static Groups :

Console#
```

ipv6 mld last-member-query-response-interval

This command configures the frequency at which to send MLD group-specific or MLDv2 group-source-specific query messages in response to receiving a group-specific or group-source-specific leave message from the last known active host on the subnet. Use the **no** form to restore the default setting.

Syntax

ipv6 mld last-member-query-response-interval *seconds*

no ipv6 mld last-member-query-response-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 seconds)

Default Setting

10 (1 second)

Command Mode

Interface Configuration (VLAN)

Command Usage

When the switch receives an MLD or MLDv2 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)#ipv6 mld last-member-query-response-interval 20
Console(config-if)#
```

ipv6 mld max-resp-interval

This command configures the maximum response time advertised in MLD queries. Use the **no** form of this command to restore the default setting.

Syntax

ipv6 mld max-resp-interval *seconds*

no ipv6 mld max-resp-interval

seconds - The report delay advertised in MLD queries.
(Range: 0-255 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 MLD 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 643).

Example

The following shows how to configure the maximum response time to 20 seconds.

```
Console(config-if)#ipv6 mld max-resp-interval 200
Console(config-if)#
```

Related Commands

ipv6 mld query-interval (643)

ipv6 mld query-interval

This command configures the frequency at which host query messages are sent. Use the **no** form to restore the default.

Syntax

ipv6 mld query-interval *seconds*

no ipv6 mld query-interval

seconds - The frequency at which the switch sends MLD 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 link-scope all-nodes multicast address FF02::1, and uses a time-to-live (TTL) value of 1.

- 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)#ipv6 mld query-interval 100
Console(config-if)#
```

Related Commands

ipv6 mld max-resp-interval (642)

ipv6 mld robustval

This command specifies the robustness (expected packet loss) for this interface. Use the **no** form of this command to restore the default value.

Syntax

ipv6 mld robustval *robust-value*

no ipv6 mld robustval

robust-value - The robustness of this interface. (Range: 1-255)

Default Setting

2

Command Mode

Interface Configuration (VLAN)

Command Usage

- The robustness value is used to compensate for expected packet lose on a link. It indicates the number of refresh packets related to the current MLD state which might be lost without having to terminate that state.
- Routers adopt the robustness value from the most recently received query. If the query's robustness variable (QRV) is zero, indicating that the QRV field does not contain a declared robustness value, the switch will set the robustness variable to the value statically configured by this command. If the QRV exceeds 7, the maximum value of the QRV field, the robustness value is set to zero, meaning that this device will not advertise a QRV in any query messages it subsequently sends.

Example

```
Console(config-if)#ipv6 mld robustval 3
Console(config-if)#
```

ipv6 mld static-group

This command statically binds multicast groups to a VLAN interface. Use the **no** form to remove the static mapping.

Syntax

ipv6 mld static-group *group-address* [**source** *source-address*]

no ipv6 mld static-group [*group-address* [**source** *source-address*]]

group-address - IPv6 multicast group address. (Note that link-local scope addresses FF02:* are not allowed.)

source-address - IPv6 source address for a multicast server transmitting traffic to the corresponding multicast group address.

Default Setting

None

Command Mode

Interface Configuration (VLAN)

Command Usage

- 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.
- Use the **no** form of this command without specifying a group address to delete all any-source and source-specific multicast entries.
- Use the **no** form of this command to delete a static group without specifying the source address to delete all any-source and source-specific multicast entries for the specified group.
- The switch supports a maximum of 64 static group entries.

Example

The following example assigns VLAN 1 as a static member of the specified multicast group.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 mld static-group FFEE::0101
Console(config-if)#
```

ipv6 mld version

This command configures the MLD version used on an interface. Use the **no** form of this command to restore the default setting.

Syntax

ipv6 mld version {**1** | **2**}

no ipv6 mld version

1 - MLD Version 1

2 - MLD Version 2

Default Setting

MLD Version 2

Command Mode

Interface Configuration (VLAN)

Command Usage

- MLDv1 is derived from IGMPv2, and MLDv2 from IGMPv3. IGMP uses IP Protocol 2 message types, and MLD uses IP Protocol 58 message types, which is a subset of the ICMPv6 messages.
- MLDv2 adds the ability for a node to report interest in listening to packets with a particular multicast address only from specific source addresses as required to support Source-Specific Multicast (SSM), or from all sources except for specific source addresses.
- MLDv2 supports Source-Specific Multicast (SSM) which builds a reverse tree from a host requesting a service back up to the multicast server.
- Multicast hosts on the subnet may support either MLD versions 1 or 2.

Example

```
Console(config-if)#ipv6 mld version 1
Console(config-if)#
```

clear ipv6 mld group

This command deletes entries from the MLD cache.

Syntax

clear ipv6 mld group [*group-address* | **interface** *interface*]

group-address - IPv6 address of the multicast group.

interface

vlan *vlan-id* - VLAN ID. (Range: 1-4094)

Default Setting

Deletes all entries in the cache if no options are selected.

Command Mode

Privileged Exec

Command Usage

Enter the address for a multicast group to delete all entries for the specified group. Enter the interface option to delete all multicast groups for the specified interface. Enter no options to clear all multicast groups from the cache.

Example

The following example clears all multicast group entries for VLAN 1.

```
Console#clear ipv6 mld interface vlan 1
Console#
```

show ipv6 mld groups

This command displays information on multicast groups active on the switch and learned through MLD.

Syntax

show ipv6 mld groups [{*group-address* | *interface*} [**detail**] | **detail**]

group-address - IPv6 multicast group address. (Note that link-local scope addresses FF02:* are not allowed.)

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, MLD must first be enabled on the interface to which a group has been assigned using the ipv6 mld command, and multicast routing must be enabled globally on the system using the ip multicast-routing command.

Example

The following shows options for displaying MLD group information.

```
Console#show ipv6 mld groups

Group Address                            Interface VLAN  Uptime   Expire
---------------------------------------  --------------- -------- --------
                               FFEE::101               1   0:1:59    Never
Console#show ipv6 mld groups detail
Interface         : VLAN 1
Group             : FFEE::101
Uptime            : 0h:2m:7s
Group Mode        : Include
Last Reporter     : FE80::0101
Group Source List:
Source Address                            Uptime     Expire      Fwd
---------------------------------------  ----------- ----------- ---
                              FFEE::0101 0h:0m:12s   0h:0m:0s    Yes
Console#
```

Table 129: show ipv6 mld groups - display description

Field	Description
`Group Address`	IP multicast group address with subscribers directly attached or downstream from the switch.
`Interface VLAN`	The interface on the switch that has received traffic directed to the multicast group address.
`Uptime`	The time elapsed since this entry was created.

Table 129: show ipv6 mld groups - display description (Continued)

Field	Description
`Expire`	The time remaining before this entry will be aged out. (The default is 260 seconds.) This field displays “stopped” if the Group Mode is INCLUDE.
`Group Mode`	In Include mode, reception of packets sent to the specified multicast address is requested only from those IP source addresses listed in the source-list parameter. In Exclude mode, reception of packets sent to the given multicast address is requested from all IP source addresses except for those listed in the source-list parameter, and where the source timer status has expired. Note that Exclude mode does not apply to SSM addresses.
`Last Reporter`	The IP address of the source of the last membership report received for this multicast group address on this interface.
`Group Source List`	A list of zero or more IP unicast addresses from which multicast reception is desired or not desired, depending on the filter mode.
`Source Address`	The address of one of the multicast servers transmitting traffic to the specified group.
`Fwd`	Indicates whether or not traffic will be forwarded from the multicast source.

show ipv6 mld interface

This command shows multicast information for the specified interface.

Syntax

show ipv6 mld interface [*interface*]

interface

vlan *vlan-id* - VLAN ID. (Range: 1-4094)

Default Setting

None

Command Mode

Privileged Exec

Example

The following example shows the MLD configuration for VLAN 1, as well as the device currently serving as the MLD querier for active multicast services on this interface.

```
Console#show ipv6 mld interface vlan 1
VLAN 1 : Up
  MLD                               : Enabled
  MLD Version                       : 2
  MLD Proxy                         : Disabled
  MLD Unsolicited Report Interval : 400 sec
  Robustness Variable               : 2
  Query Interval                    : 125 sec
  Query Max Response Time           : 10
  Last Member Query Interval        : 1
  Querier                         : FE80::200:E8FF:FE93:82A0
  Joined Groups :
  Static Groups :
    FFEE::101
Console#
```

MLD Proxy Routing

This section describes commands used to configure MLD Proxy Routing on the switch.

Table 130: IGMP Proxy Commands

Command	Function	Mode
ipv6 mld proxy	Enables MLD proxy service for multicast routing	IC
ipv6 mld proxy unsolicited-report-interval	Specifies how often the upstream interface should transmit unsolicited IGMP reports	IC
show ipv6 mld interface	Displays multicast information for the specified interface	PE

To enable MLD proxy service, follow these steps:

1. Use the ipv6 multicast-routing command to enable IP multicasting globally on the router.
2. Use the ipv6 mld proxy command to enable MLD proxy on the upstream interface that is attached to an upstream multicast router.
3. Use the ipv6 mld command to enable MLD on the downstream interfaces from which to forward MLD membership reports.
4. Optional – Use the ipv6 mld proxy unsolicited-report-interval command to indicate how often the system will send unsolicited reports to the upstream router.

ipv6 mld proxy

This command enables MLD proxy service for multicast routing, forwarding MLD membership information monitored on downstream interfaces onto the upstream interface in a summarized report. Use the **no** form to disable proxy service.

Syntax

[**no**] **ipv6 mld proxy**

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- When MLD proxy is enabled on an interface, that interface is known as the upstream or host interface. This interface performs only the host portion of MLD by sending MLD membership reports, and automatically disables MLD router functions.
- Interfaces with MLD enabled, but not located in the direction of the multicast tree root are known as downstream or router interfaces. These interfaces perform the standard MLD router functions by maintaining a database of all MLD subscriptions on the downstream interface. MLD must therefore be enabled on all downstream interfaces which require proxy multicast service.
- When changes occur in the downstream MLD groups, an MLD state change report is created and sent to the upstream router.
- If there is an MLDv1 querier on the upstream network, then the proxy device will act as an MLDv1 host on the upstream interface accordingly. Otherwise, it will act as an MLDv2 host.
- Multicast routing protocols are not supported on interfaces where MLD proxy service is enabled.
- Only one upstream interface is supported on the system.
- MLD and MLD proxy cannot be enabled on the same interface.
- A maximum of 1024 multicast streams are supported.

Example

The following example enables multicast routing globally on the switch, configures VLAN 2 as a downstream interface, and then VLAN 1 as the upstream interface.

```
Console(config)#ip multicast-routing
Console(config)#interface vlan2
Console(config-if)#ipv6 mld
Console(config-if)#exit
Console(config)#interface vlan1
Console(config-if)#ipv6 mld proxy
Console(config-if)#
```

ipv6 mld proxy unsolicited-report-interval

This command specifies how often the upstream interface should transmit unsolicited MLD reports. Use the **no** form to restore the default value.

Syntax

ipv6 mld proxy unsolicited-report-interval *seconds*

no ipv6 mld proxy unsolicited-report-interval

seconds - The interval at which to issue unsolicited reports. (Range: 1-65535 seconds)

Default Setting

400 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

- The unsolicited report interval only applies to the interface where MLD proxy has been enabled.
- MLD and MLD proxy cannot be enabled on the same interface.

Example

The following example sets the interval for sending unsolicited MLD reports to 5 seconds.

```
Console(config)#interface vlan
Console(config-if)#ip igmp proxy unsolicited-report-interval 5
Console(config)#
```

23 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 131: 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 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
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

Table 131: LLDP Commands (Continued)

Command	Function	Mode
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 dcbx-tlv ets-config	Configures an LLDP-enabled port to advertise ETS configuration settings	IC
lldp dcbx-tlv ets-recommend	Configures an LLDP-enabled port to advertise ETS recommendation information	IC
lldp dcbx-tlv pfc-config	Configures an LLDP-enabled port to advertise PFC configuration settings	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

Table 131: LLDP Commands (Continued)

Command	Function	Mode
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.
- If the local interface attached to a remote device is shut down or otherwise disabled, information about the remote device is purged immediately.

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.

Syntax

lldp med-fast-start-count *packets*

no lldp med-fast-start-count

seconds - 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 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 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 dcbx-tlv ets-config

This command configures an LLDP-enabled port to advertise ETS configuration settings. Use the **no** form to disable this feature.

Syntax

[**no**] **lldp dcbx-tlv ets-config**

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet)

Command Usage

- This command will take effect when DCBX is enabled (using the dcbx command).

- If you configure ETS on an interface (using the ets mode command), DCBX advertises each priority group on the interface, the priorities in each priority group, and the bandwidth properties of each priority group and priority.

- If you do not configure ETS on an interface, DCBX advertises the default priority group, its priorities, and the assigned bandwidth.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dcbx-tlv ets-config
Console(config-if)#
```

lldp dcbx-tlv ets-recommend

This command configures an LLDP-enabled port to advertise the ETS settings that the switch wants the connected peer interface to use. Use the **no** form to disable this feature.

Syntax

[**no**] **lldp dcbx-tlv ets-recommend**

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet)

Command Usage

- If the peer interface is “willing,” it changes its configuration to match the configuration in the ETS Recommendation TLV.

- If you disable the ETS Recommendation TLV, the switch still sends the ETS Configuration TLV to the connected peer. The connected peer is informed about the switch DCBX ETS configuration, but even if the peer is “willing,” the peer does not change its configuration to match the switch configuration.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dcbx-tlv ets-recommend
Console(config-if)#
```

lldp dcbx-tlv pfc-config

This command configures an LLDP-enabled port to advertise PFC configuration settings. Use the **no** form to disable this feature.

Syntax

[**no**] **lldp dcbx-tlv pfc-config**

Default Setting

Enabled

Command Mode

Interface Configuration (Ethernet)

Command Usage

- After enabling PFC on a switch interface (using the pfc mode command), DCBX uses autonegotiation to control the operational state of the PFC functionality.
- If the peer is "willing" to learn its PFC configuration from the switch, DCBX pushes the switch's PFC configuration to the peer.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#lldp dcbx-tlv pfc-config
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)#no 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.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no 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)#no 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.

Example

```
Console(config)#interface ethernet 1/1
Console(config-if)#no 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)#no 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

Disabled

Command Mode

Interface Configuration (Ethernet, Port Channel)

Command Usage

Refer to "Frame Size" on page 125 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 132: 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

Table 132: LLDP MED Location CA Types (Continued)

CA Type	Description	CA Value Example
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)#no 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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Example

```
Console#show lldp config
LLDP Global Configuation
 LLDP Enabled                  : Yes
 LLDP Transmit Interval        : 30 sec.
 LLDP Hold Time Multiplier     : 4
 LLDP Delay Interval           : 2 sec.
 LLDP Re-initialization Delay  : 2 sec.
 LLDP Notification Interval    : 5 sec.
 LLDP MED Fast Start Count     : 4

LLDP Port Configuration
 Port     Admin Status Notification Enabled
 -------- ------------ --------------------
 Eth 1/1  Tx-Rx        True
 Eth 1/2  Tx-Rx        True
 Eth 1/3  Tx-Rx        True
 Eth 1/4  Tx-Rx        True
 Eth 1/5  Tx-Rx        True
.
.
.
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-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          : Enabled
 MED Enabled TLVs Advertised      : med-cap
                                    network-policy
                                    location
                                    inventory
 MED Location Identification:
  Location Data Format : Civic Address LCI
  Country Name         : US
  What                 : 2 - DHCP Client
  CA Type 1            : California
  CA Type 2            : Orange
 DCBX specific TLVs Advertised  : ets-config
                                    ets-recommend
                                    pfc-config
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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Example

```
Console#show lldp info local-device
LLDP Local Global Information
 Chassis Type                 : MAC Address
 Chassis ID                   : 00-E0-0C-02-00-FD
 System Name                  :
 System Description           : AOS5700-54X
 System Capabilities Support : Bridge, Router
 System Capabilities Enabled : Bridge, Router
 Management Address           : 192.168.0.3 (IPv4)

LLDP Local Port Information
 Port     Port ID Type     Port ID           Port Description
 -------- ---------------- ----------------- --------------------------------
 Eth 1/1  MAC Address      00-E0-0C-02-00-FE Ethernet Port on unit 1, port 1
 Eth 1/2  MAC Address      00-E0-0C-02-00-FF Ethernet Port on unit 1, port 2
 Eth 1/3  MAC Address      00-E0-0C-02-01-00 Ethernet Port on unit 1, port 3
 Eth 1/4  MAC Address      00-E0-0C-02-01-01 Ethernet Port on unit 1, port 4
.
.
.
Console#show lldp info local-device detail ethernet 1/1

LLDP Port Information Details

 Port             : Eth 1/1
 Port Type        : MAC Address
 Port ID          : 00-E0-0C-00-00-AE
 Port Description : Ethernet Port on unit 0, 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 configuration summary.

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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 "Device Class" field.

```
Console#show lldp info remote-device

 LLDP Remote Devices Information

  Interface 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                : 1
 Chassis Type         : MAC Address
 Chassis ID           : 70-72-CF-80-0E-50
 Port ID Type         : MAC Address
 Port ID              : 70-72-CF-80-0E-51
 Time To Live         : 120 seconds
 Port Description     : Ethernet Port on unit 1, port 1
 System Description   : ECS4120-28P
 System Capabilities  : Bridge, Router
 Enabled Capabilities : Bridge, Router

 Management Address : 70-72-CF-80-0E-50 (MAC Address)

 Port VLAN ID : 1

 Port and Protocol VLAN ID : supported, disabled

 VLAN Name : VLAN    1 - DefaultVlan

 Protocol Identity (Hex) : 05-DC-42-42-03-00-00-00
                           05-DC-42-42-03-00-00-02
                           05-DC-42-42-03-00-00-03
                           88-09-01-01
                           88-8E-01
                           88-CC
                           89-02

 MAC/PHY Configuration/Status
  Port Auto-neg Supported            : Yes
  Port Auto-neg Enabled              : Yes
  Port Auto-neg Advertised Cap (Hex) : 0000
  Port MAU Type                      : 0

 Power via MDI
  Power Class             : PSE
  Power MDI Supported     : Yes
  Power MDI Enabled       : Yes
  Power Pair Controllable : Yes
  Power Pairs             : Signal
  Power Classification    : Class 1

 Link Aggregation
  Link Aggregation Capable : Yes
  Link Aggregation Enable  : No
  Link Aggregation Port ID : 0

 Max Frame Size : 1522
```

```
ETS Configuration
  Willing                       : False
  CBS                           : False
  Number of TCs supported       : 3
  Priority Assignment Table     : [0]00  [1]00  [2]00  [3]00
                                  [4]00  [5]00  [6]00  [7]00
  Traffic Class Bandwidth(Hex)  : [0]00  [1]00  [2]00  [3]00
                                : [4]00  [5]00  [6]00  [7]00
  Traffic Selection Algorithm   : [0]0   [1]0   [2]0   [3]0
                                : [4]0   [5]0   [6]0   [7]0
                                : [4]0   [5]0   [6]0   [7]0

PFC Configuration
  Willing                    : False
  MBC                        : True
  Max PFC classes supported  : 8
  PFC Enable Vector          : [0]0 [1]0 [2]0 [3]0 [4]0 [5]0 [6]0 [7]0


~~---------------------------------------------------------------~~
~~  Local Port Name     : Eth 1/1~~
~~  Chassis Type        : MAC Address~~
~~  Chassis ID          : 00-01-02-03-04-05~~
~~  Port ID Type        : Network Address~~
~~  Port ID             : 00-01-02-03-04-06~~
~~  System Name         :~~
~~  System Description :~~
~~  System Description : ECS5110-12M~~
~~  SystemCapSupported : Bridge~~
~~  SystemCapEnabled    : Bridge~~
~~  Remote Management Address :~~
~~    192.168.1.2 (IPv4)~~
~~  Remote Port VID : 1~~
~~  Remote Port-Protocol VLAN :~~
~~    VLAN-3 : supported, enabled~~
~~  Remote VLAN Name :~~
~~    VLAN-1 : DefaultVlan~~
~~  Remote Protocol Identity (Hex) :~~
~~    88-CC~~
~~  Remote MAC/PHY Configuration Status :~~
~~    Remote port auto-neg supported : Yes~~
~~    Remote port auto-neg enabled : Yes~~
~~    Remote port auto-neg advertised cap (Hex) : 0000~~
~~    Remote port MAU type : 6~~
~~  Remote Power via MDI :~~
~~    Remote power class : PSE~~
~~    Remote power MDI supported : Yes~~
~~    Remote power MDI enabled : Yes~~
~~    Remote power pair controllable : No~~
~~    Remote power pairs : Spare~~
~~    Remote power classification : Class1~~
~~  Remote Link Aggregation :~~
~~    Remote link aggregation capable : Yes~~
~~    Remote link aggregation enable : No~~
~~    Remote link aggregation port ID : 0~~
~~  Remote Max Frame Size : 1518~~
  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              : R01
    Firmware Revision              : 1.2.2.1
    Software Revision              : 1.2.2.1
    Serial Number                  :
    Manufacture Name               :
    Model Name                     :
    Asset ID                       :

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. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Example

```
Console#show lldp info statistics

 LLDP Device Statistics

  Neighbor Entries List Last Updated : 2450279 seconds
  New Neighbor Entries Count         : 1
  Neighbor Entries Deleted Count     : 0
  Neighbor Entries Dropped Count     : 0
  Neighbor Entries Ageout Count      : 0

  Port     NumFramesRecvd NumFramesSent NumFramesDiscarded
  -------- -------------- ------------- ------------------
  Eth 1/1               0            83                  0
  Eth 1/2              11            12                  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    : 327
 Frames Sent        : 328
 TLVs Unrecognized  : 0
 TLVs Discarded     : 0
 Neighbor Ageouts   : 0

Console#
```

24 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 133: 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 133: 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 133: 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 701), or setting the start-up delay for the cross-check operation (page 707). You can also enable SNMP traps for events discovered by continuity check messages (page 703) or cross-check messages (page 707).

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[11]. (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)#
```

[11] 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)#
```

Related Commands

ma index name (690)

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

Disabled

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

10 seconds

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(config)#
```

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. (Range: 1-8)

port - Port number. (Range: 1-28/52)

port-channel *channel-id* (Range: 1-26)

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#
```

Table 134: show ethernet cfm configuration traps - display description

Field	Description
CC MEP Up Trap	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.
CC Mep Down Trap	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.
CC Configure Trap	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.
CC Loop Trap	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.
Cross Check MEP Unknown Trap	A CCM is received from a MEP that has not been configured as a DSAP (see the ethernet cfm mep command), manually configured as a remote MEP (see the mep crosscheck mpid command), nor learned through previous CCM messages.
Cross Check MEP Missing Trap	This device failed to receive three consecutive CCMs from another MEP in the same MA.
Cross Check MA Up	Generates a trap when all remote MEPs belonging to an MA come up.

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. (Range: 1-8)

port - Port number. (Range: 1-28/52)

port-channel *channel-id* (Range: 1-26)

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. (Range: 1-8)

port - Port number. (Range: 1-28/52)

port-channel *channel-id* (Range: 1-26)

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#
```

Table 135: show ethernet cfm maintenance-points local detail mep - display

Field	Description
MPID	MEP identifier
MD Name	The maintenance domain for this entry.
MA Name	Maintenance association to which this remote MEP belongs
MA Name Format	The format of the Maintenance Association name, including primary VID, character string, unsigned Integer 16, or RFC 2865 VPN ID
Level	Maintenance level of the local maintenance point
Direction	The direction in which the MEP faces on the Bridge port (up or down).
Interface	The port to which this MEP is attached.
CC Status	Shows if the MEP will generate CCM messages.
MAC Address	MAC address of the local maintenance point. (If a CCM for the specified remote MEP has never been received or the local MEP record times out, the address will be set to the initial value of all Fs.)
Defect Condition	Shows the defect detected on the MEP.
Received RDI	Receive status of remote defect indication (RDI) messages on the MEP.
AIS Status	Shows if MEPs within the specified MA are enabled to send frames with AIS information following detection of defect conditions.
AIS Period	The interval at which AIS information is sent.
AIS Transmit Level	The maintenance level at which AIS information will be sent for the specified MEP.
Suppress Alarm	Shows if the specified MEP is configured to suppress sending frames containing AIS information following the detection of defect conditions.
Suppressing Alarms	Shows if the specified MEP is currently suppressing sending frames containing AIS information following the detection of defect conditions.

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* | **ma** *ma-name*]

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)

ma-name – Maintenance association name. (Range: 1-43 alphanumeric characters)

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#
```

Table 136: show ethernet cfm maintenance-points remote detail - display

Field	Description
MAC Address	MAC address of the remote maintenance point. (If a CCM for the specified remote MEP has never been received or the remote MEP record times out, the address will be set to the initial value of all Fs.)
Domain/Level	Maintenance domain and level of the remote maintenance point
MA Name	Maintenance association to which this remote MEP belongs
Primary VLAN	VLAN to which this MEP belongs
MPID	MEP identifier
Incoming Port	Port to which this remote MEP is attached.
CC Lifetime	Length of time to hold messages about this MEP in the CCM database
Age of Last CC Message	Length of time the last CCM message about this MEP has been in the CCM database
Frame Loss	Percentage of transmitted frames lost
CC Packet Statistics (received/error)	The number of CCM packets received successfully and those with errors

Table 136: show ethernet cfm maintenance-points remote detail - display

Field	Description
Port State	Port states include: Up – The port is functioning normally. Blocked – The port has been blocked by the Spanning Tree Protocol. No port state – Either no CCM has been received, or nor port status TLV was received in the last CCM.
Interface State	Interface states include: No Status – Either no CCM has been received, or no interface status TLV was received in the last CCM. Up – The interface is ready to pass packets. Down – The interface cannot pass packets. Testing – The interface is in some test mode. Unknown – The interface status cannot be determined for some reason. Dormant – The interface is not in a state to pass packets but is in a pending state, waiting for some external event. Not Present – Some component of the interface is missing. isLowerLayerDown – The interface is down due to state of the lower layer interfaces.
Crosscheck Status	Shows if crosscheck function has been enabled.

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 4 through 7, which in turn map to specific intervals of time. (CCM interval field options: 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)#
```

Related Commands

ethernet cfm cc enable (702)

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

Disabled

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 enabled.

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)#
```

Related Commands

ethernet cfm mep crosscheck (709)

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#
```

Table 137: show ethernet cfm errors - display description

Field	Description
Level	Maintenance level associated with this entry.
VLAN	VLAN in which this error occurred.
MPID	Identifier of remote MEP.
Interface	Port at which the error was recorded
Remote MAC	MAC address of remote MEP.
Reason	Error types include: LEAK – MA *x* is associated with a specific VID list*, one or more of the VIDs in this MA can pass through the bridge port, no MEP is configured facing outward (down) on any bridge port for this MA, and some other MA *y*, at a higher maintenance level, and associated with at least one of the VID(s) also in MA *x*, does have a MEP configured on the bridge port. VIDS – MA *x* is associated with a specific VID list* on this MA on the bridge port, and some other MA *y*, associated with at least one of the VID(s) also in MA *x*, also has an Up MEP configured facing inward (up) on some bridge port. EXCESS_LEV – The number of different MD levels at which MIPs are to be created on this port exceeds the bridge's capabilities. OVERLAP_LEV – A MEP is created for one VID at one maintenance level, but a MEP is configured on another VID at an equivalent or higher level, exceeding the bridge's capabilities.
MA	The maintenance association for this entry.

* This definition is based on the IEEE 802.1ag standard. Current software for this switch only supports a single VLAN per MA. However, since it may interact with other devices which support multiple VLAN assignments per MA, this error message may be reported.

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*

delay – The time a device waits for remote MEPs to come up before the cross-check is started. (Range: 1-65535 seconds)

Default Setting

30 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

Disabled

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*

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*

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*]

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)

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#
```

Table 138: show ethernet cfm linktrace-cache - display description

Field	Description
Hops	The number hops taken to reach the target MEP.
MA	Name of the MA to which this device belongs.
IP/Alias	IP address or alias of the target device’s CPU.
Forwarded	Shows whether or not this link trace message was forwarded. A message is not forwarded if received by the target MEP.
Ingress MAC	MAC address of the ingress port on the target device.
Egress MAC	MAC address of the egress port on the target device.
Ing. Action	Action taken on the ingress port: IngOk – The target data frame passed through to the MAC Relay Entity. IngDown – The bridge port’s MAC_Operational parameter is false. This value could be returned, for example, by an operationally Down MEP that has another Down MEP at a higher MD level on the same bridge port that is causing the bridge port’s MAC_Operational parameter to be false. IngBlocked – The ingress port can be identified, but the target data frame was not forwarded when received on this port due to active topology management, i.e., the bridge port is not in the forwarding state. IngVid – The ingress port is not in the member set of the LTM’s VIDs, and ingress filtering is enabled, so the target data frame was filtered by ingress filtering.

Table 138: show ethernet cfm linktrace-cache - display description (Continued)

Field	Description
Egr. Action	Action taken on the egress port: EgrOk – The targeted data frame was forwarded. EgrDown – The Egress Port can be identified, but that bridge port's MAC_Operational parameter is false. EgrBlocked – The egress port can be identified, but the data frame was not passed through the egress port due to active topology management, i.e., the bridge port is not in the forwarding state. EgrVid – The Egress Port can be identified, but the bridge port is not in the LTM's VID member set, and was therefore filtered by egress filtering.
Relay	Relay action: FDB – Target address found in forwarding database. MPDB – Target address found in the maintenance point database. HIT – Target located on this device.

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*] [**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)

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 1 md voip ma rd
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 139: 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 140: 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#
```

Table 141: show fault-notify-generator - display description

Field	Description
MD Name	The maintenance domain for this entry.
MA Name	The maintenance association for this entry.
Hihest Defect	The highest defect that will generate a fault alarm. (This is disabled by default.)
Lowest Alarm	The lowest defect that will generate a fault alarm (see the mep fault-notify lowest-priority command).

Table 141: show fault-notify-generator - display description (Continued)

Field	Description
Alarm Time	The time a defect must exist before a fault alarm is issued (see the mep fault-notify alarm-time, command).
Reset Time	The time after a fault alarm has been issued, and no defect exists, before another fault alarm can be issued (see the mep fault-notify reset-time command).

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#
```

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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 142: Address Table Commands

Command	Function	Mode
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
clear host	Deletes entries from the host name-to-address table	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

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 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.
- 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#
```

Related Commands

ip domain-name (725)

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

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.

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#
```

Related Commands

ip domain-name (725)
ip name-server (727)

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#
```

Related Commands

ip domain-list (724)
ip name-server (727)
ip domain-lookup (725)

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, or the clear host command to clear dynamic 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#
```

Related Commands

ip domain-name (725)
ip domain-lookup (725)

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#
```

clear host

This command deletes dynamic entries from the DNS table.

Syntax

clear host {*name* | *}

name - Name of the host. (Range: 1-100 characters)

* - Removes all entries.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

Use the **clear host** command to clear dynamic entries, or the no ip host command to clear static entries.

Example

This example clears all dynamic entries from the DNS table.

```
Console(#clear 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
------- ------- ------- --------------- ------- --------
      3       4 Host    209.131.36.158      115 www-real.wa1.b.yahoo.com
      4       4 CNAME   POINTER TO:3        115 www.yahoo.com
      5       4 CNAME   POINTER TO:3        115 www.wa1.b.yahoo.com
Console#
```

Table 143: show dns cache - display description

Field	Description
No.	The entry number for each resource record.
Flag	The flag is always “4” indicating a cache entry and therefore unreliable.
Type	This field includes “Host” which specifies the primary name for the owner, and “CNAME” which specifies multiple domain names (or aliases) which are mapped to the same IP address as an existing entry.
IP Address	The IP address associated with this record.
TTL	The time to live reported by the name server.
Host	The host name associated with this record.

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 192.168.1.55                rd5
   1    2 Address 2001:DB8:1::12              rd6
   3    4 Address 209.131.36.158           65 www-real.wa1.b.yahoo.com
   4    4 CNAME   POINTER TO:3             65 www.yahoo.com
   5    4 CNAME   POINTER TO:3             65 www.wa1.b.yahoo.com
Console#
```

Table 144: show hosts - display description

Field	Description
No.	The entry number for each resource record.
Flag	The field displays “2” for a static entry, or “4” for a dynamic entry stored in the cache.
Type	This field includes “Address” which specifies the primary name for the owner, and “CNAME” which specifies multiple domain names (or aliases) which are mapped to the same IP address as an existing entry.
IP Address	The IP address associated with this record.
TTL	The time to live reported by the name server. This field is always blank for static entries.
Host	The host name associated with this record.

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DHCP Commands

These commands are used to configure Dynamic Host Configuration Protocol (DHCP) client, relay, and server functions. Any VLAN interface can be configured to automatically obtain an IPv4 address through DHCP. This switch can be configured to relay DHCP client configuration requests to a DHCP server on another network.

Table 145: DHCP Commands

Command Group	Function
DHCP Client	Allows interfaces to dynamically acquire IPv4 address information
DHCP Relay	Relays DHCP requests from local hosts to a remote DHCP server

DHCP Client

Use the commands in this section to allow the switch's VLAN interfaces to dynamically acquire IP address information.

Table 146: DHCP Client Commands

Command	Function	Mode
DHCP for IPv4		
ip dhcp client class-id	Specifies the DHCP client identifier for an interface	IC
ip dhcp restart client	Submits a DHCP client request	PE
DHCP for IPv6		
ipv6 dhcp client rapid-commit vlan	Specifies the Rapid Commit option for DHCPv6 message exchange	GC

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, with the name AOS5700-54X

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 147: 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 148: 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)#
```

Related Commands

ip dhcp restart client (735)

ip dhcp restart client

This command submits a DHCP client request.

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- This command issues a DHCP client request for any IP interface that has been set to 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 70-72-CF-EA-1B-71
  Index: 1001, MTU: 1500
  Address Mode is DHCP
  IP Address: 192.168.2.9 Mask: 255.255.255.0
  Proxy ARP is disabled
  DHCP Vendor Class-ID: AOS5700-54X
  DHCP relay server:
Craft interface is Administrative Up
  IP Address: 192.168.3.9 Mask: 255.255.255.0
Console#
```

Related Commands

ip address (742)

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

```
ES-3026(config)#ipv6 dhcp client rapid-commit vlan 2
ES-3026(config)#
```

DHCP Relay

This section describes commands used to configure DHCP relay functions for host devices attached to the switch.

Table 149: DHCP Relay Commands

Command	Function	Mode
DHCP for IPv4		
ip dhcp relay server	Specifies DHCP server addresses for relay	IC
ip dhcp restart relay	Enables DHCP relay agent	PE
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

DHCP for IPv4

ip dhcp relay server

This command specifies the addresses of DHCP servers to be used by the switch's DHCP relay agent. 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: 1-3 addresses)

Default Setting

None

Command Mode

Interface Configuration (VLAN)

Usage Guidelines

- You must specify the IP address for at least one DHCP server. Otherwise, the switch's DHCP relay agent will not forward client requests to a DHCP server.
- 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 10.1.0.99
Console(config-if)#
```

Related Commands

ip dhcp restart relay (738)

ip dhcp restart relay

This command enables DHCP relay for the specified VLAN. 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(config)#ip dhcp restart relay
Console(config)#end
Console#show ip interface
VLAN 1 is Administrative Up - Link Up
  Address is 00-00-0C-00-00-FD
  Index: 1001, MTU: 1500
  Address Mode is DHCP
  IP Address: 192.168.0.3 Mask: 255.255.255.0
  Proxy ARP is disabled
Console#
```

Related Commands

ip dhcp relay server (737)

DHCP 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 - IPv6 address of a DHCPv6 server or another relay server. (Range: 1-3 addresses)

multicast - Uses the all DHCPv6 server multicast address.

all - Specifies all local VLAN interfaces.

vlan-id - VLAN ID (Range: 1-4094)

Default Setting

None

Command Mode

Privileged Exec

Command Usage

- 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 destination addresses may be defined using consecutive commands.

- 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 IPv6 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 DHCPv6 server on another network. When the server receives the DHCPv6 request, it allocates a free IPv6 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.

Example

In the following example, the device is reassigned the same address.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 dhcp relay destination multicast vlan 2
Console(config-if)#
Console#
```

show ipv6 dhcp relay destination

This command displays a DHCPv6 server or the VLAN to which client requests are forwarded.

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 :
  Multicast : VLAN 2
Console#
```

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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 DHCP server when it is powered on. To ensure that this router resides at a known location in the network, a global IPv6 address can only be manually configured.

An IPv4 address for this switch is obtained via DHCP by default for VLAN 1. 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 150: 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 IPv4 address is assigned to this switch using DHCP 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 151: 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

Basic IPv4 Configuration

This section describes commands used to configure IP addresses for VLAN interfaces on the switch.

Table 152: 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
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

[**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 within the range /5 to /32. For example the subnet 255.255.224.0 would be /19.

secondary - Specifies a secondary IP address.

dhcp - Obtains IP address from DHCP.

Default Setting

DHCP

Command Mode

Interface Configuration (VLAN)

Command Usage

- If this router is directly connected to end node devices (or connected to end nodes via shared media) that will be assigned to a specific subnet, then you must create a router interface for each VLAN that will support routing. The router interface consists of an IP address and subnet mask. This interface address defines both the network number to which the router interface is attached and the router’s host number on that network. In other words, a router interface address defines the network and subnetwork numbers of the segment that is connected to that interface, and allows you to send IP packets to or from the router.

- 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 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 the **dhcp** option is selected, the system will immediately start broadcasting service requests for all VLANs configured to obtain address assignments through DHCP. IP is enabled but will not function until a DHCP reply has been received. Requests are broadcast periodically by the router in an effort to learn its IP address. (DHCP values can include the IP address, default gateway, and subnet mask). If the DHCP 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 router.

Note: Each VLAN group can be assigned its own IP interface address. You can manage the router via any of these IP addresses.

- For a specific VLAN interface, multiple default-gateway addresses can be configured. However, the active default-gateway is selected as the one with the smallest IP address.

  Use the show ip route command to see the active default-gateway or show ip route database command to see the default-gateway list, including the active one.

  Use the no ip default-gateway command to remove the active default-gateway.

  Use the no ip route 0.0.0.0 0.0.0.0 *gateway-address* command to remove a specific default gateway.

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)#
```

This example shows that when multiple default gateways are defined for a VLAN interface, the active default-gateway is selected as the one with the smallest IP address.

```
Console#configure
Console(config)#ip default-gateway 192.168.1.250
Console(config)#ip default-gateway 192.168.1.224
Console(config)#ip default-gateway 192.168.1.236
Console(config)#ip default-gateway 192.168.5.250
Console(config)#ip default-gateway 192.168.5.245
Console(config)#ip default-gateway 192.168.10.240
Console(config)#ip default-gateway 192.168.1.246
Console(config)#end
Console#show ip route database
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
       > - selected route, * - FIB route, p - stale info

S    *> 0.0.0.0/0 [1/0] via 192.168.1.224, VLAN1
      >           [1/0] via 192.168.1.236, VLAN1
      >           [1/0] via 192.168.1.246, VLAN1
      >           [1/0] via 192.168.1.250, VLAN1
      >           [1/0] via 192.168.5.245 inactive
      >           [1/0] via 192.168.5.250 inactive
      >           [1/0] via 192.168.10.240 inactive
C    *> 192.168.1.0/24 is directly connected, VLAN1
Console#
```

Note: [1/0] in the example above is used to indicate administrative distance in the first field, and route metric the second field. Note that for static routes, only distance can be specified, not metric.

This example shows that the no ip default-gateway command can be used to remove the active default gateway. Note that the active default gateway in the previous example was 192.168.1.224.

```
Console#configure
Console(config)#no ip default-gateway
Console(config)#end
Console#show ip route database
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
       > - selected route, * - FIB route, p - stale info

S    *> 0.0.0.0/0 [1/0] via 192.168.1.236, VLAN1
      >           [1/0] via 192.168.1.246, VLAN1
      >           [1/0] via 192.168.1.250, VLAN1
      >           [1/0] via 192.168.5.245 inactive
      >           [1/0] via 192.168.5.250 inactive
      >           [1/0] via 192.168.10.240 inactive
C    *> 192.168.1.0/24 is directly connected, VLAN1
Console#
```

This example shows how to use the no ip route 0.0.0.0 0.0.0.0 *gateway-address* command to remove a specific default gateway. Note that the specified default gateway 192.168.1.246 is removed from the list in the preceding example.

```
Console#configure
Console(config)#no ip route 0.0.0.0 0.0.0.0 192.168.1.246
Console(config)#end
Console#show ip route database
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
       > - selected route, * - FIB route, p - stale info

S    *> 0.0.0.0/0 [1/0] via 192.168.1.236, VLAN1
      >           [1/0] via 192.168.1.250, VLAN1
      >           [1/0] via 192.168.5.245 inactive
      >           [1/0] via 192.168.5.250 inactive
      >           [1/0] via 192.168.10.240 inactive
C    *> 192.168.1.0/24 is directly connected, VLAN1
Console#
```

Related Commands

ip dhcp restart client (735)
ip default-gateway (746)
ipv6 address (756)

ip default-gateway

This command specifies the default gateway for destinations not found in the 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 command: **ip route 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 10.1.1.254
Console(config)#exit
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 192.168.0.1, VLAN1
C       192.168.2.0/24 is directly connected, VLAN1
Console#
```

Related Commands

ip address (742)
ip route (803)
ipv6 default-gateway (755)

show ip interface

This command displays the settings of an IPv4 interface.

show ip interface [**vlan** *vlan-id*]

vlan-id - VLAN ID (Range: 1-4094)

Default Setting

VLAN 1

Command Mode

Privileged Exec

Example

```
Console#show ip interface
VLAN 1 is Administrative Up - Link Down
  Address is 70-72-CF-EA-1B-71
  Index: 1001, MTU: 1500
  Address Mode is DHCP
  IP Address: 192.168.2.9 Mask: 255.255.255.0
  Proxy ARP is disabled
  DHCP Vendor Class-ID: AOS5700-54X
  DHCP relay server:
Craft interface is Administrative Up
  IP Address: 192.168.3.9 Mask: 255.255.255.0
Console#
```

Related Commands

ip address (742)
show ipv6 interface (763)

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
                     reassembly succeeded
                     reassembly 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#
```

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 192.168.0.1
Press "ESC" to abort.
Traceroute to 192.168.1.99, 30 hops max, timeout is 3 seconds

Hop Packet 1 Packet 2 Packet 3 IP Address
--- -------- -------- -------- ---------------
  1    20 ms   <10 ms   <10 ms 192.168.1.99

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: 1-16)

size - Number of bytes in a packet. (Range: 32-512)
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 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 725) and host name-to-address translation enabled (page 725). If necessary, local devices can also be specified in the DNS static host table (page 726).

Example

```
Console#ping 10.1.0.9
Type ESC to abort.
PING to 10.1.0.9, by 5 32-byte payload ICMP packets, timeout is 5 seconds
response time: 10 ms
response time: 10 ms
response time: 10 ms
response time: 10 ms
response time: 0 ms
```

```
Ping statistics for 10.1.0.9:
 5 packets transmitted, 5 packets received (100%), 0 packets lost (0%)
Approximate round trip times:
 Minimum = 0 ms, Maximum = 10 ms, Average = 8 ms
Console#
```

Related Commands

interface (360)

ARP Configuration

This section describes commands used to configure the Address Resolution Protocol (ARP) on the switch.

Table 153: 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
clear arp-cache	Deletes all dynamic entries from the ARP cache	PE
show arp	Displays entries in the ARP cache	NE, 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.)

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)#
```

Related Commands

clear arp-cache (753)
show arp (753)

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)#
```

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)?y
Console#
```

show arp

This command displays entries in the Address Resolution Protocol (ARP) cache.

Command Mode

Normal Exec, 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 : 5
Console#
```

IPv6 Interface

This switch supports the following IPv6 interface commands.

Table 154: 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 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	NE, PE
show ipv6 mtu	Displays maximum transmission unit (MTU) information for IPv6 interfaces	NE, PE
show ipv6 traffic	Displays statistics about IPv6 traffic	NE, PE
clear ipv6 traffic	Resets IPv6 traffic counters	PE
ping6	Sends IPv6 ICMP echo request packets to another node on the network	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 all IPv6 packets originated by this router	GC
ipv6 nd dad attempts	Configures the number of consecutive neighbor solicitation messages sent on an interface during duplicate address detection	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 neighbor	Configures a static entry in the IPv6 neighbor discovery cache	GC
clear ipv6 neighbors	Deletes all dynamic entries in the IPv6 neighbor discovery cache	PE

Table 154: IPv6 Configuration Commands (Continued)

Command	Function	Mode
show ipv6 nd raguard	Displays the configuration setting for RA Guard	PE
show ipv6 neighbors	Displays information in the IPv6 neighbor discovery cache	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 address

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 can only be successfully set when a network interface that directly connects to the gateway has been configured on the router.

- An IPv6 default gateway must be defined if a destination is located in a different IP segment and routing is disabled.

Example

The following example defines a default gateway for this device:

```
Console(config)#ipv6 default-gateway FE80::269:3EF9:FE19:6780%1
Console(config)#
```

Related Commands

ip route (803)
show ip route (805)
ip default-gateway (746)

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.

- 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::2e0:cff:fe02:fd%1/64
Global unicast address(es):
  2001:db8:2222:7272::72/96, subnet is 2001:db8:2222:7272::/96
Joined group address(es):
ff02::2
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: 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 advertised router lifetime is 1800 seconds

Console#
```

Related Commands

ipv6 address eui-64 (757)
show ipv6 interface (763)
ip address (742)

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 enable.
Link-local address:
  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: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: 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 advertised router lifetime is 1800 seconds

Console#
```

Related Commands

show ipv6 interface (763)

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:db8:0:1:2e0: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: 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 advertised router lifetime is 1800 seconds
Console#
```

Related Commands

ipv6 enable (760)
show ipv6 interface (763)

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 757). 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:db8:0:1:2e0: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: 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 advertised router lifetime is 1800 seconds

Console#
```

Related Commands

ipv6 address link-local (759)
show ipv6 interface (763)

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)#
```

Related Commands

show ipv6 mtu (765)
jumbo frame (126)

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 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: 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 advertised router lifetime is 1800 seconds

Console#
```

Table 155: show ipv6 interface - display description

Field	Description
VLAN	A VLAN is marked "up" if the switch can send and receive packets on this interface, "down" if a line signal is not present, or "administratively down" if the interface has been disabled by the administrator.
IPv6	IPv6 is marked "enable" if the switch can send and receive IP traffic on this interface, "disable" if the switch cannot send and receive IP traffic on this interface, or "stalled" if a duplicate link-local address is detected on the interface.
Link-local address	Shows the link-local address assigned to this interface
Global unicast address(es)	Shows the global unicast address(es) assigned to this interface
Joined group address(es)	In addition to the unicast addresses assigned to an interface, a node is required to join the all-nodes multicast addresses FF01::1 and FF02::1 for all IPv6 nodes within scope 1 (interface-local) and scope 2 (link-local), respectively. FF01::1/16 is the transient interface-local multicast address for all attached IPv6 nodes, and FF02::1/16 is the link-local multicast address for all attached IPv6 nodes. The interface-local multicast address is only used for loopback transmission of multicast traffic. Link-local multicast addresses cover the same types as used by link-local unicast addresses, including all nodes (FF02::1), all routers (FF02::2), and solicited nodes (FF02::1:FFXX:XXXX) as described below. A node is also required to compute and join the associated solicited-node multicast addresses for every unicast and anycast address it is assigned. IPv6 addresses that differ only in the high-order bits, e.g. due to multiple high-order prefixes associated with different aggregations, will map to the same solicited-node address, thereby reducing the number of multicast addresses a node must join. In this example, FF02::1:FF90:0/104 is the solicited-node multicast address which is formed by taking the low-order 24 bits of the address and appending those bits to the prefix.
MTU	Maximum transmission unit for this interface.
ND DAD	Indicates whether (neighbor discovery) duplicate address detection is enabled.
number of DAD attempts	The number of consecutive neighbor solicitation messages sent on the interface during duplicate address detection.
ND retransmit interval	The interval between IPv6 neighbor solicitation retransmissions sent on an interface during duplicate address detection.
ND advertised retransmit interval	The retransmit interval is included in all router advertisements sent out of an interface so that nodes on the same link use the same time value.
ND reachable time	The amount of time a remote IPv6 node is considered reachable after a reachability confirmation event has occurred
ND advertised reachable time	The reachable time is included in all router advertisements sent out of an interface so that nodes on the same link use the same time value.
ND advertised router lifetime	Tells the neighbor receiving this message how long this router should be used as a default router.

This example displays a brief summary of IPv6 addresses configured on the switch.

```
Console#show ipv6 interface brief
Interface       VLAN       IPv6       IPv6 Address
--------------- ---------- ---------- ------------------------------------
VLAN 1          Up         Up         2001:db8:0:1:2e0:cff:fe02:fd/64
VLAN 1          Up         Up         2001:db8:2222:7272::72/96
VLAN 1          Up         Up         fe80::269:3ef9:fe19:6779/64
```

```
Craft           Up         Down       Unassigned
Console#
```

Related Commands

show ip interface (747)

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#
```

Table 156: show ipv6 mtu - display description*

Field	Description
MTU	Adjusted MTU contained in the ICMP packet-too-big message returned from this destination, and now used for all traffic sent along this path.
Since	Time since an ICMP packet-too-big message was received from this destination.
Destination Address	Address which sent an ICMP packet-too-big message.

* No information is displayed if an IPv6 address has not been assigned to the switch.

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
                     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
                  15 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
                     multicast listener discovery version 2 reports
ICMPv6 sent
                   4 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
                   1 neighbor solicit messages
                     neighbor advertisement messages
                     redirect messages
                     group membership query messages
                     group membership response messages
                     group membership reduction messages
                     multicast listener discovery version 2 reports
UDP Statistics:
                     input
                     no port errors
                     other errors
                     output
Console#
```

Table 157: show ipv6 traffic - display description

Field	Description
IPv6 Statistics	
IPv6 received	
total received	The total number of input datagrams received by the interface, including those received in error.
header errors	The number of input datagrams discarded due to errors in their IPv6 headers, including version number mismatch, other format errors, hop count exceeded, IPv6 options, etc.
too big errors	The number of input datagrams that could not be forwarded because their size exceeded the link MTU of outgoing interface.
no routes	The number of input datagrams discarded because no route could be found to transmit them to their destination.
address errors	The number of input datagrams discarded because the IPv6 address in their IPv6 header's destination field was not a valid address to be received at this entity. This count includes invalid addresses (e.g., ::0) and unsupported addresses (e.g., addresses with unallocated prefixes). For entities which are not IPv6 routers and therefore do not forward datagrams, this counter includes datagrams discarded because the destination address was not a local address.
unknown protocols	The number of locally-addressed datagrams received successfully but discarded because of an unknown or unsupported protocol. This counter is incremented at the interface to which these datagrams were addressed which might not be necessarily the input interface for some of the datagrams.
truncated packets	The number of input datagrams discarded because datagram frame didn't carry enough data.
discards	The number of input IPv6 datagrams for which no problems were encountered to prevent their continued processing, but which were discarded (e.g., for lack of buffer space). Note that this counter does not include any datagrams discarded while awaiting re-assembly.
delivers	The total number of datagrams successfully delivered to IPv6 user-protocols (including ICMP). This counter is incremented at the interface to which these datagrams were addressed which might not be necessarily the input interface for some of the datagrams.
reassembly request datagrams	The number of IPv6 fragments received which needed to be reassembled at this interface. Note that this counter is incremented at the interface to which these fragments were addressed which might not be necessarily the input interface for some of the fragments.
reassembly succeeded	The number of IPv6 datagrams successfully reassembled. Note that this counter is incremented at the interface to which these datagrams were addressed which might not be necessarily the input interface for some of the fragments.
reassembly failed	The number of failures detected by the IPv6 re-assembly algorithm (for whatever reason: timed out, errors, etc.). Note that this is not necessarily a count of discarded IPv6 fragments since some algorithms (notably the algorithm in RFC 815) can lose track of the number of fragments by combining them as they are received. This counter is incremented at the interface to which these fragments were addressed which might not be necessarily the input interface for some of the fragments.

Table 157: show ipv6 traffic - display description (Continued)

Field	Description
IPv6 sent	
forwards datagrams	The number of output datagrams which this entity received and forwarded to their final destinations. In entities which do not act as IPv6 routers, this counter will include only those packets which were Source-Routed via this entity, and the Source-Route processing was successful. Note that for a successfully forwarded datagram the counter of the outgoing interface is incremented.
requests	The total number of IPv6 datagrams which local IPv6 user-protocols (including ICMP) supplied to IPv6 in requests for transmission. Note that this counter does not include any datagrams counted in ipv6IfStatsOutForwDatagrams.
discards	The number of output IPv6 datagrams for which no problem was encountered to prevent their transmission to their destination, but which were discarded (e.g., for lack of buffer space). Note that this counter would include datagrams counted in ipv6IfStatsOutForwDatagrams if any such packets met this (discretionary) discard criterion.
no routes	The number of input datagrams discarded because no route could be found to transmit them to their destination.
generated fragments	The number of output datagram fragments that have been generated as a result of fragmentation at this output interface.
fragment succeeded	The number of IPv6 datagrams that have been successfully fragmented at this output interface.
fragment failed	The number of IPv6 datagrams that have been discarded because they needed to be fragmented at this output interface but could not be.
ICMPv6 Statistics	
ICMPv6 received	
input	The total number of ICMP messages received by the interface which includes all those counted by ipv6IfIcmpInErrors. Note that this interface is the interface to which the ICMP messages were addressed which may not be necessarily the input interface for the messages.
errors	The number of ICMP messages which the interface received but determined as having ICMP-specific errors (bad ICMP checksums, bad length, etc.).
destination unreachable messages	The number of ICMP Destination Unreachable messages received by the interface.
packet too big messages	The number of ICMP Packet Too Big messages received by the interface.
time exceeded messages	The number of ICMP Time Exceeded messages received by the interface.
parameter problem message	The number of ICMP Parameter Problem messages received by the interface.
echo request messages	The number of ICMP Echo (request) messages received by the interface.
echo reply messages	The number of ICMP Echo Reply messages received by the interface.
router solicit messages	The number of ICMP Router Solicit messages received by the interface.
router advertisement messages	The number of ICMP Router Advertisement messages received by the interface.

Table 157: show ipv6 traffic - display description (Continued)

Field	Description
neighbor solicit messages	The number of ICMP Neighbor Solicit messages received by the interface.
neighbor advertisement messages	The number of ICMP Neighbor Advertisement messages received by the interface.
redirect messages	The number of Redirect messages received by the interface.
group membership query messages	The number of ICMPv6 Group Membership Query messages received by the interface.
group membership response messages	The number of ICMPv6 Group Membership Response messages received by the interface.
group membership reduction messages	The number of ICMPv6 Group Membership Reduction messages received by the interface.
multicast listener discovery version 2 reports	The number of MLDv2 reports received by the interface.
ICMPv6 sent	
output	The total number of ICMP messages which this interface attempted to send. Note that this counter includes all those counted by icmpOutErrors.
destination unreachable messages	The number of ICMP Destination Unreachable messages sent by the interface.
packet too big messages	The number of ICMP Packet Too Big messages sent by the interface.
time exceeded messages	The number of ICMP Time Exceeded messages sent by the interface.
parameter problem message	The number of ICMP Parameter Problem messages sent by the interface.
echo request messages	The number of ICMP Echo (request) messages sent by the interface.
echo reply messages	The number of ICMP Echo Reply messages sent by the interface.
router solicit messages	The number of ICMP Router Solicitation messages sent by the interface.
router advertisement messages	The number of ICMP Router Advertisement messages sent by the interface.
neighbor solicit messages	The number of ICMP Neighbor Solicit messages sent by the interface.
neighbor advertisement messages	The number of ICMP Router Advertisement messages sent by the interface.
redirect messages	The number of Redirect messages sent. For a host, this object will always be zero, since hosts do not send redirects.
group membership query messages	The number of ICMPv6 Group Membership Query messages sent by the interface.
group membership response messages	The number of ICMPv6 Group Membership Response messages sent.
group membership reduction messages	The number of ICMPv6 Group Membership Reduction messages sent.
multicast listener discovery version 2 reports	The number of MLDv2 reports sent by the interface.
UDP Statistics	
input	The total number of UDP datagrams delivered to UDP users.

Table 157: show ipv6 traffic - display description (Continued)

Field	Description
no port errors	The total number of received UDP datagrams for which there was no application at the destination port.
other errors	The number of received UDP datagrams that could not be delivered for reasons other than the lack of an application at the destination port.
output	The total number of UDP datagrams sent from this entity.

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: 1-16)

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: 0 bytes

Command Mode

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 725). If necessary, local devices can also be specified in the DNS static host table (see page 726).

- When using ping6 with a host name, the router 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** *max-failures*]

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.

max-failures - 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. Note that the zone-id for the craft interface is 4097.

- 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%1/64
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 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 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#
```

Related Commands

ipv6 nd ns-interval (775)
show ipv6 neighbors (780)

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.

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]
  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#
```

Related Commands

show running-config (118)

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)#pv6 nd raguard
Console(config-if)#
```

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 command 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)#pv6 nd reachable-time 1000
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 mtu

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 760) 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#
```

Related Commands

show ipv6 neighbors (780)
mac-address-table static (438)

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 nd raguard

This command displays the configuration setting for RA Guard.

Syntax

show ipv6 nd raguard [*interface*]

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

Command Mode

Privileged Exec

Example

```
Console#show ipv6 nd raguard interface ethernet 1/1
Interface RA Guard
--------- --------
Eth 1/ 1  Yes
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 VLAN
FE80::2E0:CFF:FE9C:CA10                4         00-E0-0C-9C-CA-10     R    1
Console#
```

Table 158: show ipv6 neighbors - display description

Field	Description
IPv6 Address	IPv6 address of neighbor
Age	The time since the address was verified as reachable (in seconds). A static entry is indicated by the value "Permanent."
Link-layer Addr	Physical layer MAC address.

Table 158: show ipv6 neighbors - display description (Continued)

Field	Description
State	The following states are used for dynamic entries: I1 (Incomplete) - Address resolution is being carried out on the entry. A neighbor solicitation message has been sent to the multicast address of the target, but it has not yet returned a neighbor advertisement message. I2 (Invalid) - An invalidated mapping. Setting the state to invalid dis-associates the interface identified with this entry from the indicated mapping (RFC 4293). R (Reachable) - Positive confirmation was received within the last ReachableTime interval that the forward path to the neighbor was functioning. While in REACH state, the device takes no special action when sending packets. S (Stale) - More than the ReachableTime interval has elapsed since the last positive confirmation was received that the forward path was functioning. While in STALE state, the device takes no action until a packet is sent. D (Delay) - More than the ReachableTime interval has elapsed since the last positive confirmation was received that the forward path was functioning. A packet was sent within the last DELAY_FIRST_PROBE_TIME interval. If no reachability confirmation is received within this interval after entering the DELAY state, the switch will send a neighbor solicitation message and change the state to PROBE. P1 (Probe) - A reachability confirmation is actively sought by resending neighbor solicitation messages every RetransTimer interval until confirmation of reachability is received. U (Unknown) - Unknown state. The following states are used for static entries: I1 (Incomplete)-The interface for this entry is down. R (Reachable) - The interface for this entry is up. Reachability detection is not applied to static entries in the IPv6 neighbor discovery cache. P2 (Permanent) - Indicates a static entry.
VLAN	VLAN interface from which the address was reached.

Related Commands

show mac-address-table (439)

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 159: 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

Set to the valid lifetime field in received RA packet

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)#ipv6 nd snooping max-binding 200
Console(config)#
```

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#
```

28 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 160: VRRP Commands

Command	Function	Mode
vrrp ping-enable	Allows the VRRP virtual IP address to respond to ping request	GC
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 ping-enable

This command Allows the VRRP virtual IP address to respond to ping request.

Command Mode

Global Configuration

Default Setting

Disabled

Command Usage

When a host cannot communicate, the first debug method is to ping the host's default gateway to determine whether the problem is in the first hop of the path to the destination. When the default gateway is a virtual router that does not respond to pings, this debug method is unavailable. This **vrrp ping-enable** command allows the system to respond to pings sent to the virtual IP address.

This capability adds support for responding to pings, but does not allow the VRRP Master to accept other types of packets. The VRRP Master responds to pings sent to the virtual router's primary address or any of its secondary addresses. Members of the virtual router group who are in backup state discard ping packets destined to VRRP addresses. When the VRRP master responds to a ping request, the source IPv4 address is the VRRP address and source MAC address is the virtual router's MAC address.

Example

```
Console(config)#vrrp ping-enable
Console(config)#
```

Related Commands

vrrp ip (793)

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: 1-64)

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)
The maximum number or groups which can be defined is 64.

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)
The maximum number or groups which can be defined is 64.

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)#
```

Related Commands

vrrp priority (795)

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)
The maximum number or groups which can be defined is 64.

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)#
```

Related Commands

vrrp preempt (794)

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)
The maximum number or groups which can be defined is 64.

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#
```

Table 161: show vrrp - display description

Field	Description
State	VRRP role of this interface (master or backup)
Virtual IP address	Virtual address that identifies this VRRP group
Virtual MAC address	Virtual MAC address derived from the owner of the virtual IP address
Advertisement interval	Interval at which the master virtual router advertises its role as the master
Preemption	Shows whether or not a higher priority router can preempt the current acting master
Min Delay	Delay before a router with a higher priority can preempt the current acting master
Priority	Priority of this router
Authentication	Authentication mode used to verify VRRP packets
Authentication Key	Key used to authenticate VRRP packets received from other routers
Master Router	IP address of the router currently acting as the VRRP group master
Master Priority	The priority of the router currently acting as the VRRP group master

Table 161: show vrrp - display description (Continued)

Field	Description
Master Advertisement Interval	The advertisement interval configured on the VRRP master.
Master Down interval	The down interval configured on the VRRP master (This interval is used by all the routers in the group regardless of their local settings)

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#
```

Table 162: show vrrp brief - display description

Field	Description
Interface	VLAN interface
Grp	VRRP group
State	VRRP role of this interface (master or backup)
Virtual Addr	Virtual address that identifies this VRRP group
Interval	Interval at which the master virtual router advertises its role as the master
Preempt	Shows whether or not a higher priority router can preempt the current acting master
Priority	Priority of this router

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#
```

* Refer to the show vrrp command for a description of the display items.

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#
```

29 IP Routing Commands

After network interfaces are configured for the switch, the paths used to send traffic between different interfaces must be set. If routing is enabled on the switch, traffic will automatically be forwarded between all of the local subnetworks. However, to forward traffic to devices on other subnetworks, either configure fixed paths with static routing commands, or enable a dynamic routing protocol that exchanges information with other routers on the network to automatically determine the best path to any subnetwork.

This section includes commands for both static and dynamic routing. These commands are used to connect between different local subnetworks or to connect the router to the enterprise network.

Table 163: IP Routing Commands

Command Group	Function
Global Routing Configuration	Configures global parameters for static and dynamic routing, displays the routing table and statistics for protocols used to exchange routing information
Routing Information Protocol (RIP)	Configures global and interface specific parameters for RIP
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
Border Gateway Protocol (BGPv4)	Configures general and neighbor specific parameters for BGPv4
Policy-based Routing for BGP	Configures next-hop routing policies based on criteria defined in various routing parameters

Global Routing Configuration

Table 164: Global Routing Configuration Commands

Command	Function	Mode
IPv4 Commands		
ip route	Configures static routes	GC
show ip host-route	Displays the interface associated with known routes	PE
show ip route	Displays specified entries in the routing table	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

Table 164: Global Routing Configuration Commands (Continued)

Command	Function	Mode
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		
ecmp load-balance	Configures the load-balance method used when there are multiple equal-cost paths to the same destination address including destinanation IP address with Layer 4 port, or hash selection list	GC
hash-selection list	Specifies the list index and packet type, and then enters the hash list confiiguration mode	GC
maximum-paths	Sets the maximum number of paths allowed	GC
dst-mac (MAC Hash)	Adds the dst-mac address hash attribute to the hash selection list	MAC HS[1]
ethertype (MAC Hash)	adds the EtherType hash attribute to the hash selection list	MAC HS[1]
src-mac (MAC Hash)	Adds the source-mac address hash attribute to the hash selection list	MAC HS[1]
vlan (MAC Hash)	Adds the VLAN hash attribute to the hash selection list	MAC HS[1]
dst-ip (IPv4 Hash)	Adds the destination IPv4 address hash attribute to the hash selection list	Pv4 HS[2]
dst-l4-port (IPv4 Hash)	Adds the destination Layer 4 protocol port hash attribute to the hash selection	Pv4 HS[2]
protocol-id (IPv4 Hash)	Adds the protocol ID hash attribute to the hash selection list	Pv4 HS[2]
src-ip (IPv4 Hash)	Adds the source IPv4 address hash attribute to the hash selection list	IPv4 HS[2]
src-l4-port (IPv4 Hash)	Adds the source Layer 4 protocol port hash attribute to the hash selection	Pv4 HS[2]
vlan (IPv4 Hash)	Adds the VLAN hash attribute to the hash selection list	Pv4 HS[2]
collapsed-dst-ip (IPv6 Hash)	Adds the collapsed destination IPv6 address hash attribute to the hash selection list	IPv6 HS[3]
collapsed-src-ip (IPv6 Hash)	Adds the collapsed source IPv6 address hash attribute to the hash selection list	IPv6 HS[3]
dst-l4-port (IPv6 Hash)	Adds the destination Layer 4 protocol port hash attribute to the hash selection list	IPv6 HS[3]
next-header (IPv6 Hash)	Adds the next header hash attribute to the hash selection list	IPv6 HS[3]
src-l4-port (IPv6 Hash)	Adds the source Layer 4 protocol port hash attribute to the hash selection	IPv6 HS[3]
vlan (IPv6 Hash)	Adds the VLAN hash attribute to the hash selection list	IPv6 HS[3]

Table 164: Global Routing Configuration Commands (Continued)

Command	Function	Mode
show ecmp load-balance	Shows the load-balance method used when there are multiple equal-cost paths to the same destination	PE
show hash-selection list	Shows the packet type and hash list attributes	PE

1 MAC HS – MAC hash selection.

2 IPv4 HS – IPv4 hash selection.

3 IPv6 HS – IPv6 hash selection

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*]

no ip route {*destination-ip netmask next-hop* | *****}

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)

***** – Removes all static routing table entries.

Default Setting

No static routes are configured.

Command Mode

Global Configuration

Command Usage

- Up to 512 static routes can be configured.
- Up to eight equal-cost multipaths (ECMP) can be configured for static routing using the maximum-paths command.
- 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.

- 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.
- Static routes are included in RIP and OSPF updates periodically sent by the router if this feature is enabled by the RIP or OSPF redistribute command (see page 826 or page 847, respectively).
- For information on how to define multiple default gateways or remove a default gateway for a VLAN interface refer to the Command Usage section and the examples for the ip address 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 host-route

This command displays the interface associated with known routes.

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#
```

Table 165: show ip host-route - display description

Field	Description
IP Address	IP address of the destination network, subnetwork, or host.
MAC Address	The physical layer address associated with the IP address.
VLAN	The VLAN that connects to this IP address.
Port	The port that connects to this IP address.

show ip route

This command displays information in the Forwarding Information Base (FIB).

Syntax

show ip route [**bgp** | **connected** | **database** | **ospf** | **rip** | **static** | **summary**]

bgp – Displays external routes imported from the Border Gateway Protocol (BGP) into this routing domain.

connected – Displays all currently connected entries.

database – All known routes, including inactive routes.

ospf – Displays external routes imported from the Open Shortest Path First (OSPF) protocol into this routing domain.

rip – Displays all entries learned through the Routing Information Protocol (RIP).

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.

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. Note that routes currently not accessible for forwarding, may still be displayed by using the show ip route database command.

Example

In the following example, note that the entry for RIP displays both the distance and metric for this route.

```
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

R        10.1.1.0/24 [120/2] via 192.168.1.10, VLAN1, 00:00:14
C        127.0.0.0/8 is directly connected, lo
C        192.168.1.0/24 is directly connected, VLAN1
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: 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
       > - selected route, * - FIB route, p - stale info

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
IP routing table name is Default-IP-Routing-Table(0)
IP routing table maximum-paths is 8
Connected       2
Total           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#
```

ECMP Commands

ecmp load-balance

This command configures the load-balance method used when there are multiple equal-cost paths to the same destination address in the routing table, including destinanation IP address with Layer 4 port, or hash selection list.

Syntax

ecmp load-balance {**dst-ip-l4-port** | **hash-selection-list** *index*}

dst-ip-l4-port – Selection based on destination IP address and Layer 4 protocol port.

hash-selection-list – Selection based on hash selection list.

index – Specifies the hash selection list to use for load balancing. (Range: 1-4)

Default Setting

dst-ip-l4-port

Command Mode

Global Configuration

Command Usage

- Equal-cost multi-path (ECMP) routing is a strategy where next-hop packet forwarding to a single destination can occur over multiple "best paths" which tie for the top place in routing metric calculations.

- If **dstip-l4-port** is selected, traffic matching the same destination IP address and L4 protocol port will be carried across the same ECMP path.
- If **hash-selection-list** is selected, use the hash-selection list command to enter hash-sele tion list configuration mode, and then configure the required hash list attributes.

Example

```
Console(config)#ecmp load-balance dst-ip-l4-port
Console(config)#
```

hash-selection list

This command specifies the list index and packet type, and then enters the hash list confiiguration mode.

Syntax

hash-selection list *index* {**mac** | **ipv4** | **ipv6**}

index – Specifies the hash list index to configure. (Range: 1-4)

mac – Enters list configuration mode for MAC packet types.

ipv4 – Enters list configuration mode for IPv4 packet types.

ipv6 – Enters list configuration mode for IPv6 packet types.

Command Mode

Global Configuration

Example

This example sets the hash selection mode to IPv4, and enters hash selection mode. The available commands for IPv4 selection mode are also displayed.

```
Console(config)#hash-selection list 1 ipv4
Console(config-ipv4-hash-sel)#?
Configure commands:
  dst-ip        Specifies destination IP address as hash key
  dst-l4-port   Specifies destination L4 port as hash key
  end           Exits from configure mode
  exit          Exits from hash-selection configure mode
  no            Removes hash-selection
  protocol-id   Specifies protocol ID as hash key
  src-ip        Specifies source IP address as hash key
  src-l4-port   Specifies source L4 port as hash key
  vlan          Specifies VLAN ID as hash key
Console#
```

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)#
```

dst-mac (MAC Hash)

This command adds the dst-mac address hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **dst-mac**

Command Mode

MAC hash selection mode

Example

```
Console(config)#hash-selection list 1 mac
Console(config-mac-hash-sel)#dst-mac
Console#
```

ethertype (MAC Hash)

This command adds the EtherType hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **ethertype**

Command Mode

MAC hash selection mode

Example

```
Console(config)#hash-selection list 1 mac
Console(config-mac-hash-sel)#ethertype
Console#
```

src-mac (MAC Hash)

This command adds the source-mac address hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **src-mac**

Command Mode

MAC hash selection mode

Example

```
Console(config)#hash-selection list 1 mac
Console(config-mac-hash-sel)#src-mac
Console#
```

vlan (MAC Hash)

This command adds the VLAN hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **vlan**

Command Mode

MAC hash selection mode

Example

```
Console(config)#hash-selection list 1 mac
Console(config-mac-hash-sel)#vlan
Console#
```

dst-ip (IPv4 Hash)

This command adds the destination IPv4 address hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **dst-ip**

Command Mode

IPv4 hash selection mode

Example

```
Console(config)#hash-selection list 2 ipv4
Console(config-ipv4-hash-sel)#dst-ip
Console#
```

dst-l4-port (IPv4 Hash)

This command adds the destination Layer 4 protocol port hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **dst-l4-port**

Command Mode

IPv4 hash selection mode

Example

```
Console(config)#hash-selection list 2 ipv4
Console(config-ipv4-hash-sel)#dst-l4-port
Console#
```

protocol-id (IPv4 Hash)

This command adds the protocol ID hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **protocol-id**

Command Mode

IPv4 hash selection mode

Example

```
Console(config)#hash-selection list 2 ipv4
Console(config-ipv4-hash-sel)#protocol-id
Console#
```

src-ip (IPv4 Hash)

This command adds the source IPv4 address hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **src-ip**

Command Mode

IPv4 hash selection mode

Example

```
Console(config)#hash-selection list 2 ipv4
Console(config-ipv4-hash-sel)#src-ip
Console#
```

src-l4-port (IPv4 Hash)

This command adds the source Layer 4 protocol port hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **src-l4-port**

Command Mode

IPv4 hash selection mode

Example

```
Console(config)#hash-selection list 2 ipv4
Console(config-ipv4-hash-sel)#src-l4-port
Console#
```

vlan (IPv4 Hash)

This command adds the VLAN hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **vlan**

Command Mode

IPv4 hash selection mode

Example

```
Console(config)#hash-selection list 2 ipv4
Console(config-ipv4-hash-sel)#vlan
Console#
```

collapsed-dst-ip (IPv6 Hash)

This command adds the collapsed destination IPv6 address hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **collapsed-dst-ip**

Command Mode

IPv6 hash selection mode

Command Usage

An example of an IPv6 address in full form and collapsed form is shown below.

Full IPv6 Address: FE80:0000:0000:0000:0202:B3FF:FE1E:8329

Collapsed IPv6 Address: FE80::0202:B3FF:FE1E:8329

Example

```
Console(config)#hash-selection list 3 ipv6
Console(config-ipv6-hash-sel)#collapsed-dst-ip
Console#
```

collapsed-src-ip (IPv6 Hash)

This command adds the collapsed source IPv6 address hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **collapsed-src-ip**

Command Mode

IPv6 hash selection mode

Command Usage

An example of an IPv6 address in full form and collapsed form is shown below.

Full IPv6 Address: FE80:0000:0000:0000:0202:B3FF:FE1E:8329

Collapsed IPv6 Address: FE80::0202:B3FF:FE1E:8329

Example

```
Console(config)#hash-selection list 3 ipv6
Console(config-ipv6-hash-sel)#collapsed-src-ip
Console#
```

dst-l4-port (IPv6 Hash)

This command adds the destination Layer 4 protocol port hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **dst-l4-port**

Command Mode

IPv6 hash selection mode

Example

```
Console(config)#hash-selection list 3 ipv6
Console(config-ipv4-hash-sel)#dst-l4-port
Console#
```

next-header (IPv6 Hash)

This command adds the next header hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **next-header**

Command Mode

IPv6 hash selection mode

Command Usage

The next header identifies the type of header immediately following the IPv6 header.

Example

```
Console(config)#hash-selection list 3 ipv6
Console(config-ipv4-hash-sel)#next-header
Console#
```

src-l4-port (IPv6 Hash)

This command adds the source Layer 4 protocol port hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **src-l4-port**

Command Mode

IPv6 hash selection mode

Example

```
Console(config)#hash-selection list 3 ipv6
Console(config-ipv4-hash-sel)#src-l4-port
Console#
```

vlan (IPv6 Hash)

This command adds the VLAN hash attribute to the hash selection list. Use the **no** form to remove the specified attribute.

Syntax

[**no**] **vlan**

Command Mode

IPv6 hash selection mode

Example

```
Console(config)#hash-selection list 3 ipv6
Console(config-ipv4-hash-sel)#vlan
Console#
```

show ecmp load-balance

This command shows the load-balance method used when there are multiple equal-cost paths to the same destination.

Command Mode

Privileged Exec

Example

The default setting is shown in the following example.

```
Console#show ecmp load-balance
 ECMP Load Balance Mode : Destination IP Address And L4 Port
Console#
```

show hash-selection list

This command shows the packet type and hash list parameters.

Syntax

show hash-selection list [*index*]

index – Specifies the hash selection list to use for load balancing. (Range: 1-4)

Command Mode

Privileged Exec

Command Usage

Field Selection attributes must all be matched for load balancing to be applied.

Example

```
Console#show hash-selection list 1
Hash-selection list 1
  Packet type : MAC
    Field selection : dst-mac  src-mac  ether-type  vlan-id
Console#
```

IPv6 Commands

ipv6 route

This command configures static IPv6 routes. Use the **no** form to remove static routes.

Syntax

ipv6 route *destination-ipv6-address/prefix-length* {*gateway-address* [*distance*] | *link-local-address***%***zone-id* [*distance*]}

no ipv6 route *destination-ipv6-address/prefix-length* {*gateway-address* | *link-local-address***%***zone-id*}

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 1K static routes can be configured.
- Up to eight equal-cost multipaths (ECMP) can be configured for static routing using the maximum-paths command.
- 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.

- Static routes are included in RIP, OSPF and BGP updates periodically sent by the router if this feature is enabled by the RIP, OSPF or BGP redistribute command (see page 826, 847, 889 or 940 respectively).

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)#
```

Related Commands

show ip route summary (807)

show ipv6 route

This command displays information in the Forwarding Information Base (FIB).

Syntax

show ipv6 route [*ipv6-address*[/*prefix-length*] | **bgp** | **database** | **interface vlan** *vlan-id*] | **local** | **ospf** | **rip** | **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).

bgp – Displays external routes imported from the Border Gateway Protocol (BGP) into this routing domain.

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.

ospf – Displays external routes imported from the Open Shortest Path First (OSPF) protocol into this routing domain.

rip – Displays all entries learned through the Routing Information Protocol (RIP).

static – Displays all static entries.

vlan-id - VLAN ID. (Range: 1-4094)

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: 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
?    FE80::/64, VLAN1 inactive
C    FE80::/64, VLAN1
?    FF00::/8, VLAN1 inactive
O IA 3FFF:1::/32 [110/3]
      via FE80::204:FF:FE05:6, VLAN1

Console#
```

Routing Information Protocol (RIP)

Table 166: 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
maximum-prefix	Sets the maximum number of RIP routes allowed	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
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 receive-packet	Configures the interface to receive of RIP packets	IC
ip rip send version	Sets the RIP send version to use on a network interface	IC
ip rip send-packet	Configures the interface to send RIP packets	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)#
```

Related Commands

network (825)

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)#
```

Related Commands

ip route (803)
redistribute (826)

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)#
```

Related Commands

redistribute (826)

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 network-address netmask*

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)

network-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.

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 2 192.168.3.0 255.255.255.0
Console(config-router)#
```

maximum-prefix

This command sets the maximum number of RIP routes allowed by the system. Use the **no** form to restore the default setting.

Syntax

maximum-prefix *maximum-routes*

no maximum-prefix

maximum-routes - The maximum number of RIP routes which can be installed in the routing table. (Range: 1-7168)

Default Setting

1024

Command Mode

Router Configuration

Command Usage

All the learned RIP routes may not be copied to the hardware tables in ASIC for fast data forwarding because of hardware resource limitations.

Example

```
Console(config-router)#maximum-prefix 1024
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)#
```

Related Commands

passive-interface (826)

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)#
```

Related Commands

router rip (820)

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)#
```

Related Commands

neighbor (824)

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)#
```

Related Commands

default-metric (822)

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)#
```

Related Commands

ip rip receive version (831)
ip rip send version (833)

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)#
```

Related Commands

ip rip authentication string (831)

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)#
```

Related Commands

ip rip authentication mode (830)

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**}

no ip rip receive version

1 - Accepts only RIPv1 packets.

2 - Accepts only RIPv2 packets.

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)#
```

Related Commands

version (829)

ip rip receive-packet

This command configures the interface to receive RIP packets. Use the **no** form to disable this feature.

Syntax

[**no**] **ip rip receive-packet**

Default Setting

Enabled

Command Mode

Interface Configuration (VLAN)

Default Setting

Enabled

Command Usage

Use the **no** form of this command if it is not required to add any dynamic entries to the routing table for an interface. For example, when only static routes are to be allowed for a specific interface.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip rip receive-packet
Console(config-if)#
```

Related Commands

ip rip send-packet (834)

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**}

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.

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)#
```

Related Commands

version (829)

ip rip send-packet

This command configures the interface to send RIP packets. Use the **no** form to disable this feature.

[**no**] **ip rip send-packet**

Default Setting

Enabled

Command Mode

Interface Configuration (VLAN)

Default Setting

Enabled

Command Usage

The **no** form of this command allows the router to passively monitor route information advertised by other routers attached to the network, without transmitting any RIP updates.

Example

```
Console(config)#interface vlan 1
Console(config-if)#ip rip send-packet
Console(config-if)#
```

Related Commands

ip rip receive-packet (832)

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 {*ip-address netmask* | **all** | **connected** | **ospf** | **rip** | **static**}

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.

all - Deletes all entries from the routing table.

connected - Deletes all currently connected entries.

ospf - Deletes all entries learned through the Open Shortest Path First routing protocol.

rip - Deletes all entries learned through the Routing Information Protocol.

static - Deletes all static entries.

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. To delete the RIP routes learned from neighbors and also keep the RIP network intact, use the “rip” parameter with this command (**clear ip rip route rip**).

Example

This example clears one specific route.

```
Console#clear ip rip route 192.168.1.0 255.255.255.0
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 +/-5 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 by interface set,receive version by
  interface set
    Interface  Send         Recv
    VLAN1      1-compatible 1 2
  Routing for Networks:
    10.0.0.0/24
  Routing Information Sources:
    Gateway         Distance  Last Update  Bad Packets  Bad Routes
    10.0.0.2            120    00:00:13         0           0
  The maximum number of RIP routes allowed: 7872
  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, Rc - RIP connected, Rs - RIP static,
       C - Connected, S - Static, O - OSPF

   Network            Next Hop        Metric From            Interface Time
Rc 192.168.0.0/24                     1                      VLAN1    01:57
Console#show ip rip interface vlan 1
Interface: vlan1
  Routing Protocol: RIP
    Receive RIPv1 and RIPv2 packets
    Send RIPv1 Compatible
    Passive interface: Disabled
    Authentication mode: (None)
    Authentication string: (None)
    Split horizon: Enabled with Poisoned Reverse
    IP interface address: 192.168.0.2/24
Console#
```

Open Shortest Path First (OSPFv2)

Table 167: 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
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 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
network area	Assigns specified interface to an area	RC
Interface Configuration		
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

Table 167: Open Shortest Path First Commands (Continued)

Command	Function	Mode
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
passive-interface	Suppresses OSPF routing traffic on the specified interface	RC
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
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
show ip ospf virtual-links	Displays parameters and the adjacency state of virtual links	PE
show ip protocols ospf	Displays OSPF process parameters	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)#
```

Related Commands

network area (856)

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 803.)

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)#
```

Related Commands

ip route (803)
redistribute (889)

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)#
```

Related Commands

router ospf (839)

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*

no timers spf

spf-delay - The delay after receiving a topology change notification and starting the SPF calculation. (Range: 0-2147483647 seconds)

spf-holdtime - Minimum time between two consecutive SPF calculations. (Range: 0-2147483647 seconds)

Command Mode

Router Configuration

Default Setting

SPF delay: 5 seconds
SPF holdtime: 10 seconds

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
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)#
```

Related Commands

area stub (853)
area nssa (851)

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)#
```

Related Commands

ip ospf cost (860)

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)#
```

Related Commands

redistribute (847)

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 {**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 - 10
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 BGP domain 1 (identified by tag 1) and ASBR B can redistribute routes learned from BGP domain 2 (identified by tag 2).

Example

This example redistributes routes learned from BGP as Type 1 external routes.

```
Console(config-router)#redistribute bgp metric-type 1
Console(config-router)#
```

Related Commands

default-information originate (841)

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)#
```

Related Commands

area range (887)
redistribute (889)

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)#
```

Related Commands

ip ospf authentication-key (859)
ip ospf message-digest-key (862)

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-redistribution**] | [**no-summary**] | [**default-information-originate**
[**metric** *metric-value* | **metric-type** *type-value*]]

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-redistribution - Use this keyword when the router is an NSSA Area Border Router (ABR) and you want the redistribute command to import routes only into normal areas, and not into the NSSA. In other words, this keyword prevents the NSSA ABR from advertising external routing information (learned via routers in other areas) into the NSSA.

no-summary - Allows an area to retain standard NSSA features, but does not inject inter-area routes into this area.

default-information-originate - When the router is an NSSA Area Border Router (ABR) or an NSSA Autonomous System Boundary Router (ASBR), this parameter causes it to generate Type-7 default LSA into the NSSA. This default provides a route to other areas within the AS for an NSSA ABR, or to areas outside the AS for an NSSA ASBR.

metric-value - Metric assigned to Type-7 default LSAs.
(Range: 1-16777214: Default: 1)

type-value

1 - Type 1 external route

2 - Type 2 external route (default) - Routers do not add internal cost to the external route metric.

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.

- An NSSA is similar to a stub, because when the router is an ABR, it can send a default route for other areas in the AS into the NSSA using the **default-information-originate** keyword. However, an NSSA is different from a stub, because when the router is an ASBR, it can import a default external AS route (for routing protocol domains adjacent to the NSSA but not within the OSPF AS) into the NSSA using the **default-information-originate** keyword.

- 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 10.3.0.0 nssa default-information-originate
Console(config-router)#network 10.3.0.0 255.255.0.0 area 10.2.0.0
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)#
```

Related Commands

area default-cost (844)

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)#
```

Related Commands

show ip protocols ospf (879)

network area

This command defines an OSPF area and the interfaces that operate within this area. Use the **no** form to disable OSPF for a specified interface.

Syntax

[**no**] **network** *ip-address netmask* **area** *area-id*

ip-address - Address of the interfaces to add to the area.

netmask - Network mask of the address range to add to the area.

area-id - Area to which the specified address or range is assigned. 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

Router Configuration

Default Setting

Disabled

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 using the network mask to add one or more interfaces to an area.

- If an address range is overlapped in subsequent network area commands, the router will use the network area with the address range that most closely matches the interface address. Also, note that if a more specific address range is removed from an area, the interface belonging to that range may still remain active if a less specific address range covering that area has been specified.

Example

This example creates the backbone 0.0.0.0 covering class B addresses 10.1.x.x, and a normal transit area 10.2.9.0 covering the class C addresses 10.2.9.x.

```
Console(config-router)#network 10.1.0.0 255.255.0.0 area 0.0.0.0
Console(config-router)#network 10.2.9.0 255.255.255.0 area 10.1.0.0
Console(config-router)#
```

Interface Configuration

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 [*ip-address*] **authentication** [**message-digest** | **null**]

no ip ospf [*ip-address*] **authentication**

ip-address - IP address of the interface. Enter this parameter to specify a unique authentication type for a primary or secondary IP address associated with the current VLAN. If not specified, the command applies to all networks connected to the current interface.

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)#
```

Related Commands

ip ospf authentication-key (859)
ip ospf message-digest-key (862)

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 [*ip-address*] **authentication-key** *key*

no ip ospf [*ip-address*] **authentication-key**

ip-address - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

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)#
```

Related Commands

ip ospf authentication (857)

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 [*ip-address*] **cost** *cost*

no ip ospf [*ip-address*] **cost**

ip-address - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

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 [*ip-address*] **dead-interval** *seconds*

no ip ospf [*ip-address*] **dead-interval**

ip-address - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

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)#
```

Related Commands

ip ospf hello-interval (861)

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 [ip-address] **hello-interval** *seconds*

no ip ospf [*ip-address*] **hello-interval**

ip-address - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

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 [*ip-address*] **message-digest-key** *key-id* **md5** *key*

no ip ospf [*ip-address*] **message-digest-key** *key-id*

ip-address - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

key-id - Index number of an MD5 key. (Range: 0-255)

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)#
```

Related Commands

ip ospf authentication (857)

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 [*ip-address*] **priority** *priority*

no ip ospf [*ip-address*] **priority**

ip-address - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

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 [*ip-address*] **retransmit-interval** *seconds*

no ip ospf [*ip-address*] **retransmit-interval**

ip-address - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

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 [*ip-address*] **transmit-delay** *seconds*

no ip ospf [*ip-address*] **transmit-delay**

ip-address - This parameter can be used to indicate a specific IP address connected to the current interface. If not specified, the command applies to all networks connected to the current interface.

seconds - Sets the estimated time required to send a link-state update. (Range: 1-65535)

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)#
```

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* [*ip-address*]

vlan-id - VLAN ID. (Range: 1-4094)

ip-address - An IPv4 address configured on this interface.

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)#
```

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
 Routing Process "ospf 1" with ID 192.168.1.3
 Process uptime is 20 minutes
 Conforms to RFC2328, and RFC1583Compatibility flag is disabled
 Supports only single TOS(TOS0) routes
 SPF schedule delay 5 secs, Hold time between two SPFs 10 secs
 Refresh timer 10 secs
 Number of incoming current DD exchange neighbors 0/5
 Number of outgoing current DD exchange neighbors 0/5
 Number of external LSA 0. Checksum 0x000000
 Number of opaque AS LSA 0. Checksum 0x000000
 LSDB database overflow limit is 20480
 Number of LSA originated 1
 Number of LSA received 0
 Number of areas attached to this router: 1

    Area 192.168.1.3
        Number of interfaces in this area is 1(1)
        Number of fully adjacent neighbors in this area is 0
        Area has no authentication
        SPF algorithm last executed 00:00:08.739 ago
        SPF algorithm executed 1 times
        Number of LSA 1. Checksum 0x007f09
Console#
```

Table 168: show ip ospf - display description

Field	Description
Routing Process with ID	OSPF process ID and router ID. The router ID uniquely identifies the router in the autonomous system. By convention, this is normally set to one of the router's IP interface addresses.
Process uptime	The time this process has been running
Conforms to RFC2328	Shows that this router is compliant with OSPF Version 2.
RFC1583 Compatibility flag	Shows whether or not compatibility with the RFC 1583 (an earlier version of OSPFv2) is enabled.
Supports only single TOS (TOS0) routes	Optional Type of Service (ToS) specified in OSPF Version 2, Appendix F.1.2 is not supported, so only one cost per interface can be assigned.
SPF schedule delay	Delay between receiving a change to SPF calculation.
Hold time	Sets the hold time between two consecutive SPF calculations.
Refresh timer	The time between refreshing the LSA database.
Number of current DD exchange neighbors	Number of neighbors currently exchanging database descriptor packets.
Number of external LSA	The number of external link-state advertisements (Type 5 LSAs) in the link-state database. These LSAs advertise information about routes outside of the autonomous system.
Checksum	The sum of the LS checksums of the external link-state advertisements contained in the link-state database.
Number of opaque AS LSA	Number of opaque link-state advertisements (Type 9, 10 and 11 LSAs) in the link-state database. These LSAs advertise information about external applications, and are only used by OSPF for the graceful restart process.
Checksum	The sum of the LS checksums of opaque link-state advertisements contained in the link-state database.
LSDB database overflow limit	The maximum number of LSAs allowed in the external database.

Table 168: show ip ospf - display description (Continued)

Field	Description
Number of LSA originated	The number of new link-state advertisements that have been originated.
Number of LSA received	The number of link-state advertisements that have been received.
Number of areas attached to this router	The number of configured areas attached to this router.
Number of interfaces in this area is	The number of interfaces attached to this area
Number of fully adjacent neighbors in this area is	The number of neighbors for which the exchange of recognition protocol messages has been completed and are now fully adjacent
Area has (no) authentication	Shows whether or not the authentication has been enabled
SPF algorithm last executed	The last time the shortest path first algorithm was executed
SPF algorithm executed x times	The number of times the shortest path first algorithm has been executed for this area
Number of LSA	The number of new link-state advertisements that have been originated.
Checksum	The sum of the link-state advertisements' LS checksums contained in this area's link-state database.

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 process 1 internal Routing Table

Codes: i - Intra-area route, I - Inter-area route

i 192.168.0.3 [1] via 192.168.0.3, vlan1, ABR, ASBR, Area 0.0.0.0
Console#
```

show ip ospf database

This command shows information about different OSPF Link State Advertisements (LSAs) stored in this router's database.

Syntax

show ip ospf [*process-id*] **database**
[**asbr-summary** | **external** | **network** | **nssa-external** | **router** | **summary**]
[**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)

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.

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.

asbr-summary - Shows information about Autonomous System Boundary Router summary LSAs.

external - Shows information about external LSAs.

network - Shows information about network LSAs.

nssa-external - Shows information about NSSA external LSAs.

router - Shows information about router LSAs.

summary - Shows information about summary LSAs.

Command Mode

Privileged Exec

Examples

The following shows output for the **show ip ospf database** command.

```
Console#show ip ospf database

            OSPF Router with ID (192.168.0.2) (Process ID 1)

                Router Link States (Area 0.0.0.0)

Link ID         ADV Router      Age  Seq#       CkSum  Link count
192.168.0.2     192.168.0.2      225 0x80000004 0xdac5 1
192.168.0.3     192.168.0.3      220 0x80000004 0xd8c4 1
```

```
                Net Link States (Area 0.0.0.0)

Link ID         ADV Router      Age  Seq#       CkSum
192.168.0.2     192.168.0.2      225 0x80000001 0x9c0f

                AS External Link States

Link ID         ADV Router      Age  Seq#       CkSum  Route              Tag
0.0.0.0         192.168.0.2      487 0x80000001 0xd491 E2 0.0.0.0/0 0
0.0.0.0         192.168.0.3      222 0x80000001 0xce96 E2 0.0.0.0/0 0

Console#
```

Table 169: show ip ospf database - display description

Field	Description
OSPF Router Process with ID	OSPF process ID and router ID. The router ID uniquely identifies the router in the autonomous system. By convention, this is normally set to one of the router's IP interface addresses.
Link ID	Either a Router ID or an IP Address; it identifies the piece of the routing domain that is being described by the advertisement
ADV Router	Advertising router ID
Age	Age of LSA (in seconds)
Seq#	Sequence number of LSA (used to detect older duplicate LSAs)
CkSum	Checksum of the complete contents of the LSA
Link count	Number of interfaces attached to the router
Route	Type 1 or Type 2 external metric (see the redistribute command) and route
Tag	Optional tag if defined (see the redistribute command)

The following shows output when using the **asbr-summary** keyword.

```
Console#show ip ospf database asbr-summary

            OSPF Router with ID (0.0.0.0) (Process ID 1)

                ASBR-Summary Link States (Area 0.0.0.1)

  LS Age: 0
  Options: 0x2 (*|-|-|-|-|-|E|-)
  LS Type: ASBR-summary-LSA
  Link State ID: 2.1.0.0 (AS Boundary Router address)
  Advertising Router: 192.168.2.1
  LS Seq Number: 80000001
  Checksum: 0x7b67
  Length: 28
  Network Mask: /0
        TOS: 0  Metric: 10

Console#
```

Table 170: show ip ospf database summary - display description

Field	Description
OSPF Router ID	Router ID
LS Age	Age of LSA (in seconds)
Options	Optional capabilities associated with the LSA
LS Type	Summary Links - LSA describes routes to AS boundary routers
Link State ID	Interface address of the autonomous system boundary router
Advertising Router	Advertising router ID
LS Sequence Number	Sequence number of LSA (used to detect older duplicate LSAs)
Checksum	Checksum of the complete contents of the LSA
Length	The length of the LSA in bytes
Network Mask	Address mask for the network
TOS	Type of Service – This router only supports TOS 0 (or normal service)
Metric	Cost of the link

The following shows output when using the **external** keyword.

```
Console#show ip ospf database external
OSPF Router process 100 with ID (10.10.11.50)
AS External Link States LS age: 298
Options: 0x2 (*|-|-|-|-|-|E|-)
LS Type: AS-external-LSA
Link State ID: 10.10.100.0 (External Network Number)
Advertising Router: 10.10.11.50
LS Seq Number: 80000001
Checksum: 0x7033
Length: 36
Network Mask: /24
Metric Type: 2 (Larger than any link state path)
TOS: 0
Metric: 20
Forward Address: 10.10.11.50
External Route Tag: 0


            OSPF Router with ID (0.0.0.0) (Process ID 1)

                AS External Link States

  LS Age: 0
  Options: 0x2 (*|-|-|-|-|-|E|-)
  LS Type: AS-external-LSA
  Link State ID: 0.0.0.0 (External Network Number)
  Advertising Router: 192.168.0.2
  LS Seq Number: 80000005
  Checksum: 0xcc95
  Length: 36
  Network Mask: /0
        Metric Type: 2 (Larger than any link state path)
        TOS: 0
        Metric: 1
        Forward Address: 0.0.0.0
        External Route Tag: 0

Console#
```

Table 171: show ip ospf database external - display description

Field	Description
OSPF Router ID	Router ID
LS Age	Age of LSA (in seconds)
Options	Optional capabilities associated with the LSA
LS Type	AS External Links - LSA describes routes to destinations outside the AS (including default external routes for the AS)
Link State ID	IP network number (External Network Number)
Advertising Router	Advertising router ID
LS Sequence Number	Sequence number of LSA (used to detect older duplicate LSAs)
Checksum	Checksum of the complete contents of the LSA
Length	The length of the LSA in bytes
Network Mask	Address mask for the network
Metric Type	Type 1 or Type 2 external metric (see the redistribute command)
TOS	Type of Service – This router only supports TOS 0 (or normal service)
Metric	Cost of the link
Forward Address	Next hop address. If this field is set to 0.0.0.0, data is forwarded to the originator of the advertisement.
External Route Tag	Optional tag if defined (see the redistribute command)

The following shows output when using the **network** keyword.

```
Console#show ip ospf database network

            OSPF Router with ID (0.0.0.0) (Process ID 1)

                Net Link States (Area 0.0.0.0)

  LS Age: 0
  Options: 0x2 (*|-|-|-|-|-|E|-)
  LS Type: network-LSA
  Link State ID: 192.168.0.2 (address of Designated Router)
  Advertising Router: 192.168.0.2
  LS Seq Number: 80000005
  Checksum: 0x9413
  Length: 32
  Network Mask: /24
        Attached Router: 192.168.0.2
        Attached Router: 192.168.0.3
```

```
.
.
.
```

Table 172: show ip ospf database network - display description

Field	Description
OSPF Router ID	Router ID
LS Age	Age of LSA (in seconds)
Options	Optional capabilities associated with the LSA
LS Type	Network Link - LSA describes the routers attached to the network
Link State ID	Interface address of the designated router
Advertising Router	Advertising router ID
LS Sequence Number	Sequence number of LSA (used to detect older duplicate LSAs)
Checksum	Checksum of the complete contents of the LSA
Length	The length of the LSA in bytes
Network Mask	Address mask for the network
Attached Router	List of routers attached to the network; i.e., fully adjacent to the designated router, including the designated router itself

The following shows output when using the **router** keyword.

```
Console#show ip ospf database router

            OSPF Router with ID (0.0.0.0) (Process ID 1)

                Router Link States (Area 0.0.0.0)

  LS Age: 0
  Options: 0x2 (*|-|-|-|-|-|E|-)
  Flags: 0x2 : ASBR
  LS Type: router-LSA
  Link State ID: 192.168.0.2
  Advertising Router: 192.168.0.2
  LS Seq Number: 80000008
  Checksum: 0xd2c9
  Length: 36
    Link connected to: a Transit Network
     (Link ID) Designated Router address: 192.168.0.2
     (Link Data) Router Interface address: 192.168.0.2
      Number of TOS metrics: 0
      TOS 0 Metric: 1
.
.
.
```

Table 173: show ip ospf database router - display description

Field	Description
OSPF Router ID	Router ID
LS Age	Age of LSA (in seconds)
Options	Optional capabilities associated with the LSA
Flags	Indicate if this router is a virtual link endpoint, an ASBR, or an ABR
LS Type	Router Link - LSA describes the router's interfaces.
Link State ID	Router ID of the router that originated the LSA
Advertising Router	Advertising router ID
LS Sequence Number	Sequence number of LSA (used to detect older duplicate LSAs)
Checksum	Checksum of the complete contents of the LSA
Length	The length of the LSA in bytes
Link connected to	Link-state type, including transit network, stub network, or virtual link
Link ID	Link type and corresponding Router ID or network address
Link Data	◆ Router ID for transit network ◆ Network's IP address mask for stub network ◆ Neighbor Router ID for virtual link
Number of TOS metrics	Type of Service metric – This router only supports TOS 0 (or normal service)
TOS	Type of Service – This router only supports TOS 0 (or normal service)
Metric	Cost of the link

The following shows output when using the **summary** keyword.

```
Console#show ip ospf database summary

            OSPF Router with ID (0.0.0.0) (Process ID 1)

                Summary Link States (Area 0.0.0.0)

  LS Age: 1
  Options: 0x0 (*|-|-|-|-|-|-|-)
  LS Type: summary-LSA
  Link State ID: 192.168.10.0 (summary Network Number)
  Advertising Router: 2.1.0.0
  LS Seq Number: 80000005
  Checksum: 0x479d
  Length: 28
  Network Mask: /24
        TOS: 0  Metric: 0
⋮
```

Table 174: show ip ospf database summary - display description

Field	Description
OSPF Router ID	Router ID
LS Age	Age of LSA (in seconds)
Options	Optional capabilities associated with the LSA
LS Type	Summary Links - LSA describes routes to networks
Link State ID	Router ID of the router that originated the LSA
Advertising Router	Advertising router ID
LS Sequence Number	Sequence number of LSA (used to detect older duplicate LSAs)
Checksum	Checksum of the complete contents of the LSA
Length	The length of the LSA in bytes
Network Mask	Destination network's IP address mask
Metrics	Cost of the link

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 vlan 1
VLAN1 is up, line protocol is up
  Internet Address 192.168.0.2/24, Area 0.0.0.0, MTU 1500
  Process ID 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 192.168.0.2
  Backup Designated Router (ID) 192.168.0.3, Interface Address 192.168.0.3
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
  Hello due in 00:00:10
  Neighbor Count is 1, Adjacent neighbor count is 1
  Hello received 920 sent 975, DD received 5 sent 4
  LS-Req received 1 sent 1, LS-Upd received 14 sent 18
  LS-Ack received 17 sent 13, Discarded 0
Console#
```

Table 175: show ip ospf interface - display description

Field	Description
VLAN	VLAN ID and Status of physical link
Internet Address	IP address of OSPF interface
Area	OSPF area to which this interface belongs
MTU	Maximum transfer unit
Process ID	OSPF process ID
Router ID	Router ID
Network Type	Includes broadcast, non-broadcast, or point-to-point networks
Cost	Interface transmit cost
Transmit Delay	Interface transmit delay (in seconds)
State	◆ Disabled – OSPF not enabled on this interface ◆ Down – OSPF is enabled on this interface, but interface is down ◆ Loopback – This is a loopback interface ◆ Waiting – Router is trying to find the DR and BDR ◆ DR – Designated Router ◆ BDR – Backup Designated Router ◆ DRother – Interface is on a multiaccess network, but is not the DR or BDR
Priority	Router priority
Designated Router	Designated router ID and respective interface address
Backup Designated Router	Backup designated router ID and respective interface address
Timer intervals	Configuration settings for timer intervals, including Hello, Dead and Retransmit
Neighbor Count	Count of network neighbors and adjacent neighbors
Adjacent neighbor count	Count of adjacent neighbors
Hello	Number of Hello LSAs received and sent
DD	Number of Database Descriptor packets received and sent.
LS-Req	Number of LSA requests
LS-Upd	Number of LSA updates
LS-Ack	Number of LSA acknowledgements
Discarded	Number of LSAs discarded

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

      ID          Pri        State           Address      Interface
--------------- ------ ---------------- --------------- --------------
    192.168.0.3      1         FULL/BDR    192.168.0.3           VLAN1
Console#
```

Table 176: show ip ospf neighbor - display description

Field	Description
Neighbor ID	Neighbor's router ID
Pri	Neighbor's router priority
State	OSPF state and identification flag States include: Down – Connection down Attempt – Connection down, but attempting contact (for non-broadcast networks) Init – Have received Hello packet, but communications not yet established Two-way – Bidirectional communications established ExStart – Initializing adjacency between neighbors Exchange – Database descriptions being exchanged Loading – LSA databases being exchanged Full – Neighboring routers now fully adjacent Identification flags include: D – Dynamic neighbor S – Static neighbor DR – Designated router BDR – Backup designated router
Address	IP address of this interface
Interface	The interface to which this neighbor is attached

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 process 1:
Codes: C - connected, D - Discard, 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
O  10.10.0.0/24 [10] is directly connected, fe1/1, Area 0.0.0.0
O  10.10.11.0/24 [10] is directly connected, fe1/2, Area 0.0.0.0
O  10.10.11.100/32 [10] is directly connected, lo, Area 0.0.0.0
E2 10.15.0.0/24 [10/50] via 10.10.0.1, VLAN1
IA 172.16.10.0/24 [30] via 10.10.11.50, VLAN2, Area 0.0.0.0
E2 192.168.0.0/16 [10/20] via 10.10.11.50, VLAN2

Console#
```

show ip ospf virtual-links

This command displays detailed information about virtual links.

Syntax

show ip ospf virtual-links

Command Mode

Privileged Exec

Example

```
Console#show ip ospf virtual-links
Virtual Link VLINK1 to router 192.168.0.2 is up
  Transit area 0.0.0.1 via interface VLAN1
  Local address 192.168.0.3
  Remote address 192.168.0.2
  Transmit Delay is 1 sec, State Point-To-Point,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:08
    Adjacency state Down
Console#
```

Table 177: show ip ospf virtual-links - display description

Field	Description
Virtual Link to router	OSPF neighbor and link state (up or down)
Transit area	Common area the virtual link crosses to reach the target router
Local address	The IP address of ABR that serves as an endpoint connecting the isolated area to the common transit area.
Remote address	The IP address this virtual neighbor is using. The neighbor must be an ABR at the other endpoint connecting the common transit area to the backbone itself.
Transmit Delay	Estimated transmit delay (in seconds) on the virtual link
Timer intervals	Configuration settings for timer intervals, including Hello, Dead and Retransmit

Related Commands

area virtual-link (854)

show ip protocols ospf

This command displays OSPF process parameters.

Syntax

show ip protocols ospf

Command Mode

Privileged Exec

Example

```
Console#show ip protocols ospf
Routing Protocol is "ospf 200"
Redistributing: bgp
Routing for Networks:
192.30.30.0/24
192.40.40.0/24
  Routing for Summary Address:
    192.168.1.0/24
    192.168.3.0/24
Distance: (default is 110)
Console#
```

Table 178: show ip protocols ospf - display description

Field	Description
Routing Protocol	Name and autonomous system number of this OSPF process.
Redistributing	Shows if route redistribution has been enabled with the redistribute command.
Routing for Networks	Networks for which the OSPF is currently registering routing information.

Table 178: show ip protocols ospf - display description (Continued)

Field	Description
Routing for Summary Address	Shows the networks for which route summarization is in effect
Distance	The administrative distance used for external routes learned by OSPF (see the ip route command).

Open Shortest Path First (OSPFv3)

Table 179: Open Shortest Path First Commands (Version 3)

Command	Function	Mode
General Configuration		
router ipv6 ospf	Enables or disables OSPFv3 routing process	GC
abr-type	Sets the criteria used to determine if this router can declare itself an ABR and issue Type 3 and Type 4 summary LSAs	RC
max-current-dd	Sets the maximum number of neighbors with which the switch can concurrently exchange database descriptor packets	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
Route Metrics and Summaries		
area default-cost	Sets the cost for a default summary route sent into a stub	RC
area range	Summarizes routes advertised by an ABR	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
Area Configuration		
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
ipv6 router ospf area	Binds an area to the selected interface	IC
ipv6 router ospf tag area	Binds an area to the selected interface and process	IC
Interface Configuration		
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
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

Table 179: Open Shortest Path First Commands (Version 3) (Continued)

Command	Function	Mode
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
passive-interface	Suppresses OSPF routing traffic on the specified interface	RC
Display Information		
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 interface	Displays interface information	PE
show ipv6 ospf neighbor	Displays neighbor information	PE
show ipv6 ospf route	Displays the OSPF routing table	PE
show ipv6 ospf virtual-links	Displays parameters and the adjacency state of virtual links	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.

4. Use the ipv6 router ospf area command or the ipv6 router ospf tag area command to assign an area to each interface that will participate in the specified OSPF process.

General Configuration

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

[**no**] **router ipv6 ospf** [**tag** *process-name*]

process-name - A process name must be entered when configuring multiple routing instances. (Range: Alphanumeric string up to 16 characters)

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.

- The *process-name* is only used on the local router to distinguish between different routing processes. It should not be confused with the *instance-id* configured with the ipv6 router ospf area command which is used to distinguish between different routing processes running on the same link-local network segment.

Example

```
Console(config)#router ipv6 ospf tag 0
Console(config-router)#end
Console#show ipv6 ospf
 Routing Process "ospf r&d" with ID 192.168.0.2
 Process uptime is 1 hour 34 minutes
 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: 1

    Area 0.0.0.0 (BACKBONE)
        SPF algorithm executed 1 times
        Number of LSA 2. Checksum 0x00ab4f

Console#
```

Related Commands

ipv6 router ospf area (893)

abr-type

This command sets the criteria used to determine if this router can declare itself an ABR and issue Type 3 and Type 4 summary LSAs. Use the **no** form to restore the default setting.

Syntax

abr-type {**cisco** | **ibm** | **standard**}

no abr-type

cisco - ABR criteria and functional behavior is based on RFC 3509.

ibm - ABR criteria and functional behavior is briefly described in RFC 3509, and fully documented in IBM Nways Multiprotocol Routing Services (MRS) 3.3.

standard - ABR criteria and functional behavior is based on RFC 2328.

Command Mode

Router Configuration

Default Setting

cisco

Command Usage

- The basic criteria for a router to serve as an ABR is shown below:
  - Cisco Systems Interpretation: A router is considered to be an ABR if it has more than one area actively attached and one of them is the backbone area.
  - IBM Interpretation: A router is considered to be an ABR if it has more than one actively attached area and the backbone area is configured.
  - Standard Interpretation: A router is considered to be an ABR if it is attached to two or more areas. It does not have to be attached to the backbone area.
- To successfully route traffic to inter-area and AS external destinations, an ABR must be connected to the backbone. If an ABR has no backbone connection, all traffic destined for areas not connected to it or outside the AS will be dropped. This situation is normally resolved, by configuring a virtual link from the ABR to the backbone area.
- In both the Cisco and IBM interpretation, a router connected to more than one area cannot issue a Type 1 router LSA declaring itself as an ABR unless it meets the other criteria listed above.

  Routing table calculations are changed to allow the router to consider summary-LSAs from all attached areas if it is not an ABR, but has more than one attached area, or it does not have an active backbone connection.

  In other words, inter-area routes are calculated by examining summary-LSAs. If the router is an ABR and has an active backbone connection, only backbone summary-LSAs are examined. Otherwise (when either the router is not an ABR or it has no active backbone connection), the router should consider summary-LSAs from all actively attached areas.

This ensures that the summary-LSAs originated by area border routers advertise only intra-area routes into the backbone if the router has an active backbone connection, and advertises both intra-area and inter-area routes into the other areas. Otherwise, the router only advertises intra-area routes into non-backbone areas.

Example

```
Console(config-router)#abr-type ibm
Console(config-router)#
```

max-current-dd

This command sets the maximum number of neighbors with which the switch can concurrently exchange database descriptor (DD) packets. Use the **no** form to restore the default setting.

Syntax

max-current-dd *max-packets*

no max-current-dd

max-packets - The maximum number of neighbors with which the switch can concurrently send or receive DD packets. (Range: 1-65535)

Command Mode

Router Configuration

Default Setting

5

Command Usage

This limit applies separately to the number of neighbors to which DD packets can be concurrently sent, and to the number of neighbors from which DD packets can be concurrently received.

Example

```
Console(config-router)#maximum-current-dd 10
Console(config-router)#
```

Related Commands

show ipv6 ospf (900)

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 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)#
```

Related Commands

router ipv6 ospf (882)

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*

no timers spf

spf-delay - The delay after receiving a topology change notification and starting the SPF calculation. (Range: 0-2147483647 seconds)

spf-holdtime - The minimum time between two consecutive SPF calculations. (Range: 0-2147483647 seconds)

Command Mode

Router Configuration

Default Setting

SPF delay: 5 seconds
SPF holdtime: 10 seconds

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)#
```

Route Metrics and Summaries

area default-cost

This command specifies a cost for the default summary route sent into a stub 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. (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.
(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.

Example

```
Console(config)#router ipv6 ospf tag 1
Console(config-router)#area 1 default-cost 1
Console(config-router)#
```

Related Commands

area stub (853)

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)#
```

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)#
```

Related Commands

redistribute (889)

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** | **rip** | **static**} [**metric** *metric-value*] [**metric-type** *type-value*]

no redistribute {**connected** | **rip** | **staticstatic**} [**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)#
```

Area Configuration

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)#
```

Related Commands

area default-cost (886)

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.vvvv

Syntax

area *area-id* **virtual-link** *router-id*
[**dead-interval** *seconds*] [**hello-interval** *seconds*]
[**retransmit-interval** *seconds*] [**transmit-delay** *seconds*]

no area area-id virtual-link *router-id*
[**dead-interval** | **hello-interval** | **retransmit-interval** | **transmit-delay**]

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: 1-65535 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)

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

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)#area 3 virtual-link 192.168.0.9
Console(config-router)#
```

ipv6 router ospf area

This command binds an OSPF area to the selected interface. Use the **no** form to remove an OSPF area, disable an OSPF process, or remove an instance identifier from an interface.

Syntax

[**no**] **ipv6 router ospf area** *area-id* [**tag** *process-name* | **instance-id** *instance-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.

process-name - A process name must be entered when configuring multiple routing instances. (Range: Alphanumeric string up to 16 characters)

instance-id - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

Command Mode

Interface Configuration

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 *process-name* is only used on the local router to distinguish between different routing processes (and must be configured with the router ipv6 ospf command before using it in the **ipv6 router ospf area** command).
- The *instance-id* is used on the link-local network segment to distinguish between different routing processes running on the same link, and allows routers participating in a common routing process to form adjacencies and exchange routing information.
- 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 tag 0
Console(config-router)#router-id 192.168.0.2
Console(config-router)#exit
Console(config)#interface vlan 1
Console(config-if)#ipv6 router ospf area 0 tag 0 instance-id 0
Console(config-if)#
```

Related Commands

router ipv6 ospf (882)
router-id (885)
ipv6 router ospf tag area (894)

ipv6 router ospf tag area

This command binds an OSPF area to the selected interface and process. Use the **no** form to remove the specified area from an interface.

[**no**] **ipv6 router ospf tag** *process-name* **area** *area-id* [**instance-id** *instance-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.

process-name - A process name used to distinguish between multiple routing instances configured on the local router. (Range: Alphanumeric string up to 16 characters)

instance-id - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

Command Mode

Interface Configuration (VLAN)

Default Setting

No areas are defined.

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 *process-name* is only used on the local router to distinguish between different routing processes (and must be configured with the router ipv6 ospf command before using it in this command.

- The *instance-id* is used on the link-local network segment to distinguish between different routing processes running on the same link, and allows routers participating in a common routing process to form adjacencies and exchange routing information.

- The backbone (area 0.0.0.0) must be created before any other area.

Example

This example assigns area 0.0.0.1 to the currently selected interface under routing process "1."

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 router ospf tag 1 area 0.0.0.1
Console(config-if)#
```

Related Commands

router ipv6 ospf (882)
router-id (885)
ipv6 router ospf area (893)

Interface Configuration

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* [**instance-id** *instance-id*]

no ipv6 ospf cost [**instance-id** *instance-id*]

cost - Link metric for this interface. Use higher values to indicate slower ports. (Range: 1-65535)

instance-id - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

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 40 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* [**instance-id** *instance-id*]

no ipv6 ospf dead-interval [**instance-id** *instance-id*]

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)

instance-id - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

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)#
```

Related Commands

ipv6 ospf hello-interval (897)

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* [**instance-id** *instance-id*]

no ipv6 ospf hello-interval [**instance-id** *instance-id*]

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)

instance-id - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

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)#
```

Related Commands

ipv6 ospf dead-interval (896)

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-id** *instance-id*]

no ipv6 ospf priority [**instance-id** *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: 0-255)

Command Mode

Interface Configuration (VLAN)

Default Setting

1

Command Usage

- A designated router (DR) and backup designated router (BDR) are elected for each OSPF 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* [**instance-id** *instance-id*]

no ipv6 ospf retransmit-interval [**instance-id** *instance-id*]

seconds - Sets the interval at which LSAs are retransmitted from this interface. (Range: 1-65535)

instance-id - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

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* [**instance-id** *instance-id*]

no ipv6 ospf transmit-delay [**instance-id** *instance-id*]

seconds - Sets the estimated time required to send a link-state update. (Range: 1-65535)

instance-id - Identifies a specific OSPFv3 routing process on the link-local network segment attached to this interface. (Range: 0-255)

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)#
```

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* [*ipv6-address*]

vlan-id - VLAN ID. (Range: 1-4094)

ipv6-address - A full IPv6 address including the network prefix and host address bits.

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 73::9
Console(config-router)#
```

Display Information

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 192.168.0.2
 Process uptime is 24 minutes
 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: 2

    Area 0.0.0.0 (BACKBONE)
        SPF algorithm executed 2 times
        Number of LSA 1. Checksum 0x001aa9
    Area 0.0.0.1
        SPF algorithm executed 2 times
        Number of LSA 1. Checksum 0x001aa9

Console#
```

Table 180: show ip ospf - display description

Field	Description
Routing Process	
Routing Process	OSPF process name and router ID. The router ID uniquely identifies the router in the autonomous system. By convention, this is normally set to one of the router's IP interface addresses.
Process uptime	The time this process has been running
Supports only single TOS (TOS0) routes	Optional Type of Service (ToS) specified in OSPF Version 2, Appendix F.1.2 is not supported, so only one cost per interface can be assigned.
SPF schedule delay	The delay after receiving a topology change notification and starting the SPF calculation.
Hold time	Sets the hold time between two consecutive SPF calculations.
Number of concurrent DD exchange neighbors	Number of neighbors currently exchanging database descriptor packets.
Number of external LSA	The number of external link-state advertisements (Type 5 LSAs) in the link-state database. These LSAs advertise information about routes outside of the autonomous system.
Checksum	The sum of the LS checksums of the external link-state advertisements contained in the link-state database.
Number of opaque AS LSA	Number of opaque link-state advertisements (Type 9, 10 and 11 LSAs) in the link-state database. These LSAs advertise information about external applications, and are only used by OSPF for the graceful restart process.
Checksum	The sum of the LS checksums of opaque link-state advertisements contained in the link-state database.
Number of LSA received	The number of link-state advertisements that have been received.

Table 180: show ip ospf - display description (Continued)

Field	Description
Number of areas attached to this router	The number of configured areas attached to this router.
Area Information	
Area	The area identifier. Note that “(Inactive)” will be displayed if no IPv6 address has been configured on the interface.
SPF algorithm executed x times	The number of times the shortest path first algorithm has been executed for this area
Number of LSA	The total number of link-state advertisements in this area’s link-state database, excluding AS External LSA’s.
Checksum	The sum of the LS checksums of link-state advertisements for this network (area) contained in the link-state database.

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 [**tag** *process-id*] **database**

process-id - The ID of the router process for which information will be displayed. (Range: 1-10)

Command Mode

Privileged Exec

Examples

The following shows output for the **show ip ospf database** command.

```
Console#show ipv6 ospf database

            OSPF Router with ID (192.168.0.2) (TAG: 1)

                Link-LSA
Link State ID   ADV Router       Age  Seq#       CkSum    Link
1001            192.168.0.2        71 0x80000001 0x06b7     0

                Router-LSA (Area 0)
Link State ID   ADV Router       Age  Seq#       CkSum
0               192.168.0.2        31 0x80000002 0x14b1

                AS-external-LSA
Link State ID   ADV Router       Age  Seq#       CkSum
Console#
```

Table 181: show ip ospf database - display description

Field	Description
OSPF Router Process with ID	OSPF router ID and process ID. The router ID uniquely identifies the router in the autonomous system. By convention, this is normally set to one of the router's IP interface addresses.
Link State ID	This field identifies the piece of the routing domain that is being described by the advertisement.
ADV Router	Advertising router ID
Age	Age of LSA (in seconds)
Seq#	Sequence number of LSA (used to detect older duplicate LSAs)
CkSum	Checksum of the complete contents of the LSA
Link	Number of interfaces attached to the router

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#
```

Table 182: show ip ospf interface - display description

Field	Description
VLAN	VLAN ID and Status of physical link
Link local Address	Link local address of OSPF interface
Area	OSPF area to which this interface belongs
Tag	OSPF process identifier string

Table 182: show ip ospf interface - display description (Continued)

Field	Description
Router ID	Identifier for this router
Network Type	Includes broadcast, non-broadcast, or point-to-point networks
Cost	Interface transmit cost
Transmit Delay	Interface transmit delay (in seconds)
State	◆ Backup – Backup Designated Router ◆ Down – OSPF is enabled on this interface, but interface is down ◆ DR – Designated Router ◆ DROther – Interface is on a multiaccess network, but is not the DR or BDR ◆ Loopback – This is a loopback interface ◆ PointToPoint – A direct link between two routers. ◆ Waiting – Router is trying to find the DR and BDR
Priority	Router priority
Designated Router	Designated router ID and respective interface address
Backup Designated Router	Backup designated router ID and respective interface address
Timer intervals	Configuration settings for timer intervals, including Hello, Dead and Retransmit
Neighbor Count	Count of network neighbors and adjacent neighbors
Hello	Number of Hello LSAs received and sent
DD	Number of Database Descriptor packets received and sent
LS-Req	Number of LSA requests
LS-Upd	Number of LSA updates
LS-Ack	Number of LSA acknowledgements
Discarded	Number of LSAs discarded

show ipv6 ospf neighbor

This command displays information about neighboring routers on each interface within an OSPF area.

Syntax

show ipv6 ospf [**tag** *process-id*] **neighbor**

process-id - The ID of the router process for which information will be displayed. (Range: 1-10)

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#
```

Table 183: show ipv6 ospf neighbor - display description

Field	Description
ID	Neighbor's router ID
Pri	Neighbor's router priority
State	OSPF state and identification flag States include: Down – Connection down Attempt – Connection down, but attempting contact (for non-broadcast networks) Init – Have received Hello packet, but communications not yet established Two-way – Bidirectional communications established ExStart – Initializing adjacency between neighbors Exchange – Database descriptions being exchanged Loading – LSA databases being exchanged Full – Neighboring routers now fully adjacent Identification flags include: D – Dynamic neighbor S – Static neighbor DR – Designated router BDR – Backup designated router
Interface ID	The Interface identifier that the neighbor advertises in its Hello Packets. This is a 32-bit number uniquely identifying the neighbor router's interface. MIB-II IfIndex is used for this identifier in some implementations. The advantage to using the SNMP MIB-II ifIndex value is that this number corresponds to the number that the user will see reported by SNMP.
Interface	The interface to which this neighbor is attached

show ipv6 ospf route

This command displays the OSPF routing table.

Syntax

show ipv6 ospf [**tag** *process-id*] **route**

process-id - The ID of the router process for which information will be displayed. (Range: 1-10)

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#
```

show ipv6 ospf virtual-links

This command displays detailed information about virtual links.

Syntax

show ipv6 ospf [tag *process-id*] **virtual-**links

process-id - The ID of the router process for which information will be displayed. (Range: 1-10)

Command Mode

Privileged Exec

Example

```
Console#show ipv6 ospf virtual-links
Virtual Link VLINK1 to router 192.168.0.2 is up
  Transit area 0.0.0.1 via interface VLAN1
  Local address 192.168.0.3
  Remote address 192.168.0.2
  Transmit Delay is 1 sec, State Point-To-Point,
  Timer intervals configured, Hello 10, Dead 40, Wait 40, Retransmit 5
    Hello due in 00:00:02
    Adjacency state Full
Console#
```

Table 184: show ipv6 ospf virtual-links - display description

Field	Description
Virtual Link to router	OSPF neighbor and link state (up or down)
Transit area	Common area the virtual link crosses to reach the target router
Local address	The IP address of ABR that serves as an endpoint connecting the isolated area to the common transit area.
Remote address	The IP address this virtual neighbor is using. The neighbor must be an ABR at the other endpoint connecting the common transit area to the backbone itself.
Transmit Delay	Estimated transmit delay (in seconds) on the virtual link

Table 184: show ipv6 ospf virtual-links - display description (Continued)

Field	Description
Timer intervals	Configuration settings for timer intervals, including Hello, Dead and Retransmit
Hello due	The timeout for the next hello message from the neighbor
Adjacency state	The adjacency state between these neighbors: Down – Connection down Attempt – Connection down, but attempting contact (for non-broadcast networks) Init – Have received Hello packet, but communications not yet established Two-way – Bidirectional communications established ExStart – Initializing adjacency between neighbors Exchange – Database descriptions being exchanged Loading – LSA databases being exchanged Full – Neighboring routers now fully adjacent

Related Commands

area virtual-link (891)

Border Gateway Protocol (BGPv4)

BGP Overview

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.

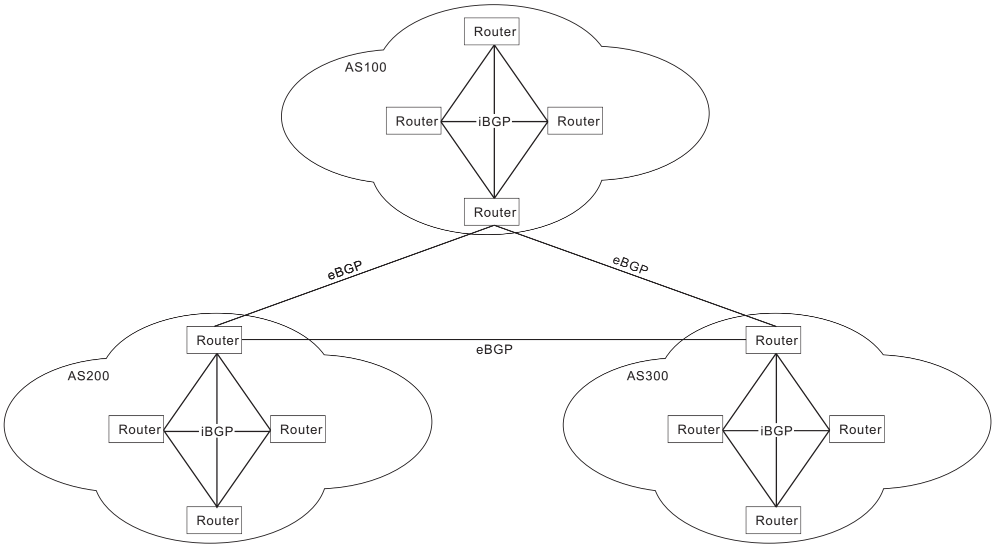
A communication session must be maintained between bordering ASs to support the periodic exchange of routing information. One of the major design choices for BGP is the use of a TCP connection to exchange routing information between peers. Exchanging connectivity information over a reliable transport mechanism effectively delegates all error control functions to TCP.

The other major innovation for BGP is the use of path vectors which carry the full list of transit networks, or ASs, traversed between the source and destination. Loops are prevented simply by checking the path vector to see if same AS is listed twice. This approach solves many of the scalability problems encountered when applying distance-vector or link-state methods to make routing decisions in complex topologies.

External and Internal BGP

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.

Figure 6: Connections for Internal and External BGP



External BGP – eBGP interconnects different ASs through border routers, or eBGP peers. These peering routers are commonly connected over a WAN link using a single physical path. Alternatively, multiple eBGP peer connections may be used to provide redundancy or load balancing. Distinct BGP sessions are used between redundancy peers to ensure that if one session fails, another will take over.

BGP uses the AS path attribute to record the ASs that must be followed to reach the prefix for a network aggregate. When a prefix is announced to an eBGP peer, the local AS number is prepended to the AS path. This prevents routing loops by rejecting any prefix announcements that include the local AS number in the AS path. These announcements are also used by eBGP in the best path selection process.

eBGP speakers, can communicate with other external peers or with iBGP peers. A BGP speaker can determine if it communicating with an external or internal peer by comparing the AS number sent in OPEN messages by a peer with that of its own internal value. If it matches, then this neighbor is an iBGP speaker, and if it does not, then it is an eBGP speaker. An eBGP speaker can advertise prefixes it has learned from another eBGP speaker to a neighboring iBGP speaker; and it can also advertise prefixes it has learned from an iBGP speaker to an eBGP speaker.

Internal BGP – In contrast to eBGP peers which have different AS numbers, iBGP peers are configured with the same AS number. All iBGP peers within the same AS should be connected to one another in a full-mesh connection (except when using route reflection). When a prefix is announced from one iBGP peer to another, the AS path is not changed. Since all iBGP peers are fully meshed, they will have the same information in their BGP table, unless routing policies have been modified for some of the peers.

When a iBGP peer receives a prefix announcement, it uses the best path selection algorithm to see if the received announcement is the best path for that prefix. If it is, the peer inserts this route into its routing table, and announces it to all of its peers, both iBGP and eBGP. If it is not the best available path, the peer keeps a copy of it in its routing table so that if path information for that prefix changes (such as if the current best available path is withdrawn), it can be used to calculate a new best available path.

BGP cannot detect routes and provide reachability information. To ensure that each iBGP peer knows how to reach other, each peer must run some sort of Interior Gateway Protocol (such as static routes, direct routes, RIP or OSPF) which provides neighbor IP addresses. In order to avoid routing loops, an iBGP speaker cannot advertise prefixes it has learned from one iGBP peer to another neighboring iBGP peer.

BGP Routing Basics

Both RIP and OSPF attach a metric, or cost, to each path. These protocols rely on every router attaching the same meaning to each metric, allowing consistent calculation of routes. However, after routing policies are put in place, routers may value some metrics differently, invalidating the basic assumptions upon which RIP and OSPF are based. This makes it unrealistic to run a distance-vector AS-level protocol

BGP uses a path vector routing approach, which is roughly based on a distance-vector approach, where the cost between two adjacent ASes is implicitly assumed to be a single hop. The shortest path from an AS to a remote AS is therefore the path with the shortest number or AS hops. Just note that each AS may be comprised of multiple routers or networks that a packet traverses as it crosses the associated route to the destination, so the AS hop count does not equal to the number of routers along that path.

Path Attributes

The key information passed along with the path vector in routing messages include the following attributes:

- ORIGIN – This attribute indicates how the network of BGP routers first learned of a route, and is set by the first BGP router to introduce the routes to its peers. There are three methods for injected a prefix into an update message: IGP, EGP and Incomplete.

- AS_PATH – This attribute lists the autonomous systems that make up the path to the routes' destination. Each entry contains a series of path segments. Each path segment begins with a 1 for SETS or a 2 for SEQUENCES, where a SET indicates that it is an aggregate prefix which was derived from multiple ASes.

- NEXT_HOP – This attribute indicates the IP address of the router that should be used as the next hop to reach the router' destination. This address is normally that of the router sending the BGP message, but a BGP router may advertise a route on behalf of another router.

- MULTI_EXIT_DISC (MED) – The multi-exit discriminator attribute lets an autonomous system set a preference for different routes when there are multiple external links to a neighboring AS. Selection is normally based on the exit point with the lowest metric.

- WEIGHT – This attribute is used locally by a router to select a path when multiple paths are available for a prefix.

- LOCAL_PREF – This local preference attribute is similar to that of the MED, but within an AS. It sets a metric which is used between BGP speakers within an AS. It can help in selecting an outgoing BGP when an AS has connectivity to multiple ASes or multiple BGP routes even with the same next hop AS.

- ATOMIC_AGGREGATE – This attribute indicates that the routes were created by aggregating more specific routes. More specific routes may exist for some the these longer prefixes, but the router chose not to send them, so as to reduce the size for the AS path parameters.

- AGGRATOR – This is an optional attribute that identifies the AS and router that originally aggregated the routes.

- COMMUNITY – This attribute associates routing information with a community of users. These communities share a common property, and tagging routes with a community makes it easier for routers to identify that property and enforce appropriate routing policies.

- ORIGINATOR_ID – This attribute is included when a route reflector reflects a route. Then if the reflector later receives a route with its own originator ID, a potential routing loop can be broken.

- CLUSTER_LIST – This attribute is of a list of the clusters through which a route has been reflected. Every route reflector adds its own cluster ID to the list. If the reflector receives a route with its own cluster ID, a potential routing loop can be broken.

- MP_REACH_NLRI – This attribute describes routes for network protocols other than IPv4. The attribute identifies the protocol with an address family identifier (AFI) and a subsequent address family identifier (SAFI). It contains the address of the next hop router for the destinations, as well as the link level (e.g., Ethernet) addresses for that next hop. It concludes with the destinations expressed as prefixes.

- MP_UNREACH_NLRI – This attribute withdraws non-IPv4 routes. It includes the route's AFI, SAFI, and network address prefixes.

- EXTENDED-COMMUNITIES – This attribute provides a mechanism for labeling various information carried in route advertisements. It provides an extended type field to ensure that communities can be assigned for a broad range of uses, without fear of overlap.

Path Selection

When there are multiple paths to the same prefix (with the same prefix length), the information included in route advertisement is used to select the best path to a destination following the rules shown below.

1. Choose the path with the highest WEIGHT. If the value of this attribute is the same for more than one candidate, go to the next step.

2. Choose the path with the highest LOCAL-PREF. If the value of this attribute is the same for more than one candidate, go to the next step.

3. Choose the path that was generated by the local router with the network or aggregate-address command. If the value of this criteria is the same for more than one candidate, go to the next step.

4. Choose the path with the shortest AS_PATH. If the value of this attribute is the same for more than one candidate, go to the next step. Note that this attribute may be disabled in the selection process using the bgp bestpath as-path ignore command.

5. Choose the path with the lowest ORIGIN (IGP < EGP < Incomplete). If the value of this criteria is the same for more than one candidate, go to the next step.

6. Choose the path with the lowest MED. By default, the MED attribute is considered only when a prefix is received from neighbors in the same AS. If the value of this criteria is the same for more than one candidate, go to the next step.

7. Choose an eBGP path over an outer confederation, and an outer confederation over an iBGP path. If the value of this criteria is the same for more than one candidate, go to the next step.

8. Choose the path with the lowest IGP metric to the next hop. If the value of this criteria is the same for more than one candidate, go to the next step.

9. Choose the path originated by the BGP router with the lowest router ID.

Message Types

Four message types are used by BGP. The OPEN message is used by BGP peers to identify their capabilities, the UPDATE message is used to advertise/withdraw prefixes, the NOTIFICATION message is used to send errors or close the session, and the KEEPALIVE messages is used to keep the BGP session up. These message types are described below.

- OPEN – BGP routers normally wait for BGP connections on TCP port 179. A router that wants to establish an association will first open a TCP connection leading to that port on the peer router. Once the connection has been set, each side sends an OPEN message to negotiate the association's parameters based on the capabilities advertised in these messages. Open messages include information about the BGP version number in use, the peer's AS number, the hold time, the BGP identifier (i.e., loopback address or the highest value of all the BGP speaker's interfaces), and optional parameter length.

- UPDATE – These messages are used to announce or withdraw IP prefixes, and include the following components: withdrawn route length, withdrawn routes, total path attributes length, path attributes, and network layer reachability information.

- NOTIFICATION – These messages are used to indicate error conditions. The underlying TCP session is closed after a notification message is sent.

- KEEPALIVE – These messages are sent at a set interval and are used to verify that the BGP session is active. The hold timer is reset upon receipt of a KEEPALIVE or UPDATE message. If the hold time is set to zero by both peers, a BGP session can be kept open without generating KEEPALIVE messages.

Route Aggregation and Dissemination

In the Internet, the number of destinations is larger than most routing protocols can manage. It is not possible for routers to track every possible destination in their routing tables. To overcome this problem BGP relies on route aggregation, whereby multiple destinations are combined in a single advertisement. Routers receiving this information, treat the combined destinations as a single destination, thus reducing the number of individual routes that must be remembered. This also reduces the network overhead required to transmit update packets and maintain routing tables.

In BGP, route aggregation combines the address blocks for networks from two or more ASes into a supernet, and transmits this information to a downstream AS. This supernetted address block is less specific, and only lists the AS number of the AS where the supernetting was done. The Atomic_Aggregate attribute indicates that attributes for more specific paths are not included in the aggregated route, and the Aggregator attribute indicates the AS and router where the aggregation was done. The aggregator node will now serve as a proxy, using the more specific routes it still maintains in its own routing table.

After inbound routes have been aggregated, the BGP speaker can propagates this information based on export policies for individual neighbors or for defined router groups, using route maps or other more precise routing criteria.

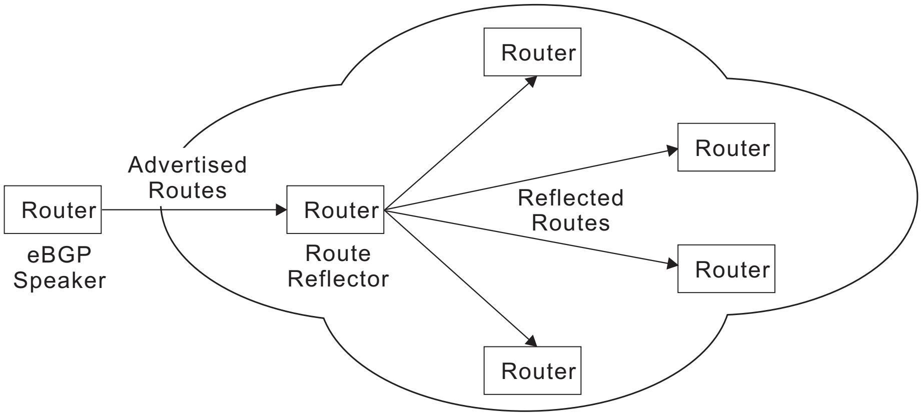
Internal BGP Scalability

An iBGP speaker cannot advertise IP prefixes it has learned from one iBGP speaker to another neighboring iBGP speaker. iBGP therefore requires full-mesh connectivity among all iBGP speakers. For local networks containing a large number of speakers, this requirement may be difficult to meet. There are several commonly used approaches to resolving this problem, including route reflectors, confederations, and route servers.

Route Reflectors

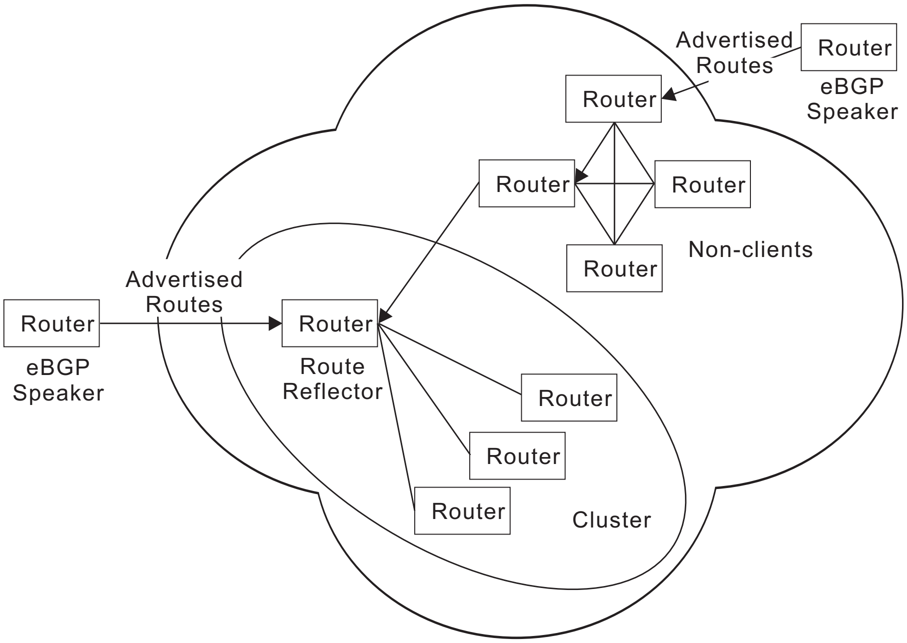
Route reflection designates one or more iBGP speakers as router concentrators or route reflectors, which are allowed to re-advertise routing information within the same autonomous system. It also clusters a subset of iBGP speakers with each route reflector (also known as route reflector clients), and adds several new attributes to help detect routing loops. Using the cluster hierarchy, connections are only required between the route reflector and its clients, overcoming the normal requirement for full-mesh connectivity among all iBGP speakers.

Figure 7: Connections for Single Route Reflector



Route reflector clients are not aware that they are connected to a route reflector, and function as though fully meshed within the autonomous system. For redundancy, a cluster many contain more than one route reflector. Each cluster is identified a Cluster-ID. When there is only one route reflector in a cluster, the Cluster-ID is the BGP identifier of the route reflector. If there is more than one route reflector in a cluster, a common identifier can be defined for use by all route reflectors in the cluster.

Figure 8: Connections for Multiple Route Reflectors



If there is only one route reflector in a cluster, that router would still have to process the same number of routing messages that would be required if it were in a fully meshed network. It is therefore preferable to use more than one route reflector in a cluster to reduce the overall number of iBGP sessions a single reflector has to handle.

If multiple route reflectors are configured in the same cluster, they must be fully meshed with each other. However, the route reflector clients only need to be connected to its designated route reflector. Once all iBGP routing sessions are established, routing advertisements must follow these rules:

- Announcements received by a route reflector from another reflector are passed to its clients.
- Announcements received by a route reflector from a reflector client are passed to other route reflectors in the cluster.
- Announcements received by a route reflector from an eBGP speaker are passed to all route reflectors in the cluster and to its own clients.

It can now be seen that routing information learned from an iBGP speaker can be passed to another iBGP speaker. This breaks the normal rules for a fully meshed iBGP autonomous system, and other steps are now required to avoid routing loops. These include the addition of the following new attributes:

- Originator-ID – When a route reflector learns about a route from one of its clients, it adds this attribute to the announcement before reflecting it to other speakers. If a route reflector receives an announcement about a route with an Originator-ID that matches its own router ID, it should drop it.
- Cluster-List – This is a list of the clusters through which a route announcement has passed. When a route reflector passes on an announcement, it must prepend the local Cluster-ID to this list. The Cluster-List thereby serves a similar function to the AS-Path attribute in detecting routing loops.

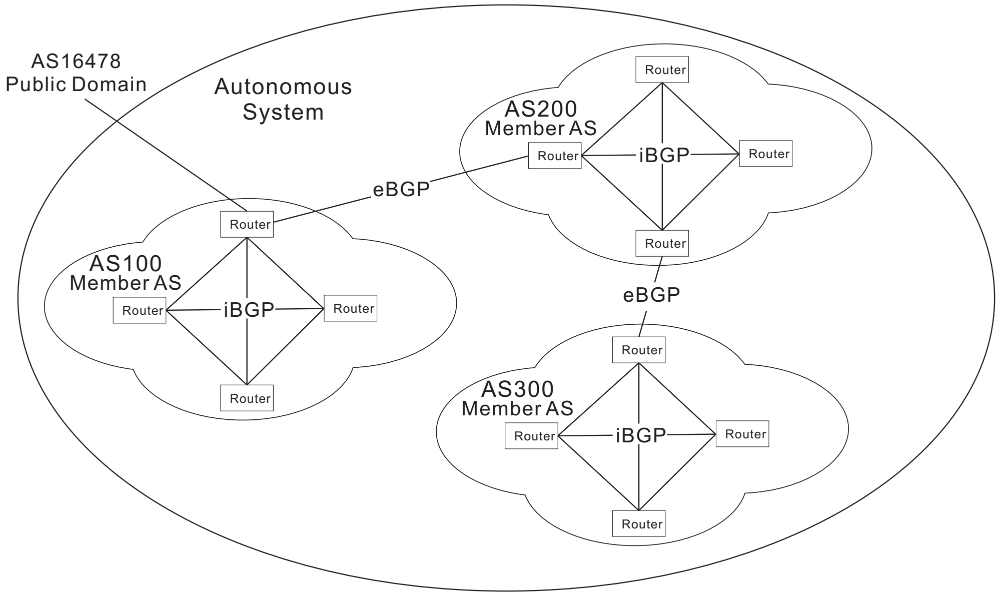
Configuration Guidelines

1. Route reflection from this router is enabled by default. If it has been disabled, use the bgp client-to-client reflection command to restore route reflection via this router.
2. If more than one route reflector is used, use the bgp cluster-id command to configure the cluster identifier.
3. Use the neighbor route-reflector-client command configure a neighboring router as a client.

Confederations

Confederations simply divides an autonomous system into smaller groups. It splits up an AS into multiple sub-ASes, where full mesh connections are maintained only within each sub-As, and sub-ASes are connected by eBGP. The overall AS is known as a confederation, while the sub-ASes may also be referred to as member ASes. The entire confederation has a unique AS number, while the member ASes may have AS numbers obtained from public AS number space, or use AS number from private AS number space.

Figure 9: Connections for BGP Confederation



To prevent looping within the confederation, the AS-Confed-Set and AS-Confed-Sequence path attributes are added. These attributes function in the same manner as AS-Set and AS-Sequence. The following additional requirements are applied for route advertisements passed between member ASes:

- The Local-Pref for a route may be passed from one member AS to another member AS. This exception to normal practice is allowed within the confederation since this attribute is meant for use by the entire AS.
- The Next-Hop for a route set by the first BGP speaker in the confederation may be passed from one member AS to another member.
- When a route advertisement is passed from one member AS to another, the AS-Confed-Sequence must be inserted into the AS-Path along with the AS number of the member AS to help prevent looping.

Border routers that also peer with outside ASes have to modify routing information that leaves the confederation so that the internal structure of the confederation remains hidden to exterior peers, primarily because this information is of no use to another external AS. The information stripped from route advertisements and update messages sent outside of the confederation include AS-Confed-Sequence and AS-Confed-Set. Neither are AS numbers of member ASes advertised to exterior peers.

Configuration Guidelines

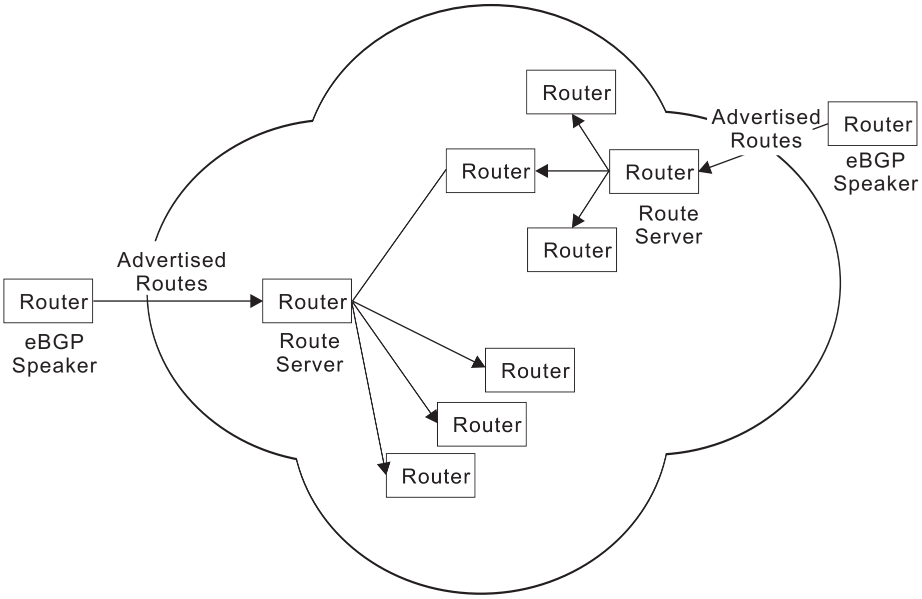
1. Use the bgp confederation identifier command to configures the identifier for a confederation containing smaller multiple internal autonomous systems.

2. Use the bgp confederation peer command to add an internal peer autonomous system to a confederation.

Route Servers

Route Servers are used to relay routes received from remote ASes to client routers, as well as to relay routes between client routers. Clients maintain BGP sessions only with the assigned route servers. Sessions with more than one server can be used to provide redundancy and load sharing. All routes received from a client router are propagated to other clients through the Route Server. Since all external routes and their attributes are relayed unmodified between client routers, they acquire the same routing information as they would via direct peering in a full mesh configuration.

Figure 10: Connections for Route Server



Configuration Guidelines

Use the neighbor route-server-client command to configure this router as a route server and the specified neighbor as its client.

Route Flap Dampening

An update message is sent from a BGP speaker to a neighboring speaker whenever any change to a route occurs. A speaker announcing such a route is also responsible for any changes, including withdrawal, change in AS-Path or Next-Hop, to the same neighbor, irrespective of where the change was learned. In practice this may cause a BGP speaker to announce a new route, and then almost immediately withdraw or update the route a few seconds later, repeatedly. Since routing information is propagated to other downstream speakers, there is a ripple effect that creates a cascading storm of updates through the ASes. This causes instability in the routing tables, as well as the computational overhead required to compute the best path, and an increase in convergence time.

Route damping provides a relief mechanism to minimize the effects of route flapping. It can reduce the propagation of updates for flapping routes without impacting the route convergence time for stable routes. When enabled, a route is assigned a penalty each time it flaps (i.e., announced and then quickly withdrawn). If the penalty exceeds 2000 (the suppress limit) the route is suppressed. After the route remains stable for a specified interval (half-life), the penalty is reduced by half. Subsequently, the penalty is reduced every 15 minutes. When the penalty falls below a specified value (reuse limit), the route is unsuppressed.

The penalty never exceeds the maximum penalty, which is computed from specified attributes as shown below:

Maximum penalty = reuse-limit * 2^(max-suppress-time/half-life)

When a route is being "damped," any updates or withdrawals for this route received from a peer are ignored. This limits the effects of route flapping to a single peering connection. Since most ASes are connected by high-speed links, it is not always necessary to use route dampening. However, when invoked, it may be necessary to fine tune the penalty attributes to ensure fair treatment to unstable routes.

Configuration Guidelines

1. Use the bgp dampening command to enable route dampening.
2. Use the bgp dampening command to adjust the penalty attributes of *half-life*, *reuse-limit*, *suppress-limit*, and *max-suppress-time*.
3. Use the clear ip bgp dampening command to clears route dampening information and unsuppresses any suppressed routes.

BGP Command List

Table 185: Border Gateway Protocol Commands – Version 4

Command	Function	Mode
General Configuration		
router bgp	Enables BGPv4 routing process and enters router configuration mode	GC
ip as-path access-list	Configures an autonomous system path access list	GC
ip community-list	Configures a community list	GC
ip 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
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

Table 185: Border Gateway Protocol Commands – Version 4 (Continued)

Command	Function	Mode
bgp confederation peer	Adds an internal peer autonomous system to a confederation	RC
bgp dampening	Configures route dampening to reduce the propagation of unstable routes	RC
bgp 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
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 scan-time	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 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 ignore	Ignores AS path length in the selection of a path	RC
bgp bestpath compare-confed-aspath	Compare confederation AS path length in addition to external 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
distance	Sets the administrative distance for a specified external BGP (eBGP) route	RC

Table 185: Border Gateway Protocol Commands – Version 4 (Continued)

Command	Function	Mode
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-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
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

Table 185: Border Gateway Protocol Commands – Version 4 (Continued)

Command	Function	Mode
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 cidr-only	Shows routes which use classless inter-domain routing network masks	
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
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 paths	Shows all paths in the database	PE

Table 185: Border Gateway Protocol Commands – Version 4 (Continued)

Command	Function	Mode
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 scan	Shows BGP scan status	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
show ip protocols bgp	Displays BGP process parameters	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)#
```

Related Commands

network (939)

ip 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

ip as-path access-list *access-list-name* {**deny** | **permit**} *regular-expression*

no ip as-path access-list *access-list-name* [{**deny** | **permit**} *regular-expression*]

access-list-name – Name of the access list. (Maximum length: 16 characters, no spaces or other special characters)

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[12].

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.

- 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.

[12] Syntax complies with the IEEE POSIX Basic Regular Expressions (BRE) standard.

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-router)#ip as-path access-list RD deny ^100$
Console(config-router)#
```

Related Commands

neighbor filter-list (958)
match as-path (996)

ip 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**] **ip community-list**
{1-99 | **standard** *community-list-name* {**deny** | **permit**}
[*AA*:*NN*] [**internet**] [**local-as**] [**no-advertise**] [**no-export**]} | {100-500 |
expanded *community-list-name* {**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)

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[12].

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)#ip community-list standard LN permit 100:10
Console(config)#
```

Related Commands

neighbor send-community (970)
match community (996)

ip 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**] **ip extcommunity-list**
{1-99 | **standard** *community-list-name* {**deny** | **permit**}
[{**rt** | **soo**} *extended-community-value*]} |
{100-500 | **expanded** *community-list-name* {**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)

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)#ip extcommunity-list standard LP permit soo 100:20
Console(config)#
```

Related Commands

neighbor filter-list (958)
match extcommunity (997)

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: 1-429496725)

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)#
```

Related Commands

neighbor prefix-list (965)
match ip address (997)

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)#
```

Related Commands

neighbor route-reflector-client (968)
bgp cluster-id (932)

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)#
```

Related Commands

bgp client-to-client reflection (931)

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 peer command to specify the autonomous systems within a confederation.

Example

```
Console(config-router)#bgp confederation identifier 600
Console(config-router)#
```

Related Commands

bgp confederation peer (934)

bgp confederation peer

This command adds an internal peer autonomous system to a confederation. Use the **no** form to remove an autonomous system from a confederation.

Syntax

bgp confederation peer *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 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 peer 101
Console(config-router)#bgp confederation peer 102
Console(config-router)#bgp confederation peer 103
Console(config-router)#bgp confederation peer 104
Console(config-router)#neighbor 192.168.0.9 remote-as 101
Console(config-router)#
```

Related Commands

bgp confederation identifier (933)

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 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**] **bgp 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)#bgp enforce-first-as
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.

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 scan-time

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 scan-time *scan-time*

no bgp scan-time

scan-time – Next hop validation interval. (Range: 5-60 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 scan-time 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**] **pathlimit** *ttl*]

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.

pathlimit *ttl* – Maximum number of hops allowed in an AS path. (Range: 0-255)

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** | **rip** | **static**} [**metric** *metric-value*] [**route-map** *map-name*]

no redistribute {**connected** | **ospf** | **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.

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 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[13] 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 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**

[13] If a router does not understand an optional non-transitive attribute, it will be removed.

Command Mode

Router Configuration

Default Setting

Disabled

Example

```
Console(config-router)#bgp bestpath as-path ignore
Console(config-router)#
```

bgp bestpath compare-confed-aspath

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 compare-confed-aspath**

Command Mode

Router Configuration

Default Setting

Disabled

Example

```
Console(config-router)#bgp bestpath compare-confed-aspath
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)#
```

Related Commands

distance bgp (949)

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)#
```

Related Commands

distance (948)

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-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 ip 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 ip 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**]]

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 – 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** 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*} **neighbor 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*

no neighbor {*ip-address* | *group-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.

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)#
```

Related Commands

set community (1005)

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 supercede 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: 0-65535 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*

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)

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* [*netmask* [**longer-prefixes**]]

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.

longer-prefixes – Specified route and all more specific routes.

Command Mode

Privileged Exec

Example

```
Console#show ip bgp
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
*>12.0.0.0          10.1.1.121               0         32768 ?
*>100.1.1.0/24      10.1.1.200               0         32768 ?
*>100.1.2.0/24      10.1.1.200               0         32768 ?
*i192.168.0.0/24    0.0.0.0                  0         32768 i

Total number of prefixes 4
Console#
```

Table 186: show ip bgp - display description

Field	Description
BGP table version	Internal version number of routing table, incremented per table change.
local router ID	IP address of router.
Status codes	Status of table entry includes these values: ◆ s – Entry is suppressed. ◆ d – Entry is dampened. ◆ h – Entry history ◆ * – Entry is valid ◆ > – Best entry for that network ◆ i – Entry learned via internal BGP (iBGP). ◆ r – Entry is Routing Information Base (RIB) failure ◆ S – Entry is stale. ◆ R – Entry removed.
Origin codes	Origin of table entry includes these values: ◆ i – Entry originated from an Interior Gateway Protocol (IGP) and was advertised using a **network** router configuration command. ◆ e – Entry originated from an Exterior Gateway Protocol (EGP). ◆ ? – Origin of the path undetermined. This normally indicates a route which has been redistributed into BGP from an IGP.
Network	IP address of network entry.
Next Hop	IP address of the next router used to reach destination network.
Metric	Value of inter-autonomous system metric.
LocPrf	Local preference value defined by the set local-preference route-map configuration command.
Weight	Weight of the route determined by autonomous system filters.
Path	Autonomous system paths used to reach the destination network.
Total number of prefixes	Total number of unique route prefixes in the table.

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
Refcnt  Nexthop
      1 0.0.0.0
      1 10.1.1.64
      3 10.1.1.64
      1 10.1.1.121
      2 10.1.1.200
Console#
```

show ip bgp cidr-only

This command shows routes which use classless interdomain routing network masks.

Syntax

show ip bgp cidr-only

Command Mode

Privileged Exec

Example

This example shows routes that do not match the natural A, B, C or D network masks defined for the earliest IP networks.

```
Console#show ip bgp cidr-only
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
*>3.3.3.0/24        10.10.10.10                             0 11 i
*>6.6.6.0/24        0.0.0.0                             32768 i
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 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     0.0.0.0                            32768 700 800 i
*> 172.0.0.0/8      0.0.0.0                            32768 700 800 i

Total number of prefixes 2
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#
```

Table 187: show ip bgp community-info - display description

Field	Description
Address	Internal address in memory where the entry is stored.
Refcnt	The number of routes which refer to this community.
Community	4-byte community number composed of a 2-byte autonomous system number and a 2-byte network number, separated by one colon

show ip bgp community-list

This command shows the routes matching a community-list.

Syntax

show ip bgp community-list {1-99 | 100-500 | *community-list-name*} [**exact-match**]

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 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 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     0.0.0.0                              32768 700 800 i
*> 172.0.0.0/8      0.0.0.0                              32768 700 800 i
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 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          From             Reuse    Path
*d 100.1.3.0/24     10.1.1.64        00:27:40 100 ?

Total number of prefixes 1
Console#
```

In this example, “Duration” indicates the time since the first flap occurred.

```
Console#show ip bgp dampening flap-statistics
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          From            Flaps Duration Reuse    Path
*d 100.1.3.0/24     10.1.1.64       3     00:06:05 00:27:00 100 ?

Total number of prefixes 1
Console#
```

This example shows the dampening parameters configured on this router.

```
Console#show ip bgp dampening parameters
 Dampening 15 750 2000 60
  Reachability half-life time    :15 min
  Reuse penalty                  :750
  Suppress penalty               :2000
  Max suppress time              :60 min
Console#
```

Table 188: show ip bgp dampening parameters- display description

Field	Description
Reachability half-life time	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.
Reuse penalty	The point to which the penalty for a flapping route must fall before a route is unsuppressed.

Table 188: show ip bgp dampening parameters- display description (Continued)

Field	Description
Suppress penalty	The point at which to start suppressing a route.
Max suppress time	The maximum time a route can be suppressed.

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 ip 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 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     10.1.1.64                0             0 100 ?
Total number of prefixes 1
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 192.168.0.3
BGP neighbor is 192.168.0.3, remote AS 200, local AS 100, external link
 Member of peer-group for session parameters
  BGP version 4, remote router ID 192.168.0.3
  BGP state = Established, up for 00:00:58
  Last read 16:40:37, hold time is 180, keepalive interval is 60 seconds
  Neighbor capabilities:
    4 Byte AS: advertised and received
    Route refresh: advertised and received(old & new)
    Address family IPv4 Unicast: advertised and received
  Message statistics:
    Inq depth is 0
    Outq depth is 0
                         Sent       Rcvd
    Opens:                  1          0
    Notifications:          0          0
    Updates:                1          1
    Keepalives:             2          1
    Route Refresh:          0          0
    Capability:             0          0
    Total:                  4          2
  Minimum time between advertisement runs is 30 seconds

 For address family: IPv4 Unicast
  Community attribute sent to this neighbor(both)
  Inbound path policy configured
  1 accepted prefixes

  Connections established 1; dropped 0
  Last reset never
Local host: 192.168.0.2, Local port: 179
Foreign host: 192.168.0.3, Foreign port: 3987
Nexthop:
Read thread: on  Write thread: off

Console#
```

Table 189: show ip bgp - display description

Field	Description
BGP neighbor	IP address of neighbor.
remote AS	Autonomous system number of the neighbor.
local AS	Local autonomous system number.
external link	“external link” is displayed for external BGP neighbors. “internal link” is displayed for iBGP neighbors.
BGP version	BGP version used to communicate with remote router.
remote router ID	IP address of the neighbor.
BGP state	Stage of session negotiation.
Last read	Time since a message was last received from this neighbor.
hold time	Time to maintain the session with this neighbor without receiving a message.

Table 189: show ip bgp - display description (Continued)

Field	Description
keepalive interval	Interval at which keepalive messages are transmitted to this neighbor.
Neighbor capabilities	BGP capabilities advertised and received from this neighbor.
Message statistics	Statistics organized by message type.
Minimum time between advertisement runs	Time between transmission of advertisements.
For address family	Address family to which the following information refers.
Local host/port	IP address and TCP port of the local BGP speaker.
Foreign host/port	IP address and TCP port of the neighbor BGP speaker.
Nexthop	IP address of next system via which packets are forwarded to the destination network.
Read thread	The read status for the socket connection with this neighbor.
Write thread	The write status for the socket connection with this neighbor.

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#
```

Table 190: show ip bgp paths - display description

Field	Description
Address	Internal address in memory where the path is stored.
Refcnt	The number of routes using this path.
ASpath	The autonomous system path for this route.

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 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     10.1.1.64                0             0 500 100 600 ?
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 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     10.1.1.64                0             0 500 100 600 ?
*>                  10.1.1.68                0             0 300 ?
Console#
```

show ip bgp scan

This command shows BGP scan status.

Syntax

show ip bgp scan

Command Mode

Privileged Exec

Example

```
Console#show ip bgp scan
BGP scan is running
BGP scan interval is 60
Current BGP nexthop cache:
 10.10.10.64 valid [IGP metric 0]
BGP connected route:
 10.10.10.0/24
 10.10.11.0/24
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 192.168.0.2, local AS number 100
RIB entries 0
Peers 1
Peer groups 0
Neighbor      V   AS MsgRcvd MsgSent   TblVer  InQ OutQ Up/Down  State/PfxRcd
192.168.0.3   4  200     166     168        0    0    0 02:45:00        1

Total number of neighbors 1

Console#
```

show ip community-list

This command shows routes permitted by a community list.

Syntax

show ip community-list [1-99 | 100-500 | *community-list-name*]

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 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 [1-99 | 100-500 | *community-list-name*]

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 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: 1-429496725)

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#
```

show ip protocols bgp

This command shows BGP process parameters.

Command Mode

Privileged Exec

Example

```
Console#show ip protocols bgp
Routing Protocol is "bgp 1"
  Neighbor(s):
    Address          FiltIn FiltOut DistIn DistOut Weight RouteMap
    192.168.1.1
  Routing Information Sources:
    Gateway         Distance      Last Update
    192.168.1.1          200      never
  Distance: external 20 internal 200 local 200
Console#
```

Table 191: show ip protocols bgp - display description

Field	Description
Neighbor(s)	
Address	IP address of route entry
FiltIn	Indicates whether a filter for incoming routing updates has been specified with the neighbor filter-list in command.
FiltOut	Indicates whether a filter for outgoing routing updates has been specified with the neighbor filter-list out command.
DistIn	Indicates whether routes are distributed into the BGP protocol domain as specified with the neighbor distribute-list in.
DistOut	Indicates whether routes are distributed out of the BGP protocol domain as specified with the neighbor distribute-list out command.
Weight	The default route weight of the neighbor as specfied by the neighbor weight command.
RouteMap	The route-map applied on incoming BGP route entries as specified by the neighbor route-map in command.
Routing Information Sources	
Gateway	The next hop used to reach this route, normally the neighbor address.
Distance	The administrative distance assigned to a route, fixed at 200
Last Update	Time the last BGP packet/message received from this source.

Related Commands

show ip route (805)

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 192: 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

Table 192: Policy-based Routing Configuration Commands (Continued)

Command	Function	Mode
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 pathlimit	Sets the maximum AS path length for propagation of more specific prefixes 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
set pathlimit ttl	Sets the maximum AS path length for propagation of more specific prefixes in routing messages	RM
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)#
```

Related Commands

ip as-path access-list (923)

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 ip 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 ip 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)#
```

Related Commands

ip prefix-list (928)
Access Control Lists (335)

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 pathlimit

This command sets the maximum AS path length allowed for propagation of more specific prefixes to match in routing messages. Use the **no** form to remove this entry from a route map.

Syntax

match pathlimit as *as-limit*

no match pathlimit as

as-limit – Maximum AS path length. (Range: 1-4294967295)

Command Mode

Route Map

Command Usage

- To perform inter-domain traffic engineering, a multi-homed site can advertise its prefix to all of its neighbors via an aggregate address, and also advertise more specific prefixes to a subset of its neighbors. The longest match lookup algorithm then causes traffic for the more specific prefixes to be forwarded to the subset of neighbors with the more specific prefix.

  These longer prefixes may be advertised in addition to an aggregate, even when the aggregate advertisement is sufficient for basic reachability. This type of inter-domain traffic engineering is a widely used phenomenon that is contributing to growth in the size of the global routing table.

Traffic engineering via longer prefixes is only effective when the longer prefixes have a different next hop from the less specific prefix. Thus, past the point where the next hops become identical, the longer prefixes provide no value whatsoever. This command can be used to limit the radius of propagation of more specific prefixes by adding a count of the ASes that may be traversed by the more specific prefix.

- Private AS numbers [RFC1930] and confederation AS members [RFC3065] found in the AS_PATH are not counted. AS numbers found within an AS_SET are not counted and an entire AS_SET is counted as a single AS. Each instance of an AS number that appears multiple times in an AS_PATH is counted.

  If the AS_PATHLIMIT attribute is attached to a prefix by a private AS, then when the prefix is advertised outside of the parent AS, the AS number contained in the AS_PATHLIMIT attribute should be replaced by the AS number of the parent AS.

  Similarly, if the AS_PATHLIMIT attribute is attached to a prefix by a member of a confederation, then when the prefix is advertised outside of the confederation boundary, then the AS number of the confederation member inside of the AS_PATHLIMIT attribute should be replaced by the confederation's AS number.

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)#
```

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 ip 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 ip 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)#
```

Related Commands

set comm-list delete (1004)

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 pathlimit ttl

This command sets the maximum AS path length for propagation of more specific prefixes in routing messages. Use the **no** form to remove this entry from a route map.

Syntax

set pathlimit ttl *ttl-value*

no set pathlimit ttl

ttl-value – Maximum number of router hops allowed in an AS path. (Range: 1-255)

Command Mode

Route Map

Command Usage

Due to the dynamic changes in connections for network paths, it is not advisable to restrict the number of router hops for any path. However, if the connections to the destination network are relatively stable, the hop count can be restricted to force traffic to follow an alternate path. This method may be used to avoid less heavily congested paths or to route traffic through a preferred provider.

Example

```
Console(config)#route-map RD permit 18
Console(config-route-map)#match peer 192.168.0.99
Console(config-route-map)#set pathlimit ttl 255
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#
```

30 Multicast Routing Commands

Multicast routers can use various kinds of multicast routing protocols to deliver IP multicast packets across different subnetworks. This router supports Protocol Independent Multicasting (PIM). (Note that IGMP will be enabled for any interface that is using multicast routing.)

Table 193: Multicast Routing Commands

Command Group	Function
General Multicast Routing	Enables IP multicast routing globally; also displays the IP multicast routing table created from static and dynamic routing information
Static Multicast Routing	Configures static multicast router ports
PIM Multicast Routing	Configures global and interface settings for PIM-DM and PIM-SM

General Multicast Routing

This section describes commands used to configure multicast routing globally on the switch.

Table 194: General Multicast Routing Commands

Command	Function	Mode
IPv4 Commands		
ip multicast-routing	Enables IPv4 multicast routing	GC
show ip mroute	Shows the IPv4 multicast routing table	PE
IPv6 Commands		
ipv6 multicast-routing	Enables IPv6 multicast routing	GC
show ipv6 mroute	Shows the IPv6 multicast routing table	PE

IPv4 Commands

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.

- To use multicast routing, IGMP proxy can not enabled on any interface of the device (see ip igmp proxy on page 638).

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#
```

Table 195: show ip mroute - display description

Field	Description
Flags	The flags associated with this entry: ◆ D (Dense) - PIM Dense mode in use. ◆ S (Sparse) - PIM Sparse mode in use. ◆ s (SSM) - A multicast group with the range of IP addresses used for PIM-SSM. ◆ C (Connected) - A member of the multicast group is present on this interface. ◆ P (Pruned) - This route has been terminated. ◆ F (Register flag) - This device is registering for a multicast source. ◆ R (RP-bit set) - The (S,G) entry is pointing to the Rendezvous Point (RP), which normally indicates a pruned state along the shared tree for a particular source. ◆ T (SPT-bit set) - Multicast packets have been received from a source on the shortest path tree. ◆ J (Join SPT) - The rate of traffic arriving over the shared tree has exceeded the SPT-threshold for this group. If the SPT flag is set for (*,G) entries, the next (S,G) packet received will cause the router to join the shortest path tree. If the SPT flag is set for (S,G), the router immediately joins the shortest path tree.
Interface state	The multicast state for the displayed interface.
group address	IP multicast group address for a requested service.
source	Subnetwork containing the IP multicast source.
uptime	The time elapsed since this entry was created.
Owner	The associated multicast protocol (PIM).

Table 195: show ip mroute - display description (Continued)

Field	Description
`Incoming Interface`	Interface leading to the upstream neighbor. PIM creates a multicast routing tree based on the unicast routing table. If the related unicast routing table does not exist, PIM will still create a multicast routing entry, but displays "Null" for the upstream interface to indicate that the unicast routing table is not valid. This field may also display "Register" to indicate that a pseudo interface is being used to send or receive PIM-SM register packets.
`RPF neighbor`	IP address of the multicast router immediately upstream for this group.
`Outgoing interface list and flags`	The interface(s) on which multicast subscribers have been recorded. The flags associated with each interface indicate: ◆ F (Register flag) - This device is registering for a multicast source. ◆ P (Pruned) - This route has been terminated. ◆ L (Local) - Downstream interface has received IGMP report message from host in this subnet.

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#
```

IPv6 Commands

ipv6 multicast-routing

This command enables IPv6 multicast routing. Use the **no** form to disable IP multicast routing.

Syntax

[**no**] **iv6p multicast-routing**

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- This command is used to enable IPv6 multicast routing globally for the router. A multicast routing protocol also needs to be enabled on the interfaces that will support multicast routing using the router pim6 command, and then specify the interfaces that will support multicast routing using the ipv6 pim command.

- To use multicast routing, MLD proxy can not enabled on any interface of the device (see ipv6 mld proxy on page 649).

Example

```
Console(config)#ipv6 multicast-routing
Console(config)#
```

show ipv6 mroute

This command displays the IPv6 multicast routing table.

Syntax

show ipv6 mroute [*group-address source*] [**summary**]

group-address - An IPv6 multicast group address with subscribers directly attached or downstream from this router.

source - The IPv6 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 ipv6 mroute FF02::0101 FE80::0202

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

(FF02::0101, FE80::0202), uptime 00:00:05
Owner: PIM-DM, Flags: D
```

```
Incoming Interface: VLAN2, RPF neighbor: FE80::0303
Outgoing Interface List:
VLAN1(F)
Console#
```

Table 196: show ip mroute - display description

Field	Description
`Flags`	The flags associated with this entry: ◆ D (Dense) - PIM Dense mode in use. ◆ S (Sparse) - PIM Sparse mode in use. ◆ s (SSM) - A multicast group with the range of IP addresses used for PIM-SSM. ◆ C (Connected) - A member of the multicast group is present on this interface. ◆ P (Pruned) - This route has been terminated. ◆ F (Register flag) - This device is registering for a multicast source. ◆ R (RP-bit set) - The (S,G) entry is pointing to the Rendezvous Point (RP), which normally indicates a pruned state along the shared tree for a particular source. ◆ T (SPT-bit set) - Multicast packets have been received from a source on the shortest path tree. ◆ J (Join SPT) - The rate of traffic arriving over the shared tree has exceeded the SPT-threshold for this group. If the SPT flag is set for (*,G) entries, the next (S,G) packet received will cause the router to join the shortest path tree. If the SPT flag is set for (S,G), the router immediately joins the shortest path tree.
`Interface state`	The multicast state for the displayed interface.
`group address`	IP multicast group address for a requested service.
`source`	Subnetwork containing the IP multicast source.
`Uptime`	The time elapsed since this entry was created.
`Owner`	The associated multicast protocol (PIM).
`Incoming Interface`	Interface leading to the upstream neighbor. PIM creates a multicast routing tree based on the unicast routing table. If the related unicast routing table does not exist, PIM will still create a multicast routing entry, but displays “Null” for the upstream interface to indicate that the unicast routing table is not valid. This field may also display “Register” to indicate that a pseudo interface is being used to send or receive PIM-SM register packets.
`RPF neighbor`	IP address of the multicast router immediately upstream for this group.
`Outgoing interface list and flags`	The interface(s) on which multicast subscribers have been recorded. The flags associated with each interface indicate: ◆ F (Register flag) - This device is registering for a multicast source. ◆ P (Pruned) - This route has been terminated. ◆ L (Local) - Downstream interface has received IGMP report message from host in this subnet.

This example lists all entries in the multicast table in summary form:

```
Console#show ipv6 mroute summary

IP Multicast Forwarding is disabled

IP Multicast Routing Table (Summary)
Flags:  F - Forwarding, P - Pruned, D - PIM-DM, S - PIM-SM, V - DVMRP,
        M - MLD
Group                          Source                        Interface  Flag
------------------------------ ------------------------------ ---------- ----
                     FF02::0101                    FE80::0101 VLAN 4096   DF
Total Entry is 1
Console#
```

Static Multicast Routing

This section describes commands used to configure static multicast routes on the switch.

Table 197: Static Multicast Routing 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 multicast router port. Use the **no** form to remove the configuration.

Syntax

ip igmp snooping vlan *vlan-id* **mrouter** *interface*

no ip igmp snooping vlan *vlan-id* **mrouter** *interface*

vlan-id - VLAN ID (Range: 1-4094)

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-16/27)

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/switch connected over the network to an interface (port or trunk) on your router, you can manually configure that interface to join all the current multicast groups.

Example

The following shows how to configure port 11 as a multicast router port within VLAN 1:

Static Multicast Routing

This section describes commands used to configure static multicast routes on the switch.

Table 198: Static Multicast Routing 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 multicast router port. Use the **no** form to remove the configuration.

Syntax

ip igmp snooping vlan *vlan-id* **mrouter** *interface*

no ip igmp snooping vlan *vlan-id* **mrouter** *interface*

vlan-id - VLAN ID (Range: 1-4094)

interface

ethernet *unit/port*

unit - Unit identifier. (Range: 1)

port - Port number. (Range: 1-32/54)

port-channel *channel-id* (Range: 1-27)

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/switch connected over the network to an interface (port or trunk) on your router, you can manually configure that interface to join all the current multicast groups.

Example

The following shows how to configure port 11 as a multicast router port within VLAN 1:

```
Console(config)#ip igmp snooping vlan 1 mrouter ethernet 1/11
Console(config)#
```

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 that port 11 in VLAN 1 is attached to a multicast router:

```
Console#show ip igmp snooping mrouter vlan 1
 VLAN M'cast Router Ports Type
 ---- ------------------- -------
    1            Eth 1/11  Static
    2            Eth 1/12  Dynamic
Console#
```

PIM Multicast Routing

This section describes the PIM commands used for IPv4 and IPv6. Note that PIM can run on an IPv4 network and PIM6 on an IPv6 network simultaneously. Also note that Internet Group Management Protocol (IGMP) is used for IPv4 networks and Multicast Listener Discovery (MLD) for IPv6 networks.

Table 199: IPv4 and IPv6 PIM Commands

Command Group	Function
IPv4 PIM Commands	Configures multicast routing for IPv4 PIM.
IPv6 PIM Commands	Co figures multicast routing for IPv6 PIM.

IPv4 PIM Commands

This section describes commands used to configure IPv4 PIM-DM and PIM-SM dynamic multicast routing on the switch.

Table 200: PIM-DM and PIM-SM Multicast Routing Commands

Command	Function	Mode
Shared Mode Commands		
router pim	Enables IPv4 PIM globally for the router	GC
ip pim	Enables PIM-DM or 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 join-prune-holdtime	Configures the hold time for the prune state	IC
ip pim lan-prune-delay	Informs downstream routers of the delay before it prunes a flow after receiving a prune request	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
ip pim trigger-hello-delay	Configures the trigger hello delay	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
PIM-DM Commands		
ip pim graft-retry-interval	Configures the time to wait for a Graft acknowledgement before resending a Graft message	IC
ip pim max-graft-retries	Configures the maximum number of times to resend a Graft message if it has not been acknowledged	IC
ip pim state-refresh origination-interval	Sets the interval between PIM-DM state refresh control messages	IC

Table 200: PIM-DM and PIM-SM Multicast Routing Commands (Continued)

Command	Function	Mode
PIM-SM Commands		
ip pim bsr-candidate	Configures the switch as a Bootstrap Router (BSR) candidate	GC
ip pim register-rate-limit	Configures the rate at which register messages are sent by the Designated Router (DR)	GC
ip pim register-source	Configure the IP source address of a register message to an address other than the outgoing interface address of the designated router (DR) leading toward the rendezvous point (RP)	GC
ip pim rp-address	Sets a static address for the rendezvous point	GC
ip pim rp-candidate	Configures the switch rendezvous point (RP) candidate	GC
ip pim spt-threshold	Prevents the last-hop PIM router from switching to Shortest Path Source Tree (SPT) mode	GC
ip pim ssm range	Sets the range for source-specific multicast addresses	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
clear ip pim bsr rp-set	Clears RP entries learned through the BSR	PE
show ip pim bsr-router	Displays information about the BSR	PE
show ip pim rp mapping	Displays active RPs and associated multicast routing entries	PE
show ip pim rp-hash	Displays the RP used for the specified multicast group	PE
show ip pim ssm range	Displays the range for source-specific multicast addresses	PE

PIM Shared Mode Commands

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-DM and PIM-SM globally for the router. You also need to enable PIM-DM or PIM-SM for each interface that will support multicast routing using the ip pim dense-mode or ip pim sparse mode command, and make any changes necessary to the multicast protocol parameters.

- To use multicast routing, IGMP proxy cannot be enabled on any interface of the device (see the ip igmp proxy command).

Example

```
Console(config)#router pim
Console(config)#exit
Console#show ip pim interface
PIM is enabled.
VLAN 1 is up.
 PIM Mode                 :      Dense 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
 Graft Retry Interval     :           3 sec
 Max Graft Retries        :           3
 State Refresh Ori Int    :          60 sec

Console#
```

ip pim

This command enables PIM-DM or PIM-SM on the specified interface. Use the **no** form to disable PIM-DM or PIM-SM on this interface.

Syntax

[**no**] **ip pim** {**dense-mode** | **sparse-mode**}

dense-mode - Enables PIM Dense 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-DM or 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. Dense mode interfaces are always added to the multicast routing table. 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.

- Dense-mode interfaces are subject to multicast flooding by default, and are only removed from the multicast routing table when the router determines that there are no group members or downstream routers, or when a prune message is received from a downstream router.

- 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 dense-mode
Console(config-if)#end
Console#show ip pim interface
PIM is enabled.
VLAN 1 is up.
 PIM Mode                 :      Dense 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
 Graft Retry Interval     :           3 sec
 Max Graft Retries        :           3
 State Refresh Ori Int    :          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 join-prune-holdtime

This command configures the hold time for the prune state. Use the **no** form to restore the default value.

Syntax

ip pim join-prune-holdtime *seconds*

no ip pim join-prune-holdtime

seconds - The hold time for the prune state. (Range: 0-65535)

Default Setting

210 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

The multicast interface that first receives a multicast stream from a particular source forwards this traffic to all other PIM interfaces on the router. If there are no requesting groups on that interface, the leaf node sends a prune message upstream and enters a prune state for this multicast stream. The prune state is maintained until the join-prune-holdtime timer expires or a graft message is received for the forwarding entry.

Example

```
Console(config-if)#ip pim join-prune-holdtime 60
Console(config-if)#
```

ip pim lan-prune-delay

This command causes this device to inform downstream routers of how long it will wait before pruning a flow after receiving a prune request. Use the **no** form to disable this feature.

Syntax

[**no**] **ip pim lan-prune-delay**

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- When other downstream routers on the same VLAN are notified that this upstream router has received a prune request, they must send a Join to override the prune before the prune delay expires if they want to continue receiving the flow. The message generated by this command effectively prompts any downstream neighbors with hosts receiving the flow to reply with a Join message. If no join messages are received after the prune delay expires, this router will prune the flow.

- Prune delay is the sum of the effective propagation-delay and effective override-interval, where effective propagation-delay is the largest propagation-delay from those advertised by each neighbor (including this switch), and effective override-interval is the largest override-interval from those advertised by each neighbor (including this switch).

Example

```
Console(config-if)#ip pim lan-prune-delay
Console(config-if)#
```

Related Commands

ip pim override-interval (1028)
ip pim propagation-delay (1029)

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)#
```

Related Commands

ip pim propagation-delay (1029)
ip pim lan-prune-delay (1027)

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)#
```

Related Commands

ip pim override-interval (1028)
ip pim lan-prune-delay (1027)

ip pim trigger-hello-delay

This command configures the maximum time before transmitting a triggered PIM Hello message after the router is rebooted or PIM is enabled on an interface. Use the **no** form to restore the default value.

Syntax

ip pim trigger-hello-delay *seconds*

no ip pim trigger-hello-delay

seconds - The maximum time before sending a triggered PIM Hello message. (Range: 0-5 seconds)

Default Setting

5 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

- When a router first starts or PIM is enabled on an interface, the hello delay is set to random value between 0 and the trigger-hello-delay. This prevents synchronization of Hello messages on multi-access links if multiple routers are powered on simultaneously.

- Also, if a Hello message is received from a new neighbor, the receiving router will send its own Hello message after a random delay between 0 and the trigger-hello-delay.

Example

```
Console(config-if)#ip pim trigger-hello-delay 3
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 up.
 PIM Mode                 :      Dense 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
 Graft Retry Interval     :           3 sec
 Max Graft Retries        :           3
 State Refresh Ori Int    :          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#
```

Table 201: show ip pim neighbor - display description

Field	Description
`Neighbor Address`	IP address of the next-hop router.
`VLAN Interface`	Interface number that is attached to this neighbor.
`Uptime`	The duration this entry has been active.

Table 201: show ip pim neighbor - display description (Continued)

Field	Description
`Expiration Time`	The time before this entry will be removed.
`DR`	The designated PIM-SM router. 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.

PIM-DM Commands

ip pim graft-retry-interval

This command configures the time to wait for a Graft acknowledgement before resending a Graft. Use the **no** form to restore the default value.

Syntax

ip pim graft-retry-interval *seconds*

no ip pim graft-retry-interval

seconds - The time before resending a Graft. (Range: 1-10 seconds)

Default Setting

3 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

A graft message is sent by a router to cancel a prune state. When a router receives a graft message, it must respond with an graft acknowledgement message. If this acknowledgement message is lost, the router that sent the graft message will resend it a number of times (as defined by the ip pim max-graft-retries command).

Example

```
Console(config-if)#ip pim graft-retry-interval 9
Console(config-if)#
```

ip pim max-graft-retries

This command configures the maximum number of times to resend a Graft message if it has not been acknowledged. Use the **no** form to restore the default value.

Syntax

ip pim max-graft-retries *retries*

no ip pim max-graft-retries

retries - The maximum number of times to resend a Graft. (Range: 1-10)

Default Setting

3

Command Mode

Interface Configuration (VLAN)

Example

```
Console(config-if)#ip pim max-graft-retries 5
Console(config-if)#
```

ip pim state-refresh origination-interval

This command sets the interval between sending PIM-DM state refresh control messages. Use the **no** form to restore the default value.

Syntax

ip pim state-refresh origination-interval *seconds*

no ip pim max-graft-retries

seconds - The interval between sending PIM-DM state refresh control messages. (Range: 1-100 seconds)

Default Setting

60 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

- The pruned state times out approximately every three minutes and the entire PIM-DM network is reflooded with multicast packets and prune messages. The state refresh feature keeps the pruned state from timing out by periodically forwarding a control message down the distribution tree, refreshing the prune state on the outgoing interfaces of each router in the tree. This also enables PIM routers to recognize topology changes (sources joining or leaving a multicast group) before the default three-minute state timeout expires.

- This command is only effectively for interfaces of first hop, PIM-DM routers that are directly connected to the sources of multicast groups.

Example

```
Console(config-if)#ip pim state-refresh origination-interval 30
Console(config-if)#
```

PIM-SM Commands

ip pim bsr-candidate

This command configures the switch as a Bootstrap Router (BSR) candidate. Use the **no** form to restore the default value.

Syntax

ip pim bsr-candidate interface vlan *vlan-id* [**hash** *hash-mask-length*] [**priority** *priority*]

no ip pim bsr-candidate

vlan-id - VLAN ID (Range: 1-4094)

hash-mask-length - Hash mask length (in bits) used for RP selection (see ip pim rp-candidate and ip pim rp-address). The portion of the hash specified by the mask length is ANDed with the group address. Therefore, when the hash function is executed on any BSR, all groups with the same seed hash will be mapped to the same RP. If the mask length is less than 32, then only the first portion of the hash is used, and a single RP will be defined for multiple groups. (Range: 0-32 bits)

priority - Priority used by the candidate bootstrap router in the election process. The BSR candidate with the largest priority is preferred. If the priority values are the same, the candidate with the larger IP address is elected to be the BSR. Setting the priority to zero means that this router is not eligible to server as the BSR. At least one router in the PIM-SM domain must be set to a value greater than zero. (Range: 0-255)

Default Setting

Hash Mask Length: 10
Priority: 0

Command Mode

Global Configuration

Command Usage

- When the **ip pim bsr-candidate** command is entered, the router starts sending bootstrap messages to all of its PIM-SM neighbors. The IP address of the designated VLAN is sent as the candidate's BSR address. Each neighbor receiving the bootstrap message compares the BSR address with the address from previous messages. If the current address is the same or a higher address, it accepts the bootstrap message and forwards it. Otherwise, it drops the message.

- This router will continue to be the BSR until it receives a bootstrap message from another candidate with a higher priority (or a higher IP address if the priorities are the same).

- To improve failover recovery, it is advisable to select at least two core routers in diverse locations, each to serve as both a candidate BSR and candidate RP. It is also preferable to set up one of these routers as both the primary BSR and RP.

Example

The following example configures the router to start sending bootstrap messages out of the interface for VLAN 1 to all of its PIM-SM neighbors.

```
Console(config)#ip pim bsr-candidate interface vlan 1 hash 20 priority 200
Console(config)#exit
Console#show ip pim bsr-router
PIMv2 Bootstrap information
BSR Address      : 192.168.0.2/32
Uptime           : 00:00:08
BSR Priority     : 200
Hash Mask Length : 20
Expire           : 00:00:57
Role             : Candidate BSR
State            : Elected BSR
Console#
```

ip pim register-rate-limit

This command configures the rate at which register messages are sent by the Designated Router (DR) for each (source, group) entry. Use the **no** form to restore the default value.

Syntax

ip pim register-rate-limit *rate*

no ip pim register-rate-limit

rate - The maximum number of register packets per second. (Range: 1-65535: Default: 0, which means no limit)

Default Setting

0

Command Mode

Global Configuration

Command Usage

This command can be used to relieve the load on the Designated Router (DR) and RP. However, because register messages exceeding the limit are dropped, some receivers may experience data packet loss within the first few seconds in which register messages are sent from bursty sources.

Example

This example sets the register rate limit to 500 pps.

```
Console(config)#ip pim register-rate-limit 500
Console(config)#
```

ip pim register-source

This command configures the IP source address of a register message to an address other than the outgoing interface address of the designated router (DR) that leads back toward the rendezvous point (RP). Use the **no** form to restore the default setting.

Syntax

ip pim register-source interface vlan *vlan-id*

no ip pim register-source

vlan-id - VLAN ID (Range: 1-4094)

Default Setting

The IP address of the DR's outgoing interface that leads back to the RP

Command Mode

Global Configuration

Command Usage

When the source address of a register message is filtered by intermediate network devices, or is not a uniquely routed address to which the RP can send packets, the replies sent from the RP to the source address will fail to reach the DR, resulting in PIM-SM protocol failures. This command can be used to overcome this type of problem by manually configuring the source address of register messages to an interface that leads back to the RP.

Example

This example sets the register rate limit to 500 pps.

```
Console(config)#ip pim register-source interface vlan 1
Console(config)#
```

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)#end
Console#show ip pim rp mapping
PIM Group-to-RP Mappings
Groups             : 224.0.0.0/4
RP address         : 192.168.1.1/32
Info source        : static
Uptime             : 00:00:33
Expire             : Never
Groups             : 224.9.0.0/16
RP address         : 192.168.2.1/32
```

```
Info source       : static
Uptime            : 00:00:21
Expire            : Never
Console#
```

ip pim rp-candidate

This command configures the router to advertise itself as a Rendezvous Point (RP) candidate to the bootstrap router (BSR). Use the **no** form to remove this router as an RP candidate.

Syntax

ip pim rp-candidate interface vlan *vlan-id* [**group-prefix** *group-address mask*] [**interval** *seconds*] [**priority** *value*]

no ip pim rp-candidate interface vlan *vlan-id*

vlan-id - VLAN ID (Range: 1-4094)

group-address - An IP multicast group address. If a group address is not specified, the RP is advertised for all multicast groups.

mask - Subnet mask that is used for the group address.

seconds - The interval at which this device advertises itself as an RP candidate. (Range: 60-16383 seconds)

value - Priority used by the candidate RP in the election process. The RP candidate with the largest priority is preferred. If the priority values are the same, the candidate with the larger IP address is elected to be the RP. Setting the priority to zero means that this router is not eligible to server as the RP. (Range: 0-255)

Default Setting

Address: 224.0.0.0/4, or the entire IPv4 multicast group family
Interval: 60 seconds
Priority: 0

Command Mode

Global Configuration

Command Usage

- When the **ip pim rp-candidate** command is entered, the router periodically sends PIMv2 messages to the BSR advertising itself as a candidate RP for the specified group addresses. The IP address of the designated VLAN is sent as the candidate's RP address. The BSR places information about all of the candidate RPs in subsequent bootstrap messages. The BSR uses the RP-election hash algorithm to select an active RP for each group range. The election process is performed by the BSR only for its own use. Each PIM-SM router that receives the list of RP candidates from the BSR also elects an active RP for each group range using the same election process.

- The election process for each group is based on the following criteria:
  - Find all RPs with the most specific group range.
  - Select those with the highest priority (lowest priority value).
  - Compute a hash value based on the group address, RP address, priority, and hash mask included in the bootstrap messages.
  - If there is a tie, use the candidate RP with the highest IP address.
- This distributed election process provides faster convergence and minimal disruption when an RP fails. It also serves to provide load balancing by distributing groups across multiple RPs. Moreover, when an RP fails, the responsible RPs are re-elected on each router, and the groups automatically distributed to the remaining RPs.
- To improve failover recovery, it is advisable to select at least two core routers in diverse locations, each to serve as both a candidate BSR and candidate RP. It is also preferable to set up one of these routers as both the primary BSR and RP.

Example

The following example configures the router to start advertising itself to the BSR as a candidate RP for the indicated multicast groups.

```
Console(config)#ip pim rp-candidate interface vlan 1 group-prefix 224.0.0.0
  255.0.0.0
Console(config)#end
Console#show ip pim rp mapping
PIM Group-to-RP Mappings
Groups           : 224.0.0.0/8
RP address       : 192.168.0.2/32
Info source      : 192.168.0.2/32, via bootstrap, priority: 0
Uptime           : 00:00:51
Expire           : 00:01:39
Console#
```

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 ssm range

This command sets the range for Source-specific Multicast (SSM) addresses. Use the **no** form to restore the default setting.

Syntax

ip pim ssm range *group-address mask*

no ip pim ssm range

group-address - Source-specific multicast group address. The address range that can be specified is 224.0.0.0 to 239.255.255.255.

mask - Subnet mask that is used for the group address.

Default Setting

232.0.0.0 255.0.0.0

Command Mode

Global Configuration

Command Usage

- For multicast group addresses that fall within fall within the default SSM range of 232/8 or within a range set by this command, source-specific multicast service mode is used. For all other multicast addresses, any-source multicast service mode is used.

- SSM requires the client to specify the multicast source address in registration messages. Only IGMPv3 currently supports the ability to designate a specific source in join messages sent to the last hop router in the multicast delivery tree. Therefore, IP multicast receiver applications will not receive any traffic if they try to use addresses in the SSM range, unless the host operating system and multicast application both support IGMPv3 explicit (S,G) channel subscription.

- Both Any-source Multicast (ASM) and SSM can be used on the same network interface because the multicast services address range used for SSM is restricted by default to 232/8 (that is 232.0.0.0 to 232.255.255.255). Therefore, any service requests from IGMPv1 or IGMPv2 clients within this address range will be denied. To use SSM in a network, the edge routers should therefore be made SSM-capable by enabling IGMPv3. The only requirement for core routers is that they are capable of forwarding IGMPv3 messages. However, when PIM-SM is used by either edge or core routers, the Rendezvous Point (RP) must not be configured to accept any registration messages for addresses within the configured SSM address range.

- SSM provides the following advantages over ASM:

  - SSM is suitable to dissemination-style applications with well-known senders. It defines service delivery channels on a per-source basis (for example, (S1,G)), and thereby avoids the problem of having to globally allocate multicast service addresses across the Internet.

  - Because SSM designates a specific source/group channel for each service request, it eliminates the problem of simultaneous delivery from multiple sources which can easily occur in the ASM delivery model. This makes it much more difficult to spam an SSM channel.

  - In contrast to PIM-SM, PIM-SSM uses only source-based forwarding. This thereby eliminates the need to collect and distribute information about local multicast devices using a bootstrap router, select a rendezvous point for coordinating service requests, and then build a shared tree for distributing multicast traffic to local clients.

- SSM has the following limitation — Because no mechanism in PIM-SSM notifies a receiver when a source is active, the network must maintain the (S,G) state as long as receivers are requesting receipt of that channel. Hence, as long as receivers send (S,G) subscriptions, the shortest path tree (SPT) state from the receivers to the source will be maintained, even if the source is not sending traffic for long periods of time, or has stopped sending altogether.

Example

This example sets the SSM address range to 224.2.151.0/24.

```
Console(config)#ip pim ssm range 224.2.151.0 255.255.255.0
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#
```

clear ip pim bsr rp-set

This command clears multicast group to RP mapping entries learned through the PIMv2 bootstrap router (BSR).

Command Mode

Privileged Exec

Command Usage

- This command can be used to update entries in the static multicast forwarding table immediately after making configuration changes to the RP.
- Use the show ip pim rp mapping command to display active RPs that are cached with associated multicast routing entries.

Example

This example clears the RP map.

```
Console#clear ip pim bsr rp-set
Console#show ip pim rp mapping
PIM Group-to-RP Mappings
Console#
```

show ip pim bsr-router

This command displays information about the bootstrap router (BSR).

Command Mode

Privileged Exec

Command Usage

This command displays information about the elected BSR.

Example

This example displays information about the BSR.

```
Console#show ip pim bsr-router
PIMv2 Bootstrap information
BSR Address       : 192.168.0.2/32
Uptime            : 01:01:23
BSR Priority      : 200
Hash Mask Length : 20
Expire            : 00:00:42
Role              : Candidate BSR
State             : Elected BSR
Console#
```

Table 202: show ip pim bsr-router - display description

Field	Description
`BSR Address`	IP address of interface configured as the BSR.
`Uptime`	The time this BSR has been up and running.
`BSR Priority`	Priority assigned to this interface for use in the BSR election process.
`Hash Mask Length`	The number of significant bits used in the multicast group comparison mask. This mask determines the multicast group for which this router can be a BSR.
`Expire`	The time before this entry will be removed.
`Role`	Candidate BSR or Non-candidate BSR.
`State`	Operation state of BSR includes: ◆ No information – No information stored for this device. ◆ Accept Any – The router does not know of an active BSR, and will accept the first bootstrap message it sees as giving the new BSR's identity and the RP-set. ◆ Accept Preferred – The router knows the identity of the current BSR, and is using the RP-set provided by that BSR. Only bootstrap messages from that BSR or from a C-BSR with higher weight than the current BSR will be accepted. ◆ Candidate BSR – Bidding in election process. ◆ Pending-BSR – The router is a candidate to be the BSR for the RP-set. Currently, no other router is the preferred BSR, but this router is not yet the elected BSR. ◆ Elected BSR – elected to serve as BSR

show ip pim rp mapping

This command displays active RPs and associated multicast routing entries.

Command Mode

Privileged Exec

Example

This example displays the RP map.

```
Console#show ip pim rp mapping
PIM Group-to-RP Mappings
Groups           : 224.0.0.0/8
RP address       : 192.168.0.2/32
Info source      : 192.168.0.2/32, via bootstrap, priority: 0
Uptime           : 00:31:09
Expire           : 00:02:21

Console#
```

Table 203: show ip pim rp mapping - display description

Field	Description
`Groups`	The multicast group address, mask length managed by the RP.
`RP address`	IP address of the RP used for the listed multicast group
`Info source`	RP that advertised the mapping, how the RP was selected (Static or Bootstrap), and the priority used in the bidding process
`Uptime`	The time this RP has been up and running
`Expire`	The time before this entry will be removed

show ip pim rp-hash

This command displays the RP used for the specified multicast group, and the RP that advertised the mapping.

Syntax

show ip pim rp-hash *group-address*

group-address - An IP multicast group address.

Command Mode

Privileged Exec

Example

This example displays the RP used for the specified group.

```
Console#show ip pim rp-hash 224.0.1.3
RP address          : 192.168.0.2/32
Info source         : 192.168.0.2/32, via (null)
Console#
```

Table 204: show ip pim rp-hash - display description

Field	Description
`RP address`	IP address of the RP used for the specified multicast group
`Info source`	RP that advertised the mapping, and how the RP was selected

show ip pim ssm range

This command displays the range for source-specific multicast (SSM) addresses.

Command Mode

Privileged Exec

Example

```
Console#show ip pim ssm range
Group-address:    224.2.151.0
Group-mask:       255.255.255.0
Console#
```

IPv6 PIM Commands

This section describes commands used to configure IPv6 PIM dynamic multicast routing on the switch.

Table 205: PIM-DM and PIM-SM Multicast Routing Commands

Command	Function	Mode
Shared Mode Commands		
router pim6	Enables IPv6 PIM globally for the router	GC
ipv6 pim	Enables PIM-DM or PIM-SM on the specified interface	IC
ipv6 pim hello-holdtime	Sets the time to wait for hello messages from a neighboring PIM router before declaring it dead	IC
ipv6 pim hello-interval	Sets the interval between sending PIM hello messages	IC
ipv6 pim join-prune-holdtime	Configures the hold time for the prune state	IC
ipv6 pim lan-prune-delay	Informs downstream routers of the delay before it prunes a flow after receiving a prune request	IC
ipv6 pim override-interval	Specifies the time it takes a downstream router to respond to a lan-prune-delay message	IC
ipv6 pim propagation-delay	Configures the propagation delay required for a LAN prune delay message to reach downstream routers	IC
ipv6 pim trigger-hello-delay	Configures the trigger hello delay	IC
show ipv6 pim interface	Displays information about interfaces configured for PIM	NE, PE
show ipv6 pim neighbor	Displays information about PIM neighbors	NE, PE

Table 205: PIM-DM and PIM-SM Multicast Routing Commands (Continued)

Command	Function	Mode
PIM-DM Commands		
ipv6 pim graft-retry-interval	Configures the time to wait for a Graft acknowledgement before resending a Graft message	IC
ipv6 pim max-graft-retries	Configures the maximum number of times to resend a Graft message if it has not been acknowledged	IC
ipv6 pim state-refresh origination-interval	Sets the interval between PIM-DM state refresh control messages	IC
PIM-SM Commands		
ipv6 pim bsr-candidate	Configures the switch as a Bootstrap Router (BSR) candidate	GC
ipv6 pim register-rate-limit	Configures the rate at which register messages are sent by the Designated Router (DR)	GC
ipv6 pim register-source	Configure the IP source address of a register message to an address other than the outgoing interface address of the designated router (DR) leading toward the rendezvous point (RP)	GC
ipv6 pim rp-address	Sets a static address for the rendezvous point	GC
ipv6 pim rp-candidate	Configures the switch rendezvous point (RP) candidate	GC
ipv6 pim spt-threshold	Prevents the last-hop PIM router from switching to Shortest Path Source Tree (SPT) mode	GC
ipv6 pim dr-priority	Sets the priority value for a DR candidate	IC
ipv6 pim join-prune-interval	Sets the join/prune timer	IC
clear ipv6 pim bsr rp-set	Clears RP entries learned through the BSR	PE
show ipv6 pim bsr-router	Displays information about the BSR	PE
show ipv6 pim rp mapping	Displays active RPs and associated multicast routing entries	PE
show ipv6 pim rp-hash	Displays the RP used for the specified multicast group	PE

PIM6 Shared Mode Commands

router pim6

This command enables IPv6 Protocol-Independent Multicast routing globally on the router. Use the **no** form to disable PIM multicast routing.

Syntax

[**no**] **router pim6**

Default Setting

Disabled

Command Mode

Global Configuration

Command Usage

- This command enables PIM-DM and PIM-SM for IPv6 globally for the router. You also need to enable PIM-DM and PIM-SM for each interface that will support multicast routing using the ipv6 pim command, and make any changes necessary to the multicast protocol parameters.

- To use PIMv6, IPv6 multicast routing must be enabled on the switch using the ipv6 multicast-routing command.

- To use IPv6 multicast routing, MLD proxy cannot be enabled on any interface of the device (see the ipv6 mld proxy command).

Example

```
Console(config)#router pim6
Console(config)#
```

ipv6 pim

This command enables IPv6 PIM-DM or PIM-SM on the specified interface. Use the **no** form to disable IPv6 PIM-DM or PIM-SM on this interface.

Syntax

[**no**] **ipv6 pim** {**dense-mode** | **sparse-mode**}

dense-mode - Enables PIM Dense 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 ipv6 multicast-routing command, enable PIM globally for the router with the router pim6 command, and also enable PIM-DM or 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 MLD (see "MLD (Layer 3)" on page 640) 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. Dense mode interfaces are always added to the multicast routing table. 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.

- Dense-mode interfaces are subject to multicast flooding by default, and are only removed from the multicast routing table when the router determines that there are no group members or downstream routers, or when a prune message is received from a downstream router.

- 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)#ipv6 pim dense-mode
Console(config-if)#end
Console#show ipv6 pim interface
PIM is enabled.
VLAN 1 is up.
 PIM Mode                : Dense Mode
 IPv6 Address            : None
 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
 Graft Retry Interval    : 3 sec
 Max Graft Retries       : 3
 State Refresh Ori Int   : 60 sec

Console#
```

ipv6 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

ipv6 pim hello-holdtime *seconds*

no ipv6 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 ipv6 pim hello-interval.

Example

```
Console(config-if)#ipv6 pim hello-holdtime 210
Console(config-if)#
```

ipv6 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

ipv6 pim hello-interval *seconds*

no pimv6 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)#ipv6 pim hello-interval 60
Console(config-if)#
```

ipv6 pim join-prune-holdtime

This command configures the hold time for the prune state. Use the **no** form to restore the default value.

Syntax

ipv6 pim join-prune-holdtime *seconds*

no ipv6 pim join-prune-holdtime

seconds - The hold time for the prune state. (Range: 0-65535)

Default Setting

210 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

The multicast interface that first receives a multicast stream from a particular source forwards this traffic to all other PIM interfaces on the router. If there are no requesting groups on that interface, the leaf node sends a prune message upstream and enters a prune state for this multicast stream. The prune state is maintained until the join-prune-holdtime timer expires or a graft message is received for the forwarding entry.

Example

```
Console(config-if)#ipv6 pim join-prune-holdtime 60
Console(config-if)#
```

ipv6 pim lan-prune-delay

This command causes this device to inform downstream routers of how long it will wait before pruning a flow after receiving a prune request. Use the **no** form to disable this feature.

Syntax

[**no**] **ipv6 pim lan-prune-delay**

Default Setting

Disabled

Command Mode

Interface Configuration (VLAN)

Command Usage

- When other downstream routers on the same VLAN are notified that this upstream router has received a prune request, they must send a Join to override the prune before the prune delay expires if they want to continue receiving the flow. The message generated by this command effectively prompts any downstream neighbors with hosts receiving the flow to reply with a Join message. If no join messages are received after the prune delay expires, this router will prune the flow.

- Prune delay is the sum of the effective propagation-delay and effective override-interval, where effective propagation-delay is the largest propagation-delay from those advertised by each neighbor (including this switch), and effective override-interval is the largest override-interval from those advertised by each neighbor (including this switch).

Example

```
Console(config-if)#ipv6 pim lan-prune-delay
Console(config-if)#
```

Related Commands

ipv6 pim override-interval (1053)
ipv6 pim propagation-delay (1054)

ipv6 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

ipv6 pim override-interval *milliseconds*

no ipv6 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 ipv6 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)#ipv6 pim override-interval 3500
Console(config-if)#
```

Related Commands

ipv6 pim propagation-delay (1054)
ipv6 pim lan-prune-delay (1052)

ipv6 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.

ipv6 pim propagation-delay *milliseconds*

no ipv6 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 ipv6 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)#ipv6 pim propagation-delay 600
Console(config-if)#
```

Related Commands

ipv6 pim override-interval (1053)
ipv6 pim lan-prune-delay (1052)

ipv6 pim trigger-hello-delay

This command configures the maximum time before transmitting a triggered PIM Hello message after the router is rebooted or PIM is enabled on an interface. Use the **no** form to restore the default value.

Syntax

ipv6 pim trigger-hello-delay *seconds*

no ipv6 pim trigger-hello-delay

seconds - The maximum time before sending a triggered PIM Hello message. (Range: 0-5)

Default Setting

5 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

- When a router first starts or PIM is enabled on an interface, the hello delay is set to random value between 0 and the trigger-hello-delay. This prevents synchronization of Hello messages on multi-access links if multiple routers are powered on simultaneously.

- Also, if a Hello message is received from a new neighbor, the receiving router will send its own Hello message after a random delay between 0 and the trigger-hello-delay.

Example

```
Console(config-if)#ipv6 pim trigger-hello-delay 3
Console(config-if)#
```

show ipv6 pim interface

This command displays information about interfaces configured for PIM.

Syntax

show ipv6 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 ipv6 pim interface vlan 1
PIM is enabled.
VLAN 1 is up.
 PIM Mode                : Dense Mode
 IPv6 Address            : fe80::7272:cfff:fe8c:2fef%1
 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
 Graft Retry Interval    : 3 sec
 Max Graft Retries       : 3
 State Refresh Ori Int   : 60 sec

Console#
```

show ipv6 pim neighbor

This command displays information about PIM neighbors.

Syntax

show ipv6 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 ipv6 pim neighbor
Neighbor Address                        VLAN Interface Uptime   Expire   DR
--------------------------------------- -------------- -------- -------- ---
FF80::0101                              VLAN 1         00:01:23 00:01:23 YES
FF80::0202                              VLAN 2         1d 11h   Never

Console#
```

Table 206: show ipv6 pim neighbor - display description

Field	Description
`Neighbor Address`	IP address of the next-hop router.
`VLAN Interface`	Interface number that is attached to this neighbor.
`Uptime`	The duration this entry has been active.
`Expiration Time`	The time before this entry will be removed.
`DR`	The designated PIM6-SM router. 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.

PIM6-DM Commands

ipv6 pim graft-retry-interval

This command configures the time to wait for a Graft acknowledgement before resending a Graft. Use the **no** form to restore the default value.

Syntax

ipv6 pim graft-retry-interval *seconds*

no ipv6 pim graft-retry-interval

seconds - The time before resending a Graft. (Range: 1-10 seconds)

Default Setting

3 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

A graft message is sent by a router to cancel a prune state. When a router receives a graft message, it must respond with an graft acknowledgement message. If this acknowledgement message is lost, the router that sent the graft message will resend it a number of times (as defined by the ipv6 pim max-graft-retries command).

Example

```
Console(config-if)#ipv6 pim graft-retry-interval 9
Console(config-if)#
```

Related Commands

ipv6 pim override-interval (1053)
ipv6 pim propagation-delay (1054)

ipv6 pim max-graft-retries

This command configures the maximum number of times to resend a Graft message if it has not been acknowledged. Use the **no** form to restore the default value.

Syntax

ipv6 pim max-graft-retries *retries*

no ipv6 pim max-graft-retries

retries - The maximum number of times to resend a Graft. (Range: 1-10)

Default Setting

3

Command Mode

Interface Configuration (VLAN)

Example

```
Console(config-if)#ipv6 pim max-graft-retries 5
Console(config-if)#
```

ipv6 pim state-refresh origination-interval

This command sets the interval between sending PIM-DM state refresh control messages. Use the **no** form to restore the default value.

Syntax

ipv6 pim state-refresh origination-interval *seconds*

no ipv6 pim max-graft-retries

seconds - The interval between sending PIM-DM state refresh control messages. (Range: 1-100 seconds)

Default Setting

60 seconds

Command Mode

Interface Configuration (VLAN)

Command Usage

- The pruned state times out approximately every three minutes and the entire PIM-DM network is reflooded with multicast packets and prune messages. The state refresh feature keeps the pruned state from timing out by periodically forwarding a control message down the distribution tree, refreshing the prune state on the outgoing interfaces of each router in the tree. This also enables PIM routers to recognize topology changes (sources joining or leaving a multicast group) before the default three-minute state timeout expires.

- This command is only effectively for interfaces of first hop, PIM-DM routers that are directly connected to sources of multicast groups.

Example

```
Console(config-if)#ipv6 pim state-refresh origination-interval 30
Console(config-if)#
```

PIM6-SM Commands

ipv6 pim bsr-candidate

This command configures the switch as a Bootstrap Router (BSR) candidate. Use the **no** form to restore the default value.

Syntax

ipv6 pim bsr-candidate interface vlan *vlan-id* [**hash** *hash-mask-length*] [**priority** *priority*]

no ipv6 pim bsr-candidate

vlan-id - VLAN ID (Range: 1-4094)

hash-mask-length - Hash mask length (in bits) used for RP selection (see ipv6 pim rp-candidate and ipv6 pim rp-address). The portion of the hash specified by the mask length is ANDed with the group address. Therefore, when the hash function is executed on any BSR, all groups with the same seed hash will be mapped to the same RP. If the mask length is less than 32, then only the first portion of the hash is used, and a single RP will be defined for multiple groups. (Range: 0-32 bits)

priority - Priority used by the candidate bootstrap router in the election process. The BSR candidate with the largest priority is preferred. If the priority values are the same, the candidate with the larger IP address is elected to be the BSR. Setting the priority to zero means that this router is not eligible to server as the BSR. At least one router in the PIM6-SM domain must be set to a value greater than zero. (Range: 0-255)

Default Setting

Hash Mask Length: 10
Priority: 0

Command Mode

Global Configuration

Command Usage

- When the **ipv6 pim bsr-candidate** command is entered, the router starts sending bootstrap messages to all of its PIM6-SM neighbors. The IP address of the designated VLAN is sent as the candidate's BSR address. Each neighbor receiving the bootstrap message compares the BSR address with the address from previous messages. If the current address is the same or a higher address, it accepts the bootstrap message and forwards it. Otherwise, it drops the message.

- This router will continue to be the BSR until it receives a bootstrap message from another candidate with a higher priority (or a higher IP address if the priorities are the same).

- To improve failover recovery, it is advisable to select at least two core routers in diverse locations, each to serve as both a candidate BSR and candidate RP. It is also preferable to set up one of these routers as both the primary BSR and RP.

Example

The following example configures the router to start sending bootstrap messages out of the interface for VLAN 1 to all of its PIM-SM neighbors.

```
Console(config)#ipv6 pim bsr-candidate interface vlan 1 hash 20 priority 200
Console(config)#exit
Console#show ipv6 pim bsr-router
PIMv2 Bootstrap information
BSR Address      : 2001:DB8:2222:7272::72
Uptime           : 00:00:08
BSR Priority     : 200
Hash Mask Length : 20
Expire           : 00:00:57
Role             : Candidate BSR
```

```
State              : Elected BSR
Console#
```

ipv6 pim register-rate-limit

This command configures the rate at which register messages are sent by the Designated Router (DR) for each (source, group) entry. Use the **no** form to restore the default value.

Syntax

ipv6 pim register-rate-limit *rate*

no ipv6 pim register-rate-limit

rate - The maximum number of register packets per second. (Range: 1-65535: Default: 0, which means no limit)

Default Setting

0

Command Mode

Global Configuration

Command Usage

This command can be used to relieve the load on the Designated Router (DR) and RP. However, because register messages exceeding the limit are dropped, some receivers may experience data packet loss within the first few seconds in which register messages are sent from bursty sources.

Example

This example sets the register rate limit to 500 pps.

```
Console(config)#ipv6 pim register-rate-limit 500
Console(config)#
```

ipv6 pim register-source

This command configures the IP source address of a register message to an address other than the outgoing interface address of the designated router (DR) that leads back toward the rendezvous point (RP). Use the **no** form to restore the default setting.

Syntax

ipv6 pim register-source interface vlan *vlan-id*

no ipv6 pim register-source

vlan-id - VLAN ID (Range: 1-4094)

Default Setting

The IP address of the DR's outgoing interface that leads back to the RP

Command Mode

Global Configuration

Command Usage

When the source address of a register message is filtered by intermediate network devices, or is not a uniquely routed address to which the RP can send packets, the replies sent from the RP to the source address will fail to reach the DR, resulting in PIM6-SM protocol failures. This command can be used to overcome this type of problem by manually configuring the source address of register messages to an interface that leads back to the RP.

Example

This example sets the register source address to the interface address for VLAN 1.

```
Console(config)#ipv6 pim register-source interface vlan 1
Console(config)#
```

ipv6 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**] **ipv6 pim rp-address** *rp-address* [**group-prefix** *group-prefix*]

rp-address - Static IPv6 address of the router that will be an RP for the specified multicast group(s).

group-prefix - An IPv6 network prefix for a multicast group. If a group prefix is not specified, the RP is used for all multicast groups.

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 PIM6-SM domain if no groups are specified. A static RP can either be configured for the whole multicast group range FF00::/8, 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 PIM6-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, 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)#ipv6 pim rp-address 2001:DB8:2222:7272::72
Console(config)#ipv6 pim rp-address 2001:DB8:2222:7272::72 group-prefix
  FFAA::0101/8
Console(config)#end
Console#show ipv6 pim rp mapping
PIM Group-to-RP Mappings
Groups            : FF00::/8
RP address        : 2001:DB8:2222:7272::72/128
Info source       : static
Uptime            : 00:03:10
Expire            : Never
Console#
```

ipv6 pim rp-candidate

This command configures the router to advertise itself as a Rendezvous Point (RP) candidate to the bootstrap router (BSR). Use the **no** form to remove this router as an RP candidate.

Syntax

ipv6 pim rp-candidate interface vlan *vlan-id*
[**group-prefix** *group-prefix*] [**interval** *seconds*] [**priority** *value*]

no ipv6 pim rp-candidate interface vlan *vlan-id*

vlan-id - VLAN ID (Range: 1-4094)

group-prefix - An IPv6 network prefix for a multicast group. If a group prefix is not specified, the RP is advertised for all multicast groups.

seconds - The interval at which this device advertises itself as an RP candidate. (Range: 60-16383 seconds)

value - Priority used by the candidate RP in the election process. The RP candidate with the largest priority is preferred. If the priority values are the same, the candidate with the larger IP address is elected to be the RP. Setting the priority to zero means that this router is not eligible to server as the RP. (Range: 0-255)

Default Setting

Interval: 60 seconds
Priority: 0

Command Mode

Global Configuration

Command Usage

- When the **ipv6 pim rp-candidate** command is entered, the router periodically sends PIMv2 messages to the BSR advertising itself as a candidate RP for the specified group addresses. The IP address of the designated VLAN is sent as the candidate's RP address. The BSR places information about all of the candidate RPs in subsequent bootstrap messages. The BSR uses the RP-election hash algorithm to select an active RP for each group range. The el6ection process is performed by the BSR only for its own use. Each PIM-SM router that receives the list of RP candidates from the BSR also elects an active RP for each group range using the same election process.

- The election process for each group is based on the following criteria:

  - Find all RPs with the most specific group range.

  - Select those with the highest priority (lowest priority value).

  - Compute a hash value based on the group address, RP address, priority, and hash mask included in the bootstrap messages.

  - If there is a tie, use the candidate RP with the highest IP address.

- This distributed election process provides faster convergence and minimal disruption when an RP fails. It also serves to provide load balancing by distributing groups across multiple RPs. Moreover, when an RP fails, the responsible RPs are re-elected on each router, and the groups automatically distributed to the remaining RPs.

- To improve failover recovery, it is advisable to select at least two core routers in diverse locations, each to serve as both a candidate BSR and candidate RP. It is also preferable to set up one of these routers as both the primary BSR and RP.

Example

The following example configures the router to start advertising itself to the BSR as a candidate RP for the indicated multicast groups.

```
Console(config)#ipv6 pim rp-candidate interface vlan 1 group-prefix
  FFAA::0101/8
Console(config)#end
Console#show ipv6 pim rp mapping
PIM Group-to-RP Mappings
Groups            : FF00::/8
RP address        : 2001:DB8:2222:7272::72/128
Info source       : 2001:DB8:2222:7272::72/128, via bootstrap, priority: 0
Uptime            : 00:02:35
Expire            : 00:01:55
Console#
```

ipv6 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

ipv6 pim spt-threshold infinity [**group-prefix** *group-prefix*]

no ipv6 pim spt-threshold infinity

group-prefix - An IPv6 network prefix for a multicast group. If a group address is not specified, the command applies to all multicast groups. (Range: FFXX:X:X:X::X/<8-128>)

Default Setting

The last-hop PIM6 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 FF01:1::0101/64.

```
Console(config)#interface vlan 1
Console(config-if)#ipv6 pim sparse-mode
Console(config-if)#exit
Console(config)#ipv6 multicast-routing
Console(config)#router pim6
Console(config)#ipv6 pim spt-threshold infinity group-prefix FF01:1::0101/64
Console#
```

ipv6 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

ipv6 pim dr-priority *priority-value*

no ipv6 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)#ipv6 pim dr-priority 20
Console(config-if)#end
Console#show ipv6 pim interface
PIM is enabled.
VLAN 1 is up.
 PIM Mode                : Sparse Mode
 IPv6 Address            : FE80::200:E8FF:FE93:82A0
 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#
```

ipv6 pim join-prune-interval

This command sets the join/prune timer. Use the **no** form to restore the default setting.

Syntax

ipv6 pim join-prune-interval *seconds*

no ipv6 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)#ipv6 pim join-prune-interval 220
Console#show ipv6 pim interface
PIM is enabled.
VLAN 1 is up.
 PIM Mode                : Sparse Mode
 IPv6 Address            : FE80::200:E8FF:FE93:82A0
 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             : 1
 Join/Prune Interval     : 220 sec

Console#
```

clear ipv6 pim bsr rp-set

This command clears multicast group to RP mapping entries learned through the PIMv2 bootstrap router (BSR).

Command Mode

Privileged Exec

Command Usage

- This command can be used to update entries in the static multicast forwarding table immediately after making configuration changes to the RP.

- Use the show ipv6 pim rp mapping command to display active RPs that are cached with associated multicast routing entries.

Example

This example clears the RP map.

```
Console#clear ipv6 pim bsr rp-set
Console#show ipv6 pim rp mapping
PIM Group-to-RP Mappings
Console#
```

show ipv6 pim bsr-router

This command displays information about the bootstrap router (BSR).

Command Mode

Privileged Exec

Command Usage

This command displays information about the elected BSR.

Example

This example displays information about the BSR.

```
Console#show ipv6 pim bsr-router
PIMv2 Bootstrap information
BSR address      : 2001:DB8:2222:7272::72/128
Uptime           : 00:00:04
BSR Priority     : 200
Hash mask length : 20
Expire           : 00:02:06
Role             : Candidate BSR
State            : Elected BSR
Console#
```

Table 207: show ip pim bsr-router - display description

Field	Description
`BSR Address`	IP address of interface configured as the BSR.
`Uptime`	The time this BSR has been up and running.
`BSR Priority`	Priority assigned to this interface for use in the BSR election process.
`Hash Mask Length`	The number of significant bits used in the multicast group comparison mask. This mask determines the multicast group for which this router can be a BSR.
`Expire`	The time before this entry will be removed.
`Role`	Candidate BSR or Non-candidate BSR.
`State`	Operation state of BSR includes: ◆ No information – No information stored for this device. ◆ Accept Any – The router does not know of an active BSR, and will accept the first bootstrap message it sees as giving the new BSR's identity and the RP-set. ◆ Accept Preferred – The router knows the identity of the current BSR, and is using the RP-set provided by that BSR. Only bootstrap messages from that BSR or from a C-BSR with higher weight than the current BSR will be accepted. ◆ Candidate BSR – Bidding in election process. ◆ Pending-BSR – The router is a candidate to be the BSR for the RP-set. Currently, no other router is the preferred BSR, but this router is not yet the elected BSR. ◆ Elected BSR – elected to serve as BSR

show ipv6 pim rp mapping

This command displays active RPs and associated multicast routing entries.

Command Mode

Privileged Exec

Example

This example displays the RP map.

```
Console#show ipv6 pim rp mapping
PIM Group-to-RP Mappings
Groups              : FF00::/8
RP address          : 2001:DB8:2222:7272::72/128
Info source         : static
Uptime              : 00:23:21
Expire              : Never
Console#
```

Table 208: show ip pim rp mapping - display description

Field	Description
`Groups`	The multicast group address, mask length managed by the RP.
`RP address`	IP address of the RP used for the listed multicast group
`Info source`	RP that advertised the mapping, how the RP was selected (Static or Bootstrap), and the priority used in the bidding process
`Uptime`	The time this RP has been up and running
`Expire`	The time before this entry will be removed

show ipv6 pim rp-hash

This command displays the RP used for the specified multicast group, and the RP that advertised the mapping.

Syntax

show ipv6 pim rp-hash *group-address*

group-address - An IP multicast group address.

Command Mode

Privileged Exec

Example

This example displays the RP used for the specified group.

```
Console#show ipv6 pim rp-hash FF00::
RP address          : 2001:DB8:2222:7272::72/128
Info source         : 2001:1::0101, via bootstrap
Console#
```

Table 209: show ip pim rp-hash - display description

Field	Description
`RP address`	IP address of the RP used for the specified multicast group
`Info source`	RP that advertised the mapping, and how the RP was selected

Section III

Appendices

This section provides additional information and includes these items:

A

Legacy and Hybrid Operating Mode Feature Set Differences

Table 210: Legacy and Hybrid Operating Mode Feature Set Differences

Function	Feature	Legacy Mode	Hybrid Mode
L2 Features			
Link Aggregation	802.3ad with LACP	YES 1) Total 27 Trunks (including Cisco EtherChannel Like trunks) 2) 2~8 port/trunk 10GE 3) 2~4 port/trunk 40GE	NO
	Cisco EtherChannel Like	YES 1) Total 27 Trunks (including Cisco EtherChannel Like trunks) 2) 2~8 port/trunk 10GE 3) 2~4 port/trunk 40GE	NO
	Unicast/Multicast load balance over trunking port	YES (load balance mechanism: SA/DS/SIP/DIP)	NO
VLAN	Traffic Segmentation (Port Isolation)	YES	NO
Spanning Tree	IEEE 802.1D STP	YES	NO
	IEEE 802.1s MSTP	YES (32 instances)	NO
	IEEE802.1w RSTP	YES	NO
	Spanning Tree Fast Forwarding	YES	NO
	Auto EdgePort	YES	NO
IGMP Snooping	IGMP Snooping v1/v2	YES (1K groups)	NO
	IGMP v1/v2 querier support	YES	NO
	IGMP Immediate Leave	YES	NO
	IGMP Filtering/ Throttling	YES	NO
	IGMP SNMP Proxy(V1/V2/V3)	YES	NO
	Source Filtering Mode Data Forwarding	YES	NO

Table 210: Legacy and Hybrid Operating Mode Feature Set Differences

Function	Feature	Legacy Mode	Hybrid Mode
DiffServ	SRTCM (1 rate 3 color) Color aware /color blind	YES	NO
	TRTCM (2 rate 3 color) Color aware /color blind	YES	NO
	Ingress Policy map	YES	NO
	Egress Policy map	YES	NO
Security Features			
ACL	Ingress	YES	NO
	Egress	YES	NO
	Statistics	YES	NO
User Name/ Password Authentication	Remote Authentication via RADIUS	YES	NO
	Remote Authentication via TACACS+	YES	NO
HTTPS and SSL (Secured Web)		YES	NO
Management Interface Access Filtering (SNMP, WEB, TELNET)		YES	NO
Management Features			
Software Download/ Upgrade	TFTP	YES	NO
	FTP	YES	NO
	HTTP	YES	NO
RMON	RMON1 (1,2,3,9 groups)	YES	NO
	RMON2	YES (partial implementation)	NO
DHCP	Relay	YES	NO
LLDP (802.1ab)	Link Layer Discovery Protocol	YES	NO
	LLDP-MED (VoIP related)	YES	NO
	IEEE 802.3at	YES	NO
Mac Flush		YES	NO
sFlow(V4/V5)		YES	NO
CLI “show debug”		YES	NO

Table 210: Legacy and Hybrid Operating Mode Feature Set Differences

Function	Feature	Legacy Mode	Hybrid Mode
CLI "show tech"		YES	NO
IPV6 Management (Telnet Server/ ICMP v6)		YES	NO
MAC learning		YES	NO
USB Port Management		YES	NO
IPv6 Features			
SNMP over IPv6		YES	NO
HTTP over IPv6		YES	NO
IPv6 sFlow		YES	NO
DHCPv6	Client	YES	NO
	Relay	YES	NO
IPv6 Security Features			
IPv6 ACL		YES	NO
L3 Features IPv4			
Multi-netting		YES	NO
CIDR (Classless Inter-Domain Routing)		YES	NO
Unicast Routing	Static Unicast Routes	YES	NO
	Equal Cost multipath routing (ECMP)	YES	NO
	OSPF	YES	NO
ARP		YES Global share with routing entries) 1) Static arp 256 Entries 2) Dynamic arp 16K-512-256 Entries	NO
Data Center Features			
802.1Qbb (PFC)		YES	NO
802.1Qau (ECN)		YES	NO
802.1Qaz (ETS)		YES	NO
DCBx		YES	NO
MLAG		YES	NO
OpenFlow 1.3	Ingress Port Flow Table	NO	YES
	VLAN Flow Table	NO	YES

Table 210: Legacy and Hybrid Operating Mode Feature Set Differences

Function	Feature	Legacy Mode	Hybrid Mode
	Termination MAC Flow Table	NO	YES
	Bridging Flow Table	NO	YES
	Unicast Routing Flow Table	NO	YES
	Multicast Routing Flow Table	NO	YES
	ACL Policy Flow Table	NO	YES

B

Troubleshooting

Problems Accessing the Management Interface

Table 211: 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 both an RSA and DSA 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
⋮
```

C

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Glossary

ACL Access Control List. ACLs can limit network traffic and restrict access to certain users or devices by checking each packet for certain IP or MAC (i.e., Layer 2) information.

ARP Address Resolution Protocol converts between IP addresses and MAC (hardware) addresses. ARP is used to locate the MAC address corresponding to a given IP address. This allows the switch to use IP addresses for routing decisions and the corresponding MAC addresses to forward packets from one hop to the next.

CoS Class of Service is supported by prioritizing packets based on the required level of service, and then placing them in the appropriate output queue. Data is transmitted from the queues using weighted round-robin service to enforce priority service and prevent blockage of lower-level queues. Priority may be set according to the port default, the packet's priority bit (in the VLAN tag), TCP/UDP port number, IP Precedence bit, or DSCP priority bit.

DHCP Dynamic Host Control Protocol. Provides a framework for passing configuration information to hosts on a TCP/IP network. DHCP is based on the Bootstrap Protocol (BOOTP), adding the capability of automatic allocation of reusable network addresses and additional configuration options.

DHCP Option 82 A relay option for sending information about the requesting client (or an intermediate relay agent) in the DHCP request packets forwarded by the switch and in reply packets sent back from the DHCP server. This information can be used by DHCP servers to assign fixed IP addresses, or set other services or policies for clients.

DHCP Snooping A technique used to enhance network security by snooping on DHCP server messages to track the physical location of hosts, ensure that hosts only use the IP addresses assigned to them, and ensure that only authorized DHCP servers are accessible.

DiffServ Differentiated Services provides quality of service on large networks by employing a well-defined set of building blocks from which a variety of aggregate forwarding behaviors may be built. Each packet carries information (DS byte) used by each hop to give it a particular forwarding treatment, or per-hop behavior, at each network node. DiffServ allocates different levels of service to users on the network with mechanisms such as traffic meters, shapers/droppers, packet markers at the boundaries of the network.

DNS Domain Name Service. A system used for translating host names for network nodes into IP addresses.

DSCP Differentiated Services Code Point Service. DSCP uses a six-bit tag to provide for up to 64 different forwarding behaviors. Based on network policies, different kinds of traffic can be marked for different kinds of forwarding. The DSCP bits are mapped to the Class of Service categories, and then into the output queues.

EAPOL Extensible Authentication Protocol over LAN. EAPOL is a client authentication protocol used by this switch to verify the network access rights for any device that is plugged into the switch. A user name and password is requested by the switch, and then passed to an authentication server (e.g., RADIUS) for verification. EAPOL is implemented as part of the IEEE 802.1X Port Authentication standard.

EUI Extended Universal Identifier is an address format used by IPv6 to identify the host portion of the network address. The interface identifier in EUI compatible addresses is based on the link-layer (MAC) address of an interface. Interface identifiers used in global unicast and other IPv6 address types are 64 bits long and may be constructed in the EUI-64 format. The modified EUI-64 format interface ID is derived from a 48-bit link-layer address by inserting the hexadecimal number FFFE between the upper three bytes (OUI field) and the lower 3 bytes (serial number) of the link layer address. To ensure that the chosen address is from a unique Ethernet MAC address, the 7th bit in the high-order byte is set to 1 (equivalent to the IEEE Global/Local bit) to indicate the uniqueness of the 48-bit address.

GARP Generic Attribute Registration Protocol. GARP is a protocol that can be used by endstations and switches to register and propagate multicast group membership information in a switched environment so that multicast data frames are propagated only to those parts of a switched LAN containing registered endstations. Formerly called Group Address Registration Protocol.

GMRP Generic Multicast Registration Protocol. GMRP allows network devices to register end stations with multicast groups. GMRP requires that any participating network devices or end stations comply with the IEEE 802.1p standard.

GVRP GARP VLAN Registration Protocol. Defines a way for switches to exchange VLAN information in order to register necessary VLAN members on ports along the Spanning Tree so that VLANs defined in each switch can work automatically over a Spanning Tree network.

ICMP Internet Control Message Protocol is a network layer protocol that reports errors in processing IP packets. ICMP is also used by routers to feed back information about better routing choices.

IEEE 802.1D Specifies a general method for the operation of MAC bridges, including the Spanning Tree Protocol.

IEEE 802.1Q VLAN Tagging—Defines Ethernet frame tags which carry VLAN information. It allows switches to assign endstations to different virtual LANs, and defines a standard way for VLANs to communicate across switched networks.

IEEE 802.1p An IEEE standard for providing quality of service (QoS) in Ethernet networks. The standard uses packet tags that define up to eight traffic classes and allows switches to transmit packets based on the tagged priority value.

IEEE 802.1s An IEEE standard for the Multiple Spanning Tree Protocol (MSTP) which provides independent spanning trees for VLAN groups.

IEEE 802.1w An IEEE standard for the Rapid Spanning Tree Protocol (RSTP) which reduces the convergence time for network topology changes to about 10% of that required by the older IEEE 802.1D STP standard. (Now incorporated in IEEE 802.1D-2004)

IEEE 802.1X Port Authentication controls access to the switch ports by requiring users to first enter a user ID and password for authentication.

IEEE 802.3ac Defines frame extensions for VLAN tagging.

IEEE 802.3x Defines Ethernet frame start/stop requests and timers used for flow control on full-duplex links. (Now incorporated in IEEE 802.3-2002)

IGMP Internet Group Management Protocol. A protocol through which hosts can register with their local router for multicast services. If there is more than one multicast switch/router on a given subnetwork, one of the devices is made the “querier” and assumes responsibility for keeping track of group membership.

IGMP Proxy Proxies multicast group membership information onto the upstream interface based on IGMP messages monitored on downstream interfaces, and forwards multicast traffic based on that information. There is no need for multicast routing protocols in an simple tree that uses IGMP Proxy.

IGMP Query On each subnetwork, one IGMP-capable device will act as the querier — that is, the device that asks all hosts to report on the IP multicast groups they wish to join or to which they already belong. The elected querier will be the device with the lowest IP address in the subnetwork.

IGMP Snooping Listening to IGMP Query and IGMP Report packets transferred between IP Multicast Routers and IP Multicast host groups to identify IP Multicast group members.

In-Band Management Management of the network from a station attached directly to the network.

IP Multicast Filtering A process whereby this switch can pass multicast traffic along to participating hosts.

IP Precedence The Type of Service (ToS) octet in the IPv4 header includes three precedence bits defining eight different priority levels ranging from highest priority for network control packets to lowest priority for routine traffic. The eight values are mapped one-to-one to the Class of Service categories by default, but may be configured differently to suit the requirements for specific network applications.

LACP Link Aggregation Control Protocol. Allows ports to automatically negotiate a trunked link with LACP-configured ports on another device.

Layer 2 Data Link layer in the ISO 7-Layer Data Communications Protocol. This is related directly to the hardware interface for network devices and passes on traffic based on MAC addresses.

Layer 3 Network layer in the ISO 7-Layer Data Communications Protocol. This layer handles the routing functions for data moving from one open system to another.

Link Aggregation *See Port Trunk*.

LLDP Link Layer Discovery Protocol is used to discover basic information about neighboring devices in the local broadcast domain by using periodic broadcasts to advertise information such as device identification, capabilities and configuration settings.

MD5 MD5 Message-Digest is an algorithm that is used to create digital signatures. It is intended for use with 32 bit machines and is safer than the MD4 algorithm, which has been broken. MD5 is a one-way hash function, meaning that it takes a message and converts it into a fixed string of digits, also called a message digest.

MIB Management Information Base. An acronym for Management Information Base. It is a set of database objects that contains information about a specific device.

MRD Multicast Router Discovery is a A protocol used by IGMP snooping and multicast routing devices to discover which interfaces are attached to multicast routers. This process allows IGMP-enabled devices to determine where to send multicast source and group membership messages.

MSTP Multiple Spanning Tree Protocol can provide an independent spanning tree for different VLANs. It simplifies network management, provides for even faster convergence than RSTP by limiting the size of each region, and prevents VLAN members from being segmented from the rest of the group.

Multicast Switching A process whereby the switch filters incoming multicast frames for services for which no attached host has registered, or forwards them to all ports contained within the designated multicast VLAN group.

MVR Multicast VLAN Registration is a method of using a single network-wide multicast VLAN to transmit common services, such as such as television channels or video-on-demand, across a service-provider's network. MVR simplifies the configuration of multicast services by using a common VLAN for distribution, while still preserving security and data isolation for subscribers residing in both the MVR VLAN and other standard or

private VLAN groups.

NTP Network Time Protocol provides the mechanisms to synchronize time across the network. The time servers operate in a hierarchical-master-slave configuration in order to synchronize local clocks within the subnet and to national time standards via wire or radio.

OSPF Open Shortest Path First is a link-state routing protocol that functions better over a larger network such as the Internet, as opposed to distance-vector routing protocols such as RIP. It includes features such as unlimited hop count, authentication of routing updates, and Variable Length Subnet Masks (VLSM).

Out-of-Band Management Management of the network from a station not attached to the network.

Port Authentication *See IEEE 802.1X.*

Port Mirroring A method whereby data on a target port is mirrored to a monitor port for troubleshooting with a logic analyzer or RMON probe. This allows data on the target port to be studied unobstructively.

Port Trunk Defines a network link aggregation and trunking method which specifies how to create a single high-speed logical link that combines several lower-speed physical links.

Private VLANs Private VLANs provide port-based security and isolation between ports within the assigned VLAN. Data traffic on downlink ports can only be forwarded to, and from, uplink ports.

QinQ QinQ tunneling is designed for service providers carrying traffic for multiple customers across their networks. It is used to maintain customer-specific VLAN and Layer 2 protocol configurations even when different customers use the same internal VLAN IDs.

QoS Quality of Service. QoS refers to the capability of a network to provide better service to selected traffic flows using features such as data prioritization, queuing, congestion avoidance and traffic shaping. These features effectively provide preferential treatment to specific flows either by raising the priority of one flow or limiting the priority of another flow.

RADIUS 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-compliant devices on the network.

RIP Routing Information Protocol seeks to find the shortest route to another device by minimizing the distance-vector, or hop count, which serves as a rough estimate of transmission cost. RIP-2 is a compatible upgrade to RIP. It adds useful capabilities for subnet routing, authentication, and multicast transmissions.

RMON Remote Monitoring. RMON provides comprehensive network monitoring capabilities. It eliminates the polling required in standard SNMP, and can set alarms on a variety of traffic conditions, including specific error types.

RSTP Rapid Spanning Tree Protocol. RSTP reduces the convergence time for network topology changes to about 10% of that required by the older IEEE 802.1D STP standard.

SMTP Simple Mail Transfer Protocol is a standard host-to-host mail transport protocol that operates over TCP, port 25.

SNMP Simple Network Management Protocol. The application protocol in the Internet suite of protocols which offers network management services.

SNTP Simple Network Time Protocol allows a device to set its internal clock based on periodic updates from a Network Time Protocol (NTP) server. Updates can be requested from a specific NTP server, or can be received via broadcasts sent by NTP servers.

SSH Secure Shell is a secure replacement for remote access functions, including Telnet. SSH can authenticate users with a cryptographic key, and encrypt data connections between management clients and the switch.

STA Spanning Tree Algorithm is a technology that checks your network for any loops. A loop can often occur in complicated or backup linked network systems. Spanning Tree detects and directs data along the shortest available path, maximizing the performance and efficiency of the network.

TACACS+ Terminal Access Controller Access Control System Plus. TACACS+ is a logon authentication protocol that uses software running on a central server to control access to TACACS-compliant devices on the network.

TCP/IP Transmission Control Protocol/Internet Protocol. Protocol suite that includes TCP as the primary transport protocol, and IP as the network layer protocol.

Telnet Defines a remote communication facility for interfacing to a terminal device over TCP/IP.

TFTP Trivial File Transfer Protocol. A TCP/IP protocol commonly used for software downloads.

UDP User Datagram Protocol. UDP provides a datagram mode for packet-switched communications. It uses IP as the underlying transport mechanism to provide access to IP-like services. UDP packets are delivered just like IP packets – connection-less datagrams that may be discarded before reaching their targets. UDP is useful when TCP would be too complex, too slow, or just unnecessary.

UTC Universal Time Coordinate. UTC is a time scale that couples Greenwich Mean Time (based solely on the Earth’s rotation rate) with highly accurate atomic time. The UTC does not have daylight saving time.

VLAN Virtual LAN. A Virtual LAN is a collection of network nodes that share the same collision domain regardless of their physical location or connection point in the network. A VLAN serves as a logical workgroup with no physical barriers, and allows users to share information and resources as though located on the same LAN.

VRRP Virtual Router Redundancy Protocol uses a virtual IP address to support a primary router and multiple backup routers. The backups can be configured to take over the workload if the master fails or to load share the traffic. The primary goal of VRRP 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.

XModem A protocol used to transfer files between devices. Data is grouped in 128-byte blocks and error-corrected.

List of CLI Commands

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AS5700-54X
AS6700-32X
E032016/ST-R02
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