Clemson University Enables Research-Based Education

With OpenStack and Big Cloud Fabric

Executive Summary

Customer Name: Clemson University

Industry: Higher Education

Location: South Carolina

Number of Students: 21,303 (16,931 are under graduate students)

Objective:

- Speed delivery of course specific software to students by providing every student with common Virtual Desktop environment
- Reduce operational complexity for IT staff by allowing them to provision and sandbox applications centrally for entire classes, regardless of size
- Build a scalable and economical solution to address current and future needs

Solution:

- Deploy an open production-grade OpenStack Virtual Desktop environment to economically provide students with a consistent environment that can easily and quickly be provisioned for course specific needs.
- Leverage Big Cloud Fabric, an SDN-based networking solution, for easy and highly scalable provisioning and management and to future proof their growth.

Results:

- Infrastructure agility enables course work to be delivered on-demand.
- Operational efficiencies for the data center team, what used to take weeks is now accomplished in a matter of clicks.
- Reduced Capex/Opex driven by the combination of the production-grade OpenStack orchestration system, with the BCF's SDN and bare metal hardware approach

Objective

As one of the country's most selective public research universities, Clemson University serves a uniquely driven and highly accomplished student body. Ranked as the 20th best national public university by U.S. News & World Report, Clemson is a science- and engineering-oriented college dedicated to teaching, research and service. Clemson University leads the way in providing a hands-on education — in the lab, in the arts and in the field. Academic programs lay the groundwork for innovative research at this South Carolina University.

With 6 different colleges and more than 80 undergraduate majors and 110 graduate degree programs serving over 20,000 students, Clemson's IT department has a large and complex job. In addition to providing seamless, secure connectivity and managing a range of IT applications and infrastructure, technology has been a key part of the curriculum. Many classes have specific assignments that require course specific software packages, simulation modules and in some cases, access to specially configured computers in a physical lab.

To accomplish this, professors historically had to request the IT department to either make specific software modules available to the student body for download and install on their personal computers or provision a certain number of dedicated workstations in the physical computer labs. This initial provisioning, along with the ongoing support effort that continues throughout the academic year, places an enormous workload on the IT department resources. It also creates a delay, sometimes taking several weeks for the infrastructure to be provisioned for a class. In the case where specific software is installed on lab workstations (despite the availability of remote software deployment tools to deploy the software), managing software licenses and enabling proper sandbox environments is an ongoing challenge. For example, for a class size of 40 students, the IT department had to provision up to 40 workstations separately – causing drastic delays in service.

Clemson specifically was looking to provide needed tools to students on-demand while having each student be sand boxed in their own, unique and private environment. They needed a scalable and economical solution to not only address their current needs but also something that enables them to innovate into the future.

Solution

After researching several options, including remote software installation tools, sophisticated software license management systems and expensive network management solutions, the Clemson IT department decided that they really needed to move to a cloud-based Virtual Desktop architecture. A cloud-based architecture was deemed as the best and most cost efficient way to provide students with a consistent environment that could easily and quickly be provisioned for their specific class needs. Such a solution provided operational efficiencies for the IT team and furthermore allowed their customers an agility that was not available to-date. For example, the course professors and teaching staff could now structure labs to evolve as the course progressed.

To get to a cloud-based architecture, Clemson became an early adopter and very active member of the OpenStack community.

OpenStack offers one of the simplest ways to deploy private clouds that enable rapid, elastic and massively scalable services for end-users. An OpenStack Cloud environment would allow Clemson IT to deploy software modules once, take a snapshot and quickly deploy to virtual desktops on demand. For certain Computer Science and Electrical Engineering courses, students could even get access to their own sand boxed networks for advanced multi-system simulations.

The OpenStack team at Clemson recognized early on that the networking capabilities of OpenStack and the integration with the underlying physical networking infrastructure was critical to their eventual Virtual Desktop IaaS project. Some of the key requirements from their OpenStack networking included:

- Manage consumption of shared infrastructure and enable customer (teaching staff) to provision and modify "labs-on-demand"
- Ensure network level Virtual Desktop segmentation for threat or fault isolation, trouble- shooting, monitoring and compliance.
- Provide connectivity that maps to the topologies typically being used in the Clemson hands-on student labs.

As the transformation to Cloud began, Clemson put a strategy in place to leverage a SDN-based networking solution, Big Switch Networks' Big Cloud Fabric (BCF).

Big Cloud Fabric's flexible, scale-out design allowed Clemson OpenStack architects to start at the size and scale that satisfied their immediate needs while future-proofing their growth. Big Cloud Fabric leverages a bare metal, SDN leaf/spine design that integrates with both Nova and Neutron for OpenStack pods.

- **OpenStack Nova-networking**: In a Nova implementation, Big Cloud Fabric has optimized configurations and performance enhancements that let it serve as a multi-path Leaf-Spine Clos servicing up to 4k VLANs to every edge port. Unlike traditional spanning-tree based switching designs, full cross-section bandwidth can be achieved while delivering 4k VLANs to every edge port with no performance penalty.
- **OpenStack Neutron**: In a Neutron implementation, BCF leverages the BSN ML2 Driver, enabling automation and orchestration of the Fabric with the OpenStack controller.
- **OpenStack Horizon Enhancements**: Big Cloud Fabric also offers (optional) extensions to the OpenStack Horizon dashboard to expose key features enabled by this bare metal SDN approach to cloud networking.

Results

Using the Big Cloud Fabric to provide the networking fabric for it's OpenStack Virtual Desktop environment, Clemson's IT team now benefits from rapid application agility, significant operational efficiencies while achieving dramatic cost savings.

- **Infrastructure Agility Enables Innovation in the Classroom:**

  Instructors and teaching staff are now able to create pre-packaged, virtualized course lab modules and make them available to their students on demand. Providing preconfigured, tested virtual machine images to students in their individual sandboxed environment created using Big Cloud Fabric network segmentation ensures that all students get the same experience. Additionally, this flexible lab deployment model allows for courses to be built-up over time, as new lab modules or virtual machines are made available to students within and even across certain course levels.

- **Operational Efficiencies for the Data Center Team:**

  A key advantage of the new OpenStack Virtual Desktop environment is the productivity gains for the Data Center infrastructure team. Provisioning and management of the underlying networking infrastructure benefits greatly from the Zero Touch Fabric capabilities of BCF – automated fabric bring up, centralized configuration of tenants & logical routers/segments, automated fabric-wide rapid upgrade. Seamless OpenStack integration with Big Switch plugins and enhancements, ensures a single pane of glass experience for OpenStack admins and tenants.

  Now, course specific labs for courses serving multiple classes of students can be easily provisioned in parallel. What used to take weeks can now be done in a matter of clicks.

- **OpenStack + BCF Networking Enables Dramatic Cost Savings:**

  BCF is built with bare metal hardware, disaggregating hardware from software and providing flexibility, vendor choice and dramatic cost advantages.

Get hands-on experience with some of the OpenStack integration with Big Cloud Fabric, including VM-to-VM reachability functionality as well as Heat Templates for network provisioning, using the OpenStack Module within Big Switch Labs (http://labs.bigswitch.com).