Storage Manufacturer Builds Highly Scalable Testing Cloud

Executive Summary

NetApp, Inc.

- Manufacturer
- Sunnyvale, California
- 8000 employees

Challenge

- Deliver on-demand server and storage resources for testing extreme workloads
- Accelerate test-bed setup
- Minimize data center space, power, and cooling requirements

Solution

- Built private cloud for engineering-as-a-service (EaaS)

Results

- Consolidated from 204 to 2 management points for servers
- Deployed 10,000 virtual machines in less than 1 hour
- Reduced cabling by 78 percent

NetApp used Unified Computing System and Nexus platform to build a shared test environment supporting 23,000 virtual machines.

Challenge

A global company headquartered in Sunnyvale, California, NetApp creates innovative storage and data management solutions. More than 12,000 customers worldwide use more than 87,000 NetApp storage platforms.

As part of the company's commitment to ongoing innovation and rigorous quality control, NetApp engineers conduct stress tests on new NetApp storage hardware and software products, reproducing the conditions in demanding customer environments. "We test against conditions that meet or exceed extreme performance conditions in enterprise data centers," says Brad Flanary, manager of Engineering Support Systems for NetApp.

Tests are conducted in a 30,000-square-foot data center within NetApp's Global Dynamic Laboratory, located in Research Triangle Park, North Carolina. The test environment, called the NetApp Kilo Client, is designed to enable the company's engineers to quickly configure and boot a large number of physical and virtual clients to conduct tests. For example, an engineering team might request four NetApp storage controllers with a specified I/O profile and 100 Linux virtual machines handling network file server (NFS) traffic.

By mid-2007, the Kilo Client had grown to include more than 1700 blade servers that could boot over Small Computer System Interface over IP (iSCSI) or Fibre Channel. The shared environment worked well. Therefore, when server leases expired, the Engineering Support Systems team decided to supplement it with a new platform capable of replicating more intense workloads typical of customers' cloud environments.

"The Cisco UCS supports our very dynamic environment, in which a test engineer might want to quickly change 500 clients from Red Hat Linux to Windows 2008. With Cisco UCS Manager service profiles, we can make that change in less than five minutes."

– **Brad Flanary,**
Manager of Engineering Support Systems, NetApp, Inc.

Requirements included:

- 10 Gigabit Ethernet (GbE).
- Support for Fibre Channel over Ethernet (FCoE), an increasingly popular customer requirement.
- Capability to set up test environments with hundreds or thousands of clients in hours, not the weeks needed using traditional IT architectures. "Essentially, our designers and test engineers needed to begin sharing test beds, to reduce hardware spend and increase utilization," says Flanary.

Solution

After evaluating four compute platforms for the shared test environment, NetApp chose the Cisco Unified Computing System™ (UCS), which combines compute, networking, storage access, and virtualization in a single system managed as a cohesive entity. "The Cisco UCS met our requirements for the shared lab infrastructure because of its high performance, built-in virtualization, and the single point of management for all servers in a Cisco UCS instance," says Flanary. "In addition, Cisco UCS Manager service profiles make it very easy to provision virtual testing clients." For data center switching, NetApp selected the Cisco Nexus® platform.

The Cisco® UCS used in the NetApp Global Dynamic Laboratory consists of 78 chassis containing 624 Cisco UCS B200 M1 Blade Servers with 24 GB or 48 GB of RAM. The Kilo Client uses 26 of the chassis, containing 208 servers. Engineering Support Systems has successfully tested more than 27,000 virtual machines in just its own partition of the larger Cisco UCS environment.

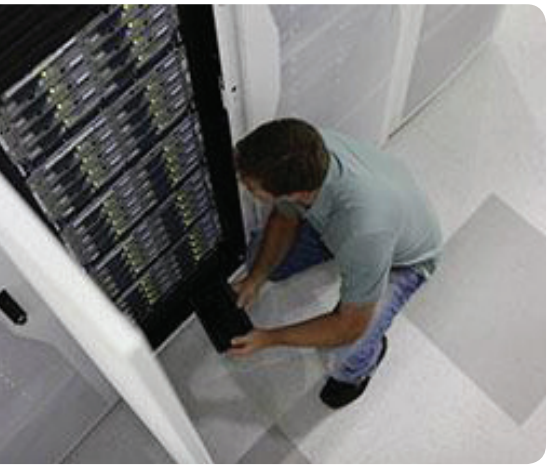
All 208 Cisco UCS blade servers in the Kilo Client connect through two pairs of Cisco UCS 6100 Fabric Interconnects to redundant Cisco Nexus 7018 Switches at the distribution layer and to 20 NetApp FAS3170 unified storage systems. The fabric interconnects save the time and expense of procuring and provisioning separate Ethernet and Fibre Channel interface cards and cables for each server.

Using Cisco UCS Manager, the team built service profiles for the numerous operating systems that NetApp engineers use for testing. When an engineer requests several hundred Linux servers, for example, the Engineering Systems Support team can apply the service profile in minutes, with a few clicks. "Our standard is to virtualize applications, but if the requester can justify a nonvirtualized application, we can deploy it on bare metal in the same Cisco UCS," says Jonathan Davis, technical lead for Engineering Systems Support in NetApp's Global Dynamic Lab.

NetApp continues to use its existing rack-optimized and blade servers in the Kilo Client, connecting them to the core using Cisco Nexus 2248 (1 GbE and 1000Base-T) and Cisco Nexus 2232 (10 GbE) Fabric Extenders. The fabric extenders, in turn, connect to the Cisco Nexus 5000 over a 10 GbE uplink. "The Cisco Nexus 2232 Fabric Extenders make it cost-effective to give engineers a 10 GbE port, or even multiple ports if needed," Flanary says. "And they provide FCoE support through the Cisco Nexus 5000, so we'll be ready when our engineers need to test with FCoE."

Results

Major benefits of the Cisco UCS and Cisco Nexus architecture for the Kilo Client include scalability, rapid provisioning, and simplified management. “With the Cisco UCS, we estimate that we’ve been able to achieve 100 times the capacity within the same cost structure as the original shared-test environment,” Flanary says.



Rapid System Provisioning

Cisco UCS makes it much faster to deploy new servers in the rapidly growing Kilo Client. “It took just an hour to deploy the first 112-server Cisco UCS with NetApp storage and VMware vSphere,” says Brandon Agee, technical lead in Engineering Support Systems. “Alternative solutions would have required physically touching and configuring each blade, which would have taken one person at least one or two weeks. We saved 6 to 12 weeks for the first six pods alone.”

Rapid Test-Bed Setup

In most companies, test engineers have to wait days or weeks for a test bed. At NetApp, in contrast, test-bed setup does not delay new feature introduction because Engineering Support Services can act like a cloud provider. When someone requests a server, Engineering Support Services offers a standard image on the Cisco UCS: VMware or bare metal with the Linux or Windows operating system. Engineers customize the image and add their applications, and then Engineering Support Services can implement the server with a few clicks. “The Cisco UCS supports our very dynamic environment, in which a test engineer might want to quickly change 500 clients from Red Hat Linux to Windows 2008,” says Flanary. “With Cisco UCS Manager service profiles, we can make that change in less than five minutes.”

Cisco UCS Manager service profiles also enable the company’s engineers to rapidly recreate test beds, saving hours or days.

Simplified Management

Engineering Support Services manages all 208 servers in the Cisco UCS as a single entity, minimizing IT resource requirements. When NetApp migrated the first 120 servers to the Cisco UCS, 168 management points were consolidated to just two, the pair of Cisco UCS 6100 Fabric Interconnects. Switch management for the lab’s blade servers and rack-optimized servers is also easier because the team can manage all Cisco Nexus 2000 Fabric Extenders as part of the Cisco Nexus 5000 Switch.

Lower Costs

By moving virtual machines from standalone clients to the Cisco UCS, NetApp consolidated the Kilo Client from 51 blade server chassis with 714 servers to 15 Cisco UCS chassis with 120 servers. Since then, NetApp has added more servers. Server consolidation reduced data center space, power, and cooling costs. In addition, using the converged network adapter on the Cisco UCS instead of separate Ethernet and Fibre Channel adapters enabled the company to decrease the cable count by 78 percent, from 1440 to 250.

Product List

Data Center

- Cisco Unified Computing System
  - Cisco B200 M2 Blade Servers
  - Cisco UCS 6100 Fabric Interconnects
- Cisco Nexus 7018 and 7010 Switches
- Cisco Nexus 5020 and 5010 Switches
- Cisco Nexus 4000 Blade Switches
- Cisco Nexus 2148, 2248, and 2232 Fabric Extenders

Next Steps

NetApp plans to begin using the Cisco FabricPath support in the Cisco Nexus 7018 Switch to build non-blocking Layer 2 domains with many links, without Spanning Tree restrictions. "Some internal customers have test beds distributed between two buildings, and Cisco FabricPath will help ensure that this arrangement doesn't affect performance," Flanary says.

Engineering Support Services will also take advantage of the Virtual Device Context (VDC) feature of the Cisco Nexus 7018 Switch to provide a separate logical switch to engineers who need it. These engineers will have their own network from the distribution layer down, with full access.

Yet another plan is to connect the Cisco UCS 6100 Fabric Interconnects directly to the Cisco Nexus 7018 Switch, simplifying the switching architecture. To accomplish this, NetApp will use the high-performance Cisco Nexus 7000 F1 Series modules with 32 10-Gbps ports. These modules provide 320-Gbps line-rate performance within the card and 230 Gbps per slot by way of the fabric, increasing the number of nonblocking ports on the Cisco Nexus 7000 Switch that can connect to the Cisco UCS 6100 Fabric Interconnect.

Technical Implementation

In addition to the Cisco UCS, the data center contains four quadrants with 540 server racks apiece. Each quadrant connects to the core through a pair of Cisco Nexus 7010 Switches at the distribution layer. Within each quadrant, rows contain ten pods with three server racks apiece. Each pod has one or two Cisco Nexus 2000 Series Fabric Interconnects, which aggregate into a pair of Cisco Nexus 5000 switches for each row. The Cisco Nexus 2148, 2248, and 2232 Fabric Extenders connect to servers using a wide variety of fibre-optic cables as well as 1000BaseT and Twinax copper cables. IBM blade servers connect to the Cisco Nexus 5000 by way of Cisco Nexus 4000 Blade Switches.

For More Information

For more information on the Cisco Unified Computing System, visit: http://www.cisco.com/go/ucs.

For more information on the Cisco Nexus family of data center switches, visit http://www.cisco.com/go/nexus.

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