Cisco Desktop Virtualization Solution with Nimble Storage Reference Architecture

VMware View 5.1 with VMware vSphere 5 Support for Up to 1000 Virtual Desktops Using Cisco Unified Computing System and Nimble Storage

November 2012

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What You Will Learn

This document describes the reference architecture for desktop virtualization with storage for up to 1000 virtual desktops based on VMware View 5.1 and VMware vSphere 5, built on Cisco UCS® B-Series Blade Servers and Nimble Storage CS-Series storage appliance.

The purpose of the reference architecture is to provide tested and modular architecture built with proven best-in-class technologies to create a complete desktop virtualization solution, including the desktop software, hypervisor, computing, networking, and storage elements. These reference architectures accelerate your desktop transformation by enabling faster deployments, greater flexibility of choice, greater efficiency, and lower risk.

Choosing the correct storage solution for virtual desktop infrastructure (VDI) is a critical step. VMware provides its partners with the VMware View Planner tool to help assess and plan the proper network and storage configuration for VMware View environments.

Using the VMware View Planner tool and the latest VMware vSphere and View releases, Nimble Storage has achieved desktop deployment levels of 1000 Microsoft Windows 7 32-bit virtual desktops on a single three-rack-unit (3RU) Nimble Storage CS220G-X2 flash optimized storage system. This configuration is described in this document.

This reference architecture is not intended to be a comprehensive guide to deployment and configuration for every aspect of this solution.

Summary of Main Findings

- The combination of the Cisco Unified Computing System™ (Cisco UCS) and Nimble Storage hardware with VMware ESXi 5 and VMware View 5.1 software produces a virtual desktop delivery system with a high density per blade and chassis.
- Cisco maintains industry leadership with the new Cisco UCS Manager Release 2.0 software, which makes scaling and maintenance simple and helps ensure consistency.
- The Cisco 10-Gbps unified fabric is also validated on second-generation Cisco UCS 6200 Series Fabric Interconnects, testing more challenging workloads and maintaining unsurpassed user response times.
- Up to 1000 virtual desktops can run on an entry-level Nimble Storage CS220G-X2 storage array, meeting both the boot and login storm and end-user workload test requirements specified by VMware View Planner.

Business Value

Proliferations of mobile devices and software-as-a-service (SaaS) cloud application offerings have added great complexity to traditional IT environments. Companies big and small are looking for ways to respond to this ongoing trend without spending more budget dollars than needed for physical desktops, and without incurring additional operation management expenditures. A well-designed, thoroughly tested VDI can strategically empower a company to respond to the post-PC era. However, high storage costs have been the biggest factor inhibiting VDI adoption.

Customers require a scalable, tiered, and highly available infrastructure on which to deploy their virtual desktop environment. Several new technologies are available to assist them in designing a virtual desktop solution, but they need to know how to use these technologies to get the most from their investments, support service-level agreements (SLAs), and reduce their total cost of ownership (TCO).

This solution builds a replica of a common customer VDI environment and validates the environment for performance, scalability, and capability. Customers achieve:

- Increased control and security of their global, mobile desktop environment, which is typically their most at-risk environment
- Better end-user productivity with a more consistent environment
- Simplified management, with the environment contained in the data center
- Better support for SLAs and compliance initiatives
- Lower operation and maintenance costs

Modular Virtual Desktop Infrastructure Overview

Cisco Data Center Infrastructure for Desktop Virtualization

Cisco focuses on three main elements to deliver the best desktop virtualization data center infrastructure: simplification, security, and scalability. The software in combination with platform modularity provides a simplified, secure, and scalable desktop virtualization platform.

- Simplified
  - Virtual desktop density per sever
  - Unified management, providing common view of the platform
  - Predefined, validated infrastructure
- Secure
  - Virtual desktop-aware access and control policies
  - Virtual desktop-aware networking and on-demand provisioning
  - Segmentation and network security policies across LAN and WAN
- Scalable
  - Capability to linearly scale up to thousands of desktops in a single domain
  - Rapid desktop provisioning through service profiles
  - Low-latency, high-bandwidth network for virtual desktop and multimedia delivery

The simplified, secure, scalable Cisco data center infrastructure solution for desktop virtualization saves time and money. It provides faster payback and ongoing savings (better return on investment [ROI] and lower TCO) with the industry's highest virtual desktop density per server, meaning that fewer servers are needed, reducing both capital expenditures (CapEx) and operating expenses (OpEx). The solution also has much lower network infrastructure costs, with fewer cables per server and fewer ports required, through the use of the Cisco UCS architecture and unified fabric.

The simplified deployment of Cisco UCS for desktop virtualization accelerates time to productivity and enhances business agility. IT staff and end users are more productive more quickly, and the business can respond to new opportunities by simply deploying virtual desktops whenever and wherever needed. The high-performance Cisco system and network deliver a near-native end-user experience, allowing users to be productive anytime and anywhere.

Project Planning and Solution Sizing Sample Questions

You must understand user groups, applications, and data requirements to properly size computing, networking, and storage resources.

Some general project questions should be addressed at the outset:

- Has a VDI pilot plan been created based on the business analysis of the desktop groups, applications, and data?
- Is the infrastructure and budget in place to run the pilot program?
- Are the skill sets needed to implement the VDI project available? Can these be acquired through hiring or contract?
- Have end-user experience performance metrics been identified for each desktop subgroup?
- How will success or failure be measured?
- What are the future implications of success or failure?

The following is a short, nonexhaustive list of sizing questions that should be addressed for each user subgroup:

- What is the desktop OS planned? Microsoft Windows 7 or Windows XP? 32-bit or 64-bit desktop OS?
- How many virtual desktops will be deployed in the pilot? In production? Will all desktops use Microsoft Windows 7?
- How much memory is needed per target desktop group desktop?
- Are there any multimedia, Adobe Flash, or graphics-intensive workloads?
- What is the endpoint graphics processing capability?
- Are any VMware ThinApp applications planned? Will they be packaged or installed?
- What is the storage configuration in the existing environment?
- Are sufficient I/O operations per second (IOPS) available for the write-intensive VDI workload?
- Will storage be dedicated and tuned for VDI service?
- Does the desktop have a voice component?
- Is antivirus software a part of the image?
- Is user profile management (nonroaming profile based) part of the solution?
- What are the fault tolerance, failover, and disaster recovery plans?
- Are there any additional desktop-subgroup-specific questions that need to be addressed?

The Solution: A Unified, Pretested, and Validated Infrastructure for Desktop Virtualization

Cisco's desktop virtualization solution binds together the three critical elements of an end-to-end deployment: the end-user, the network, and the data center. It draws on Cisco's architectural advantage to provide a solution that supports a diversity of endpoint devices, extends pervasive security and policy management to each virtual desktop, and uses a new and innovative virtualization-optimized stateless server computing model (Cisco UCS).

Base Components

- The computing platform with Cisco UCS includes:
  - Cisco UCS 6200 Series Fabric Interconnects
  - Cisco UCS 2200 Series Fabric Extenders
  - Cisco UCS 5108 Blade Server Chassis
  - Cisco UCS B230 M2 Blade Servers for virtual desktop hosting
- Hypervisor: VMware ESXi 5
- Virtual desktop connection broker: VMware View 5.1
- Storage platform with Nimble CS-Series

Cisco Unified Computing System

Cisco UCS is the first truly unified data center platform that combines industry-standard, x86-architecture blade and rack servers with networking and storage access into a single system. Innovations in the platform include a standards-based unified network fabric, Cisco virtualized interface card (VIC) support, and Cisco Extended Memory Technology. The system uses a wire-once architecture with a self-aware, self-integrating, intelligent infrastructure that eliminates the time-consuming, manual, error-prone assembly of components into systems.

Cisco UCS B-Series Blade Servers provide a comprehensive line of 2 and 4-socket servers to deliver world-record-setting performance to a wide range of workloads. Based on Intel® Xeon® processor E7 and E5 product families, these servers are excellent for virtualized and nonvirtualized applications. These servers:

- Reduce CapEx and OpEx with converged network fabrics and integrated systems management
- Deliver performance, versatility, and density without compromise
- Address a broad set of workloads, including IT and web infrastructure and distributed databases, for both virtualized and nonvirtualized environments
- Increase IT staff productivity and business agility through just-in-time provisioning and mobility support for both virtualized and nonvirtualized environments

VMware vSphere 5

VMware vSphere 5 is the market-leading virtualization platform that is used in thousands of IT environments around the world. VMware vSphere 5 transforms a computer's physical resources by virtualizing the CPU, RAM, hard disk, and network controller. This transformation creates fully functional virtual desktops that run isolated and encapsulated operating systems and applications just like physical computers.

The high-availability features of VMware vSphere 5 are coupled with VMware Distributed Resources Scheduler (DRS) and vMotion, which enables the transparent migration of virtual desktops from one VMware vSphere server to another with little or no impact on the customer's use.

This reference architecture uses VMware vSphere Desktop edition for deploying desktop virtualization. It provides the full range of features and functions of the VMware vSphere Enterprise Plus edition, allowing customers to achieve scalability, high availability, and optimal performance for all their desktop workloads. Also, VMware vSphere Desktop comes with unlimited virtual RAM (vRAM). VMware vSphere Desktop edition is intended for customers who want to purchase only VMware vSphere licenses to deploy desktop virtualization.

VMware View 5.1

VMware View is a desktop virtualization solution that simplifies IT manageability and control while delivering one of the highest-fidelity end-user experiences for devices and networks. The VMware View solution helps IT departments automate desktop and application management, reduce costs, and increase data security through centralization of the desktop environment. This centralization results in greater end-user freedom and increased control for IT departments. By encapsulating the operating systems, applications, and user data into isolated layers, IT departments can deliver a modern desktop. IT can then deliver dynamic, elastic desktop cloud services such as applications, unified communications and 3D graphics for real-world productivity and greater business agility.

Unlike other desktop virtualization products, VMware View is built on, and tightly integrated with, VMware vSphere, the industry-leading virtualization platform, allowing customers to extend the value of VMware infrastructure and its enterprise-class features such as high availability, disaster recovery, and business continuity. VMware View 5 includes many enhancements to the end-user experience and IT control. Some of the notable features include:

- VMware View Storage Accelerator (VSA): Helps accelerate virtual desktops during boot storms (when large number of virtual desktops boot simultaneously) by using host-side memory
- VMware PCoIP Optimization Controls: Deliver protocol efficiency and enable IT administrators to configure bandwidth settings by use case, user, or network requirements and consume up to 75 percent less bandwidth
- VMware PCoIP Continuity Services: Deliver a smooth end-user experience regardless of network reliability by detecting interruptions and automatically reconnecting the session
- VMware PCoIP Extension Services: Allow Microsoft Windows Management Instrumentation (WMI)-based tools to collect more than 20 session statistics for monitoring, trending, and troubleshooting end-user support problems
- VMware View Media Services for 3D Graphics: Enable VMware View desktops to run basic 3D applications such as Microsoft Windows Aero and Office 2010 or those requiring OpenGL or DirectX, without the need for specialized graphics cards or client devices
- VMware View Media Services for Integrated Unified Communications: integrate voice over IP (VoIP) and the VMware View desktop experience for the end user through an architecture that optimizes performance for both the desktop and unified communications
- VMware View Persona Management (VMware View Premier edition only): Dynamically associates a user persona with stateless floating desktops; IT administrators can deploy easier-to-manage stateless floating desktops to more use cases while enabling user personalization to persist between sessions
- VMware View Client for Android: Enables end users with Android-based tablets to access VMware View virtual desktops

Support for VMware vSphere 5 uses the latest functions of the leading cloud infrastructure platform for highly available, scalable, and reliable desktop services.

Nimble Storage CS-Series

Nimble Storage arrays are the industry's first flash-optimized storage designed from the start to increase efficiency. Built on the patented Cache Accelerated Sequential Layout (CASL) architecture, Nimble Storage offers scalable performance, exceptional efficiency, integrated data protection, and simple push-button management. As a result, customers can run more workloads and perform more backup operations with less storage infrastructure and empower IT to take on new projects with higher returns. CASL accelerates applications by using flash memory as a read cache in conjunction with a write-optimized data layout. It protects data by supporting instant snapshots for easy backup and restoration, along with efficient replication for disaster recovery. Nimble Storage's intuitive, automated tools greatly simplify storage and data management, reducing operations overhead.

Nimble Storage delivers:

- Accelerated performance for greater throughput and IOPS, and latencies of less than a millisecond
- Greater storage efficiency, reducing the storage footprint needed by 30 to 75 percent
- Nondisruptive scaling to fit changing application needs through increased performance or capacity, or both
- Increased data and storage availability with integrated data protection and disaster recovery
- Simplified storage management and reduced day-to-day operation overhead

Solution Overview and Benefits

This solution uses Cisco UCS, Nimble Storage, and VMware vSphere 5 to provide resources for a VMware View 5.1 environment of Microsoft Windows 7 virtual desktops provisioned by VMware View Composer.

Planning and designing the server, networking, and storage infrastructure for the VMware View environment is a critical step because the server infrastructure should be sized to handle the desktop workload, both in terms of density and scale, the networking infrastructure should be provisioned to handle the burst of data traffic, and the shared storage must be able to absorb large bursts of I/O traffic that occur during a workday.

To provide a cost-effective and predictable performance for a virtual desktop infrastructure, the infrastructure must be able to:

- Support a high density of virtual desktops per server
- Scale linearly with increases in the number of virtual desktops
- Rapidly provision a scale-out infrastructure
- Provide low latency and high bandwidth for clustering, provisioning, and storage interconnect networks Handle the peak I/O load from clients while maintaining a quick response time

Solution Benefits

- High performance: Nimble Storage arrays with Cisco UCS deliver the adaptive performance needed to handle comprehensive desktop virtualization functions delivered by VMware View, in a compact footprint. This capability allows IT to maintain a positive user experience through boot and login storms, patch operations, and upgrades, because this joint platform is powerful enough to handle the infrastructure needs for VDI.

- Greater consolidation: VMware View frees IT departments from the chores of desktop upgrades by centralizing the creation and deployment of linked clones. This feature complements Nimble Storage's in-line compression and the dense computing and I/O capabilities of Cisco UCS. IT departments that have deployed the joint platform have seen 30 to 75 percent reduction in their storage footprint compared to traditional solutions, with no degradation of the end-user experience.

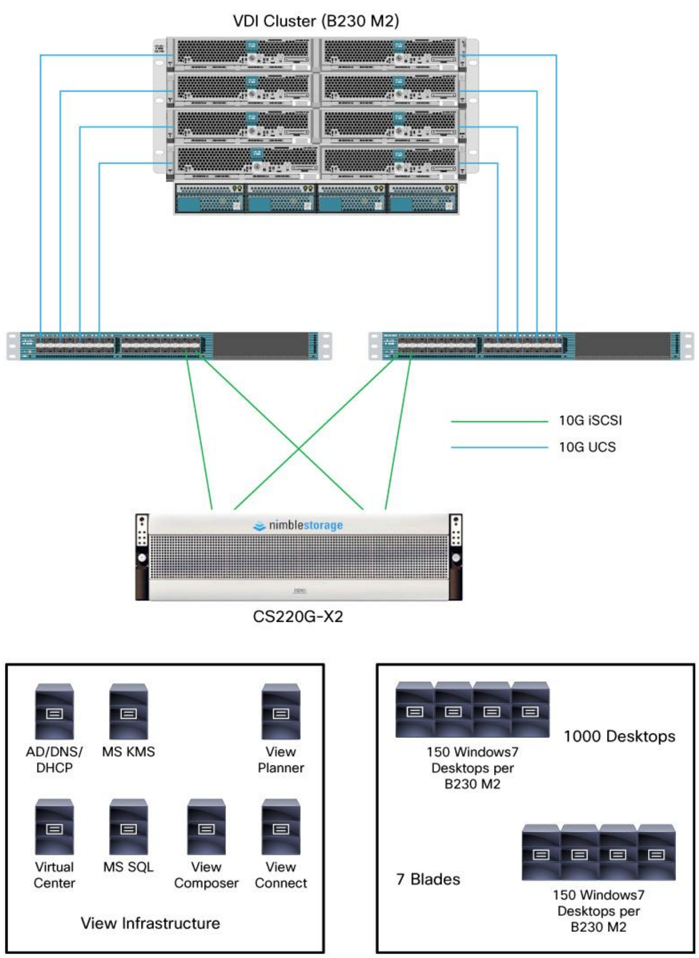
- High availability: Nimble Storage and Cisco UCS both incorporate redundant components, with no single point of failure, along with proactive monitoring and reporting. These features complement VMware vCenter's capability to trigger efficient Nimble Storage snapshots for instant backup and fast restore operations. The result is less end-user disruption and fewer calls to the help desk.

- Expansion on demand: By integrating computing, fabric, storage, and virtualization resources in a single architecture, IT can start small and independently scale horizontally or vertically to large deployments supporting thousands of virtual desktops as needs grow.

Architecture and Design of VMware View 5 on Cisco UCS and Nimble Storage Solution

Figure 1 shows the basic components and connectivity used to for the server, storage, and network. A single Nimble Storage array was connected to the Cisco UCS chassis through a pair of Cisco UCS fabric interconnects using appliance ports. The VMware Infrastructure components and the VMware View desktops were all run on the blades in Cisco UCS.

Figure 1: Solution Topology



- Cisco UCS B230 M2 (10-Gbps Cisco UCS)
- Nimble Storage CS220G-X2 (10-Gbps iSCSI)
- Active Directory, DNS, and DHCP
- Microsoft KMS
- VMware View Planner
- VMware vCenter
- Microsoft SQL Server
- VMware View Composer
- VMware View Connect
- VMware View Infrastructure
- 150 Microsoft Windows 7 Desktops per Cisco UCS B230 M2
- 1000 Desktops
- 7 Blades

Cisco UCS B-Series Blade Servers

The VMware View test was performed on a Cisco UCS blade system targeted to host approximately 150 desktops per blade. For the targeted 1000-desktop test, seven blades were configured into a VMware VDI service cluster.

Each Cisco UCS B230 M2 blade was configured as follows:

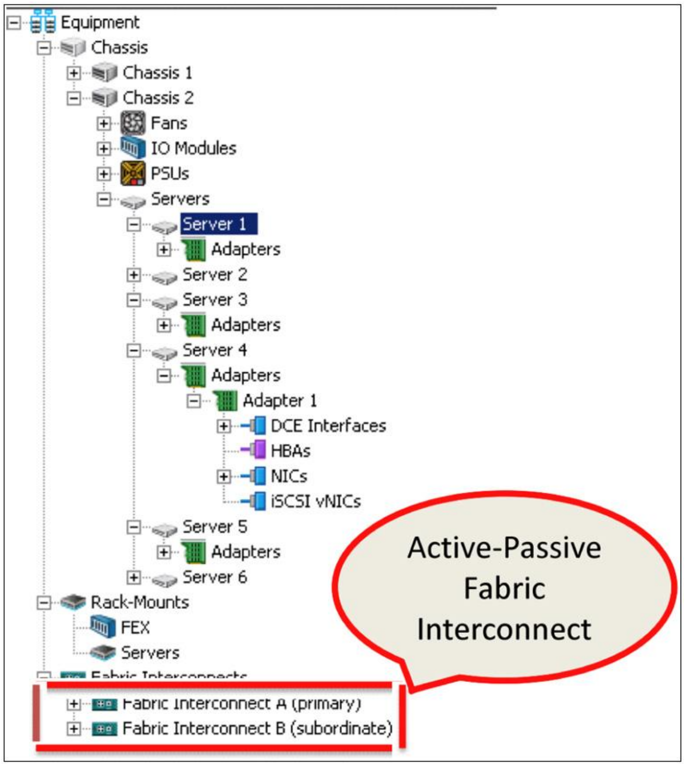
- Two Intel Xeon E7-2870 2.4-GHz processors (20 cores total)
- 256 GB of RAM

The Cisco UCS configuration was connected to the Nimble Storage as an iSCSI array directly to the Cisco fabric interconnect with dual, redundant 10-Gbps connections. This architecture provides the most efficient use of hardware and lowers the total cost (cost per desktop) of the server, network, and storage solution.

The chassis is connected to each fabric interconnect with four 10-Gbps network connections.

Note: The dual fabric interconnect pairs are active-passive in this configuration (Figure 2). For more information about additional Nimble Storage connectivity scenarios with Cisco UCS, please refer to Appendix E.

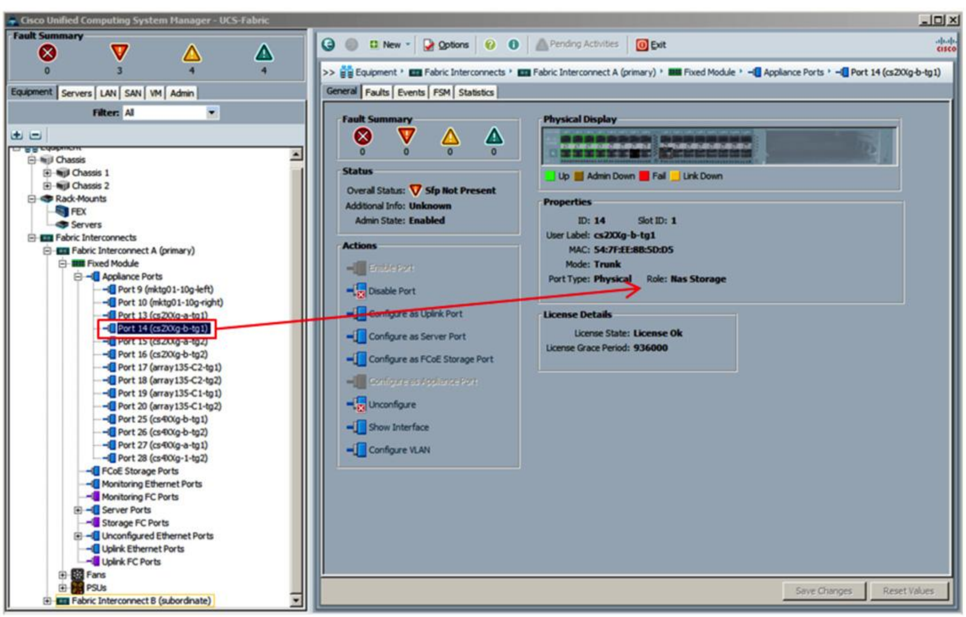
Figure 2: Cisco UCS Fabric Interconnect Configuration



Active-Passive Fabric Interconnect

For a configuration without an access-layer switch (Cisco Nexus® 5000 Series Switches), the fabric interconnect ports connected to the Nimble Storage array must be configured to operate in Appliance mode (Figure 3).

Figure 3: Cisco UCS Appliance Port Mode: Nimble Storage Data Ports



Seven of the Cisco UCS blades in this chassis were used to host the Microsoft Windows 7 desktop virtual machines, and a separate blade was used to provide the core virtualization infrastructure services as described in the following paragraphs.

VMware vSphere 5

For this test, VMware vSphere 5.0 Update 1 and View 5.1 were deployed. All Cisco UCS blades were installed with VMware ESX 5.0 Update 1 on the local solid-state drive (SSD). The goal was to make the environment as simple as possible.

A VMware View Infrastructure host blade was used to support the VDI components, which include the following Microsoft Windows Server 2008 R2 virtual machines:

- Microsoft Windows Active Directory, Domain Name System (DNS), and Dynamic Host Configuration Protocol (DHCP)
- Microsoft Key Management Server (KMS)
- VMware vCenter Server
- VMware View Connection Server (View Manager)
- VMware View Composer
- Microsoft SQL Server (to support the VMware infrastructure)
- VMware View Planner 2.1 appliance (Linux based) to run the real-world workload tests

The desktop virtual machines were run on a virtual desktop cluster composed of seven dedicated Cisco UCS B230 M2 blades. The desktop configuration used for this test was a Microsoft Windows 7 Enterprise (x86 32-bit) virtual machine with 1 GB of RAM, one virtual CPU (vCPU), and a 24-GB disk. The configuration of the desktop application environment consisted of:

- Microsoft Office 2010 (Word, Excel, and PowerPoint)
- Microsoft Outlook
- Adobe Reader
- Mozilla Firefox
- 7-Zip tools

Also configured in the Microsoft Windows 7 golden image were the VMware View Agent and the VMware View Planner Agent. The configuration of the golden image followed the VMware View Planner guide for optimizations, system settings, and other configuration requirements. For details about the specific setup, refer to Appendix A of the VMware View Planner Installation and User Guide, Version 2.1 (October 24, 2011).

VMware View 5.1

VMware View 5.1 was used to construct and manage the desktop virtual machines. This test used a floating pool of nonpersistent linked-clone desktop virtual machines. The details of the specific VMware View pool definition are included at the end of this document.

In addition to the linked-clone method of deploying desktop virtual machines, VMware View 5.1 uses VMware VSA technology. This technology allows a small amount of VMware ESXi host RAM to be used as a content-based read cache for the selected desktops' read I/O operations. VMware VSA was configured at 2 GB for each VMware ESXi host and for each VMware View pool used for this test.

VMware View Planner

To perform the workload test, the VMware View Planner tool was used to run a sample workload on each of the 1000 active Microsoft Windows 7 desktops. The VMware View Planner tool can be configured in many ways for configuration testing. This test followed the guidelines of the VMware Rapid Desktop Program (RDP) testing. The result of the VMware View Planner workload is close to that for a typical Microsoft Windows-based task worker with a steady-state IOPS rate of 7 to 10 IOPS per desktop.

Nimble Storage CS-Series

The Nimble Storage system used for this testing was a CS220G-X2 model that has 12 TB of raw capacity (12 x 1-TB HDD), 640 GB of SSD-based flash memory, and dual 10 Gigabit Ethernet data network interface card (NIC) connections per controller. The Nimble Storage CS220G-X2 has two controllers operating in an active-standby redundant configuration.

For the 1000-desktop virtual machines solution, the storage volumes were configured to have no more than 50 desktop virtual machines in each VMware Virtual Machine File System (VMFS) datastore. Each datastore volume was configured with 500 GB, using thin provisioning at the storage level and providing plenty of room at the linked-clone level for conservative desktop provisioning methods. The Nimble Storage appliance was then configured with twenty 500-GB iSCSI volumes presenting 20 individual datastores at the VMware level. Each Cisco UCS blade had shared access to each volume. Through the VMware View pool balanced allocation, each volume contained approximately 50 desktop linked-clone virtual machines.

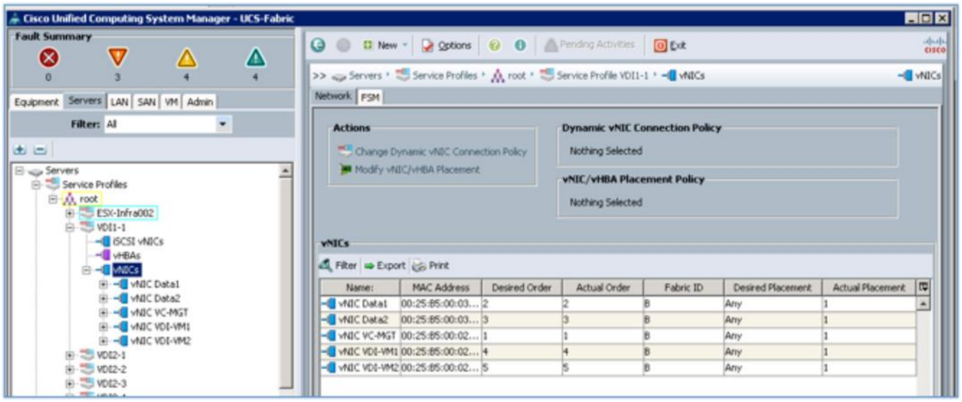
The VMware View storage component that mapped to the Nimble Storage solution used a simple and easy-to-manage approach: everything for the desktop was in the same datastore. With Nimble Storage capabilities, it is not necessary to separate the various VMware View storage artifacts into different storage tiers or locations. The CASL file system is optimized to handle VDI workloads, including boot storms. During a boot storm, the virtual desktop replica image is automatically cached in the built-in SSDs, thereby accelerating the access time for populating each VMware ESX host RAM dedicated to VMware VSA. As a result, boot times are greatly reduced, even when large numbers of virtual desktops boot at the same time. During steady-state operations, in which end users access applications in a random fashion, random write I/O is also optimized with the CASL write-coalescing technology.

Solution Validation

Server: Cisco UCS

The Cisco UCS B230 M2 Blade Servers were configured with multiple virtual NIC (vNIC) interfaces to allow separation of management traffic, VDI desktop traffic, and iSCSI data traffic. Figure 4 shows a typical server service profile.

Figure 4: Cisco UCS Blade Server vNIC Configuration



Each Cisco UCS blade server is configured with five vNIC interfaces, with the VMware ESX vSwitch network configuration shown here (Figures 5 through 8):

vSwitch0 (management network)

vmnic0

vSwitch1 (iSCSI data traffic)

vmnic1 and vmnic2 (no teaming; VMware ESX software iSCSi multipathing is enabled with PSP_Round Robin algorithm)

vSwitch2 (virtual desktop traffic)

vmnic3 and vmnic4 (teamed for load distribution and failover)

Figure 5: VMware Network Configuration

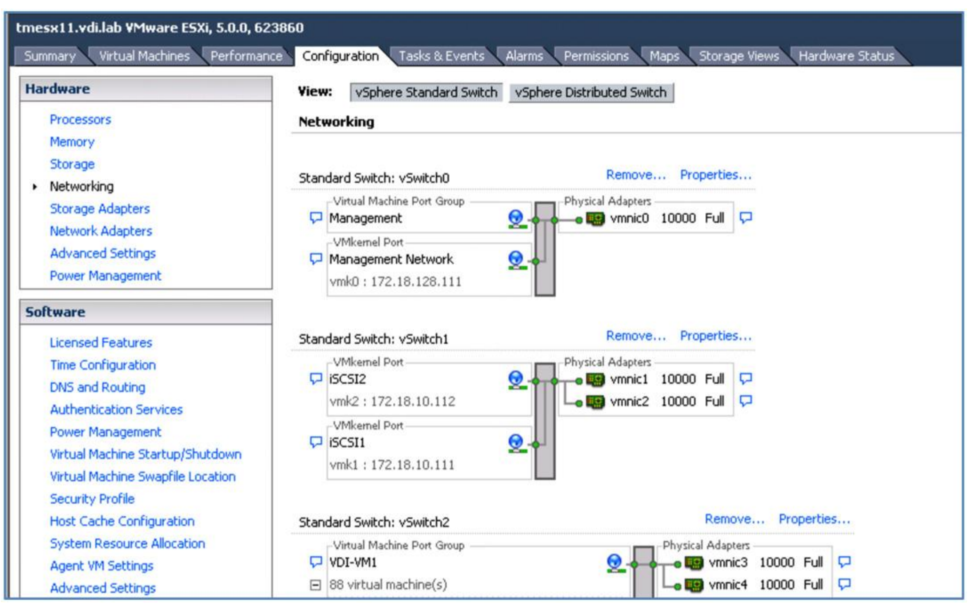


Figure 6: VMware iSCSI Port 1 Configuration Details

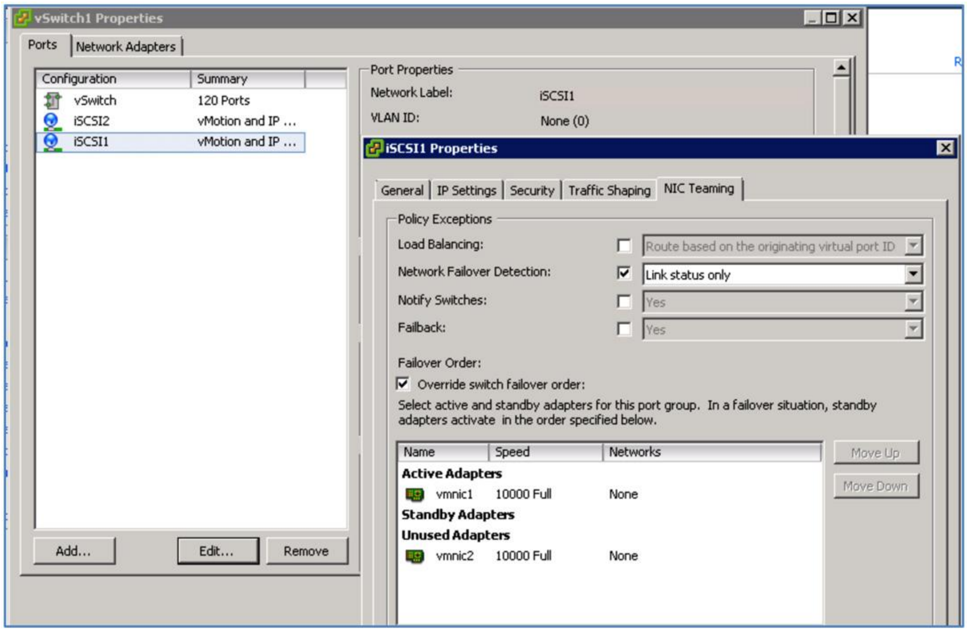


Figure 7: VMware iSCSI Port 2 Configuration Details

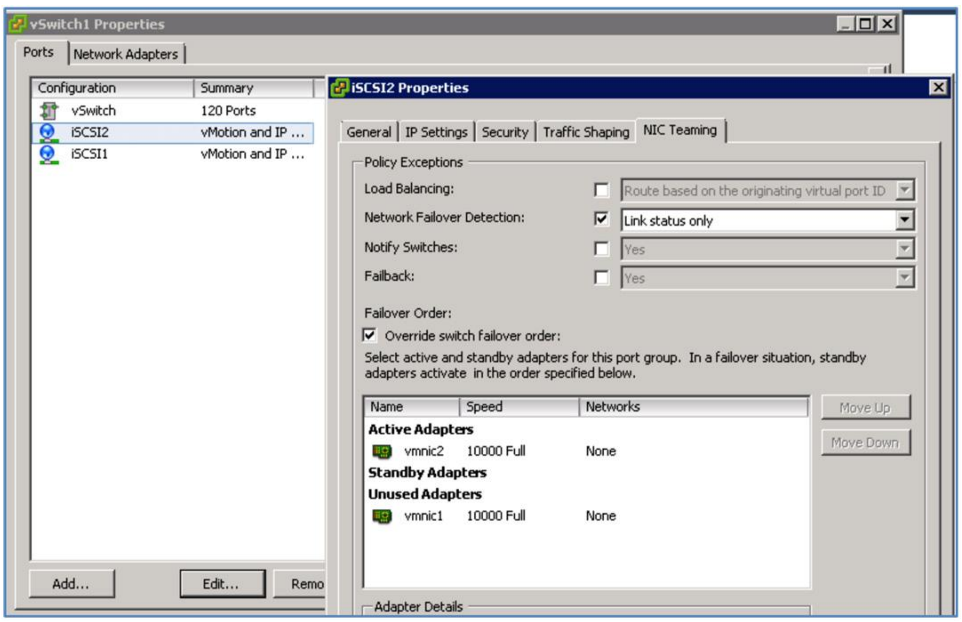
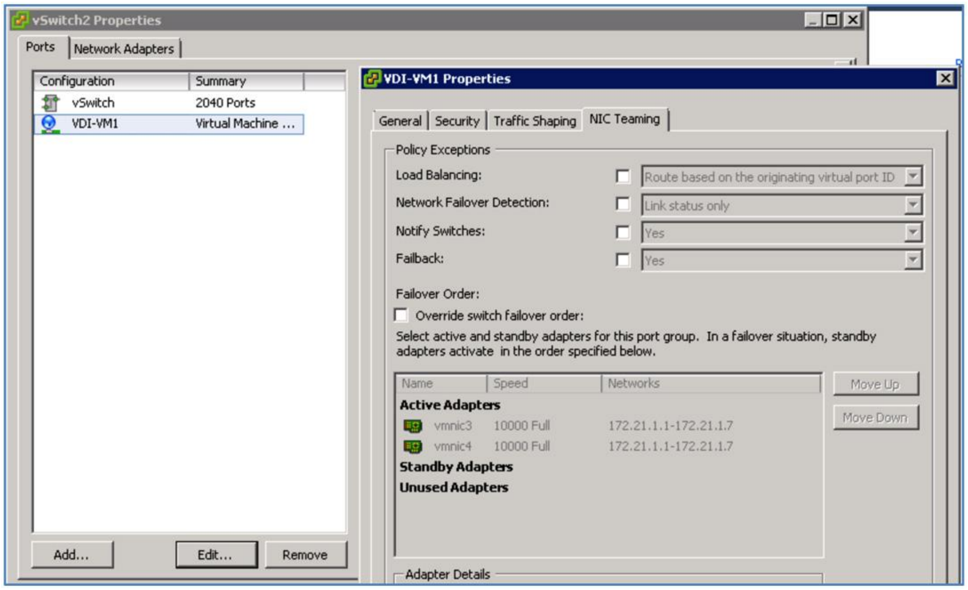


Figure 8: VMware Desktop Virtual Machine Network Configuration Details

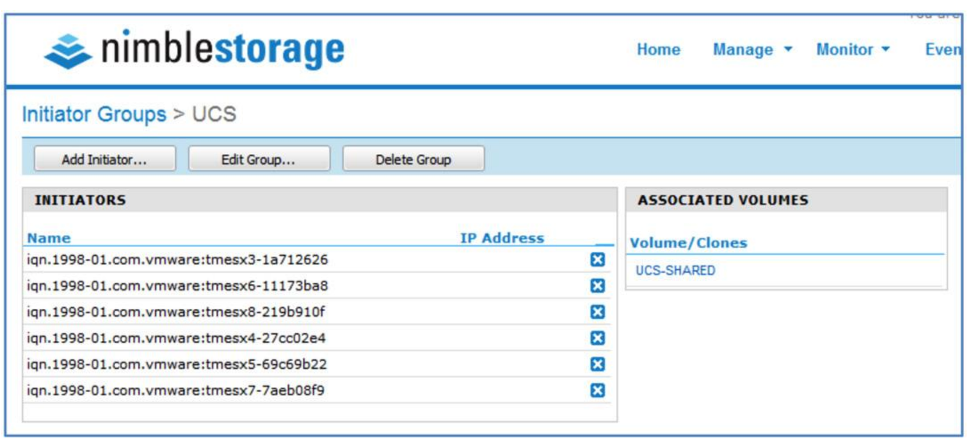


Storage: Nimble Storage CS-Series

The Nimble Storage CS220G-X2 was configured with multiple volumes presented to the Cisco UCS VDI cluster as shown in the figures that follow. Each of the 20 volumes was configured as 500 GB of thin-provisioned iSCSI SAN storage VMFS datastore.

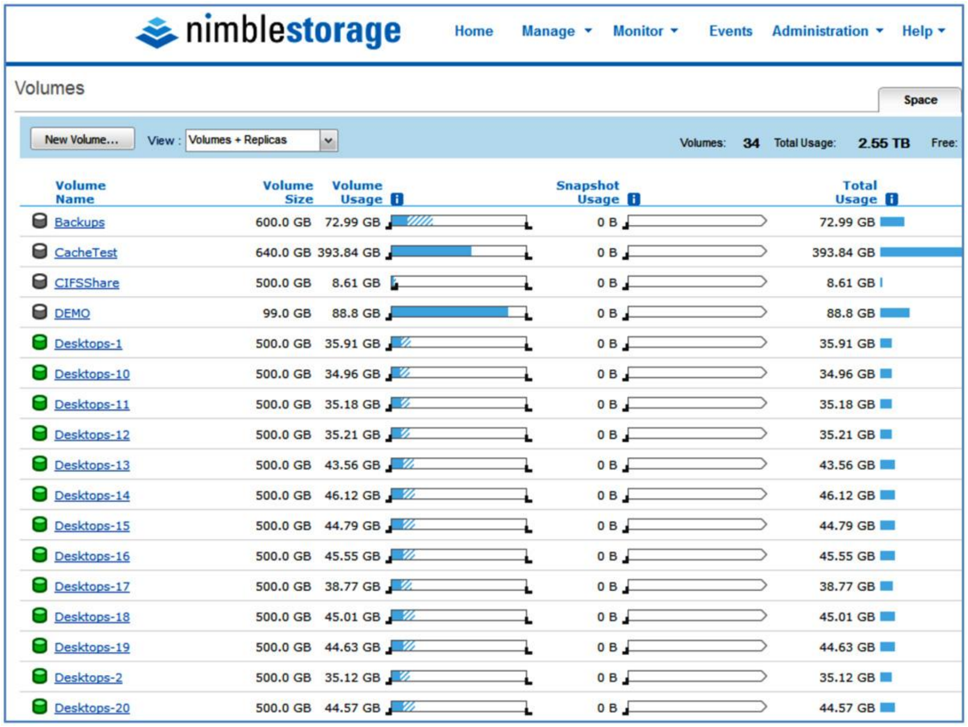
The iSCSI initiators of the Cisco UCS blades were defined in a single initiator group for ease of management and presentation. Nimble Storage allows all host initiator iSCSI qualified names (IQNs) to be grouped into a single group, which eases the need to provision storage for multiple groups of VMware ESX host initiators. This approach is a best-practice recommendation for VMware vSphere environments, because it prevents inconsistent performance policy settings and volume presentations to a VMware ESX host cluster that shares the same group of volumes. Figure 9 shows the grouping of all VMware ESX hosts in the VDI environment sharing a single initiator group. The initiator group is constructed by adding the IQN information for each blade's iSCSI initiator in a single combined group representing the VMware ESX cluster formed by the blades.

Figure 9: Nimble Storage iSCSI Initiator Setup



The 20 VMFS datastores were then configured into separate VMware View pools as described in Appendix D: VMware View Pool Details (Figure 10).

Figure 10: Nimble Storage Volume Management

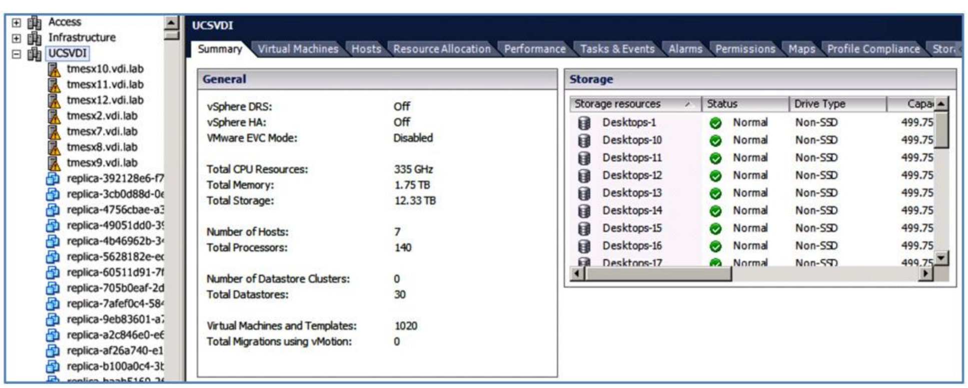


Volume Name	Volume Size	Volume Usage	Snapshot Usage	Total Usage
Backups	600.0 GB	72.99 GB	0 B	72.99 GB
CacheTest	640.0 GB	393.84 GB	0 B	393.84 GB
CIFSShare	500.0 GB	8.61 GB	0 B	8.61 GB
DEMO	99.0 GB	88.8 GB	0 B	88.8 GB
Desktops-1	500.0 GB	35.91 GB	0 B	35.91 GB
Desktops-10	500.0 GB	34.96 GB	0 B	34.96 GB
Desktops-11	500.0 GB	35.18 GB	0 B	35.18 GB
Desktops-12	500.0 GB	35.21 GB	0 B	35.21 GB
Desktops-13	500.0 GB	43.56 GB	0 B	43.56 GB
Desktops-14	500.0 GB	46.12 GB	0 B	46.12 GB
Desktops-15	500.0 GB	44.79 GB	0 B	44.79 GB
Desktops-16	500.0 GB	45.55 GB	0 B	45.55 GB
Desktops-17	500.0 GB	38.77 GB	0 B	38.77 GB
Desktops-18	500.0 GB	45.01 GB	0 B	45.01 GB
Desktops-19	500.0 GB	44.63 GB	0 B	44.63 GB
Desktops-2	500.0 GB	35.12 GB	0 B	35.12 GB
Desktops-20	500.0 GB	44.57 GB	0 B	44.57 GB

VDI: VMware

The VMware vSphere and View environment was set up with a single cluster of VMware ESXi hosts for the VDI configuration (Figure 11).

Figure 11: VDI Cluster Configuration



Testing Methodology and Results

To validate the capability to run up to 1000 desktop virtual machines on the Nimble Storage CS220G-X2 array, the VMware View Planner tool was used to run sample tests for a variety of configurations. The goal was to exercise and measure the storage infrastructure under a reference workload. The workload consisted of the following:

- 1000 desktop virtual machines configured into five VMware View pools of 200 desktops each
- Seven blade servers in a Cisco UCS and VMware cluster, each running approximately 143 virtual machines based on VMware View pool allocations for the cluster resource
- All 1000 virtual desktops configured in floating pools (they represent nonpersistent desktops used by task workers, with random workloads throughout the day)

As shown in the workload profile in Figure 12, a typical VMware View Planner configuration consists of a set of applications to exercise and a set of virtual machines on which to run that workload profile.

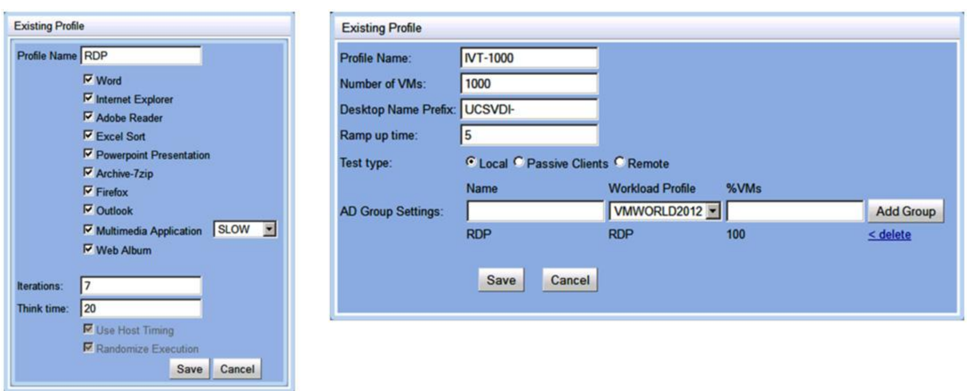
Figure 12 shows examples of the VMware View Planner Workload Profile and the VMware View Planner Run Definition used for the test of the Nimble Storage and Cisco UCS VDI solution.

For this test, all applications were selected for the workload profile. The Multimedia Application value was set to Fast. The Iterations value should be set to at least 7 to allow ramp up and ramp down of the individual desktop workloads during the test run and still obtain 5 iterations for steady-state measurements.

The Think Time setting was used to adjust the intensity of the desktop activity. Think Time dictates the average interval that each user session waits before moving on to the next workload profile task and can be a value between 5 and 20. For the 1000 desktop tests for average use cases, a Think Time value of 20 was used.

This selection of run profile characteristics is representative of a workload in the range of 7 to 10 IOPS per user, or comparable to a user roughly between a task worker (3 to 7 IOPS) and knowledge worker (7 to 10 IOPS).

Figure 12: VMware View Planner Workload and Run Profile



Boot and Login Scenarios

The VMware View Planner tool allows control of an orderly boot and login sequence when you are performing a test run. Two main options are available for the boot-process test. You can choose whether to reset each virtual machine to a fresh state at the beginning of each test run, or to run the VMware View Planner workload against a set of desktops that is already booted and ready. For each of the workload tests performed, the desktop virtual machines were reset manually each time before the workload was processed. This approach allowed measurement of the boot and login process separately from the measurement of the actual desktop workload processes.

The seven Cisco UCS blades are configured in a VMware cluster, and the VMware View pools and datastores are shared across the set. This approach provides greater simplicity of management for the environment and allows better distribution of the computing assets.

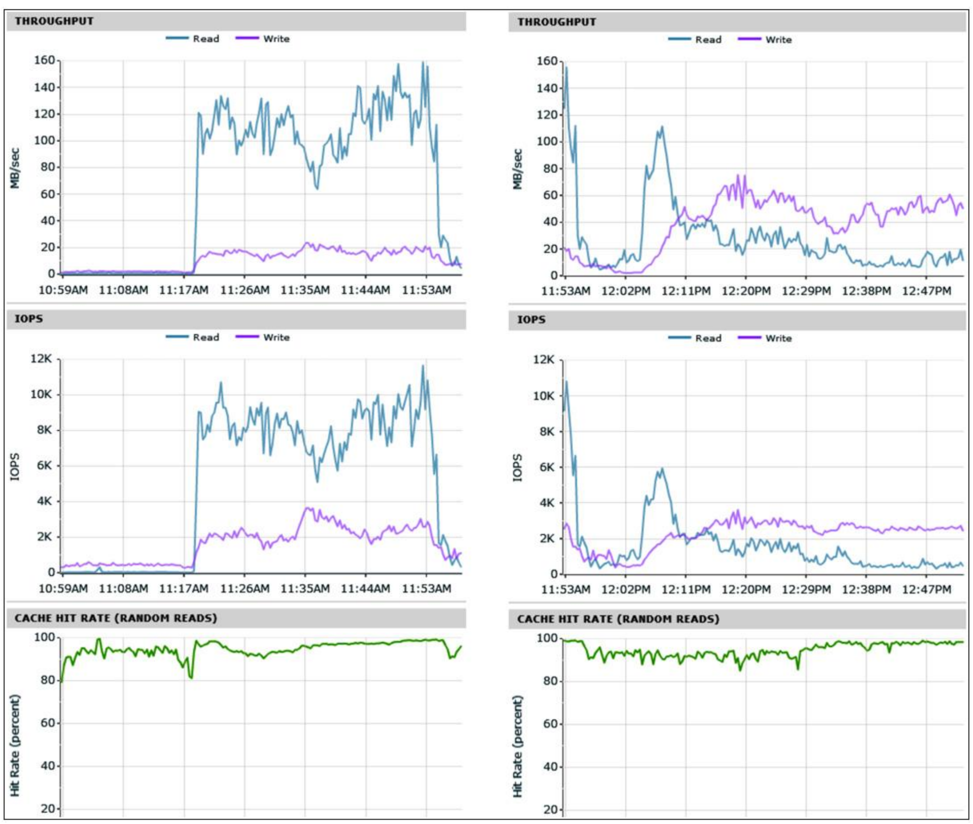
The total time to boot 1000 desktops and have the VMware View Planner agent log in is approximately 30 minutes. This time is measured by the completion of the VMware View Agent registration with the VMware View Administrator and the VMware View Planner Agent registration with the VMware View Planner appliance. Keep in mind that the desktop sessions are booting to an operational state and automatically logging in the test user (administrator), who then connects to the VMware View Planner harness. This user registration takes a little extra time, but it allows you to monitor the ready state of the desktop virtual machines under test.

The effect on the Nimble Storage appliance during the boot storm period can be seen in Figure 13, which contains three graphs:

- MBps throughput
- IOPS
- Cache hits

These graphs show that the storage infrastructure is delivering data well within the operational specifications expected. The system under test is capable of approximately 15,000 mixed-workload IOPS. The cache hit rate for random read operations is also steady and above the desired 85 percent threshold. Throughput is simply a result of the I/O rate and block sizes coming from the desktop virtual machines.

Figure 13: Nimble Storage Boot Storm: Steady-State Performance

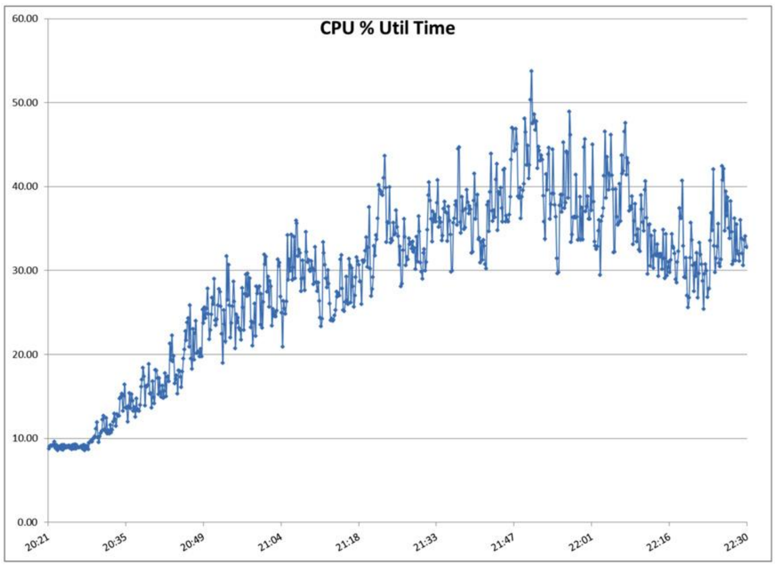


Steady-State Scenarios

As you can see, the transition to steady state causes a dramatic shift in the number of random read operations required to support the desktop workload. As the desktop virtual machines shift into various VMware View Planner tasks as defined by the workload profile, the random write operations become the dominant factor, at three to four times the number of random read I/O operations.

Figure 14 shows that as the workload approaches steady state, the CPU utilization is within the performance bounds desired for each blade in the Cisco UCS blade system.

Figure 14: Cisco UCS Blade: Steady-State Workload



Conclusion

The VDI solution test conducted with the Cisco UCS B-Series Servers, Nimble Storage CS220G-X2 array, and VMware View 5.1 showed that a robust yet simple configuration is possible for VDI scenarios with up to 1000 average worker desktops.

For More Information

http://www.nimblestorage.com/blog/technology/smartstack-vdi-architecture-from-cisco-nimble-storage-and-vmware/

http://info.nimblestorage.com/cisco-vmware-nimblestorage-solutions.html

Appendix A: Bill of Materials

Table 1 shows the bill of materials (BOM) for the test.

Table 1: Bill of Materials

VENDOR	COMPONENT MODEL (QUANTITY)	SOFTWARE OR OS VERSION
Cisco	Cisco UCS B230 M2 Blade Server (8)	Release 2.0(3c)
	Cisco UCS 2200 Series Fabric Extenders	
	Cisco UCS 5108 Blade Server Chassis	
	Cisco UCS 6248 48-Port Fabric Interconnect (2)	
Nimble Storage	Nimble Storage CS220G-X2 (1)	Release 1.4.1.0
VMware	VMware vSphere ESXi	VMware ESXi 5.0 Update 1
	VMware vSphere vCenter Server Standard	VMware vCenter 5.0 Update 1
	VMware View Premier	VMware View 5.1
	VMware View Planner (optional)	Release 2.1

Appendix B: VMware esxtop Graphs

Boot Storm Cisco UCS Performance Graphs

Approximately 30 minutes were needed to boot and log in 1000 desktops. The operations were sampled with VMware esxtop for one Cisco UCS B230 M2 Blade Server (Figures 15 through 20).

Figure 15: Boot Storm Cisco UCS CPU Utilization: Percentage of Core Utilized (Total)

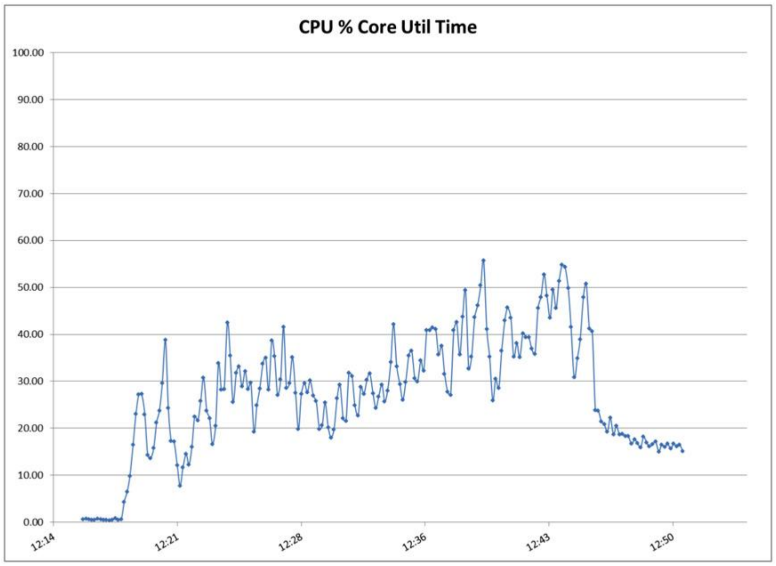


Figure 16: Boot Storm Cisco UCS Nonkernel Memory Use

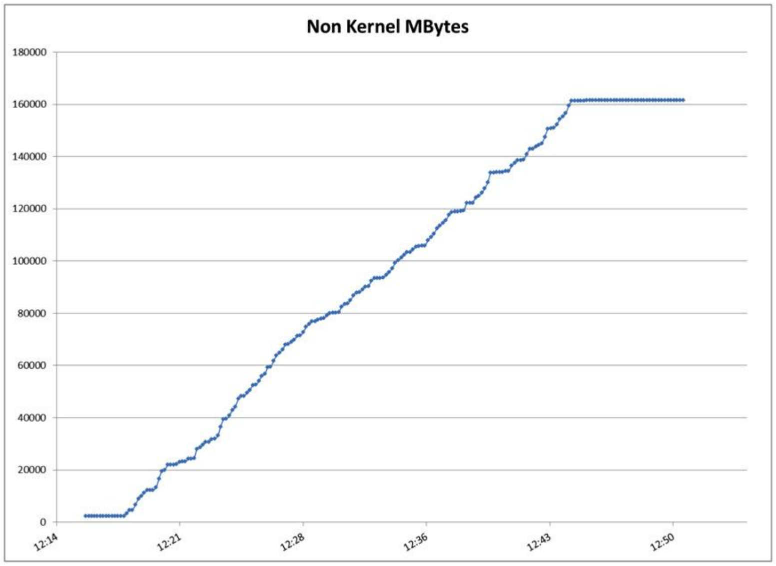


Figure 17: Boot Storm iSCSI Transmit (MBps): Multipath I/O (MPIO)

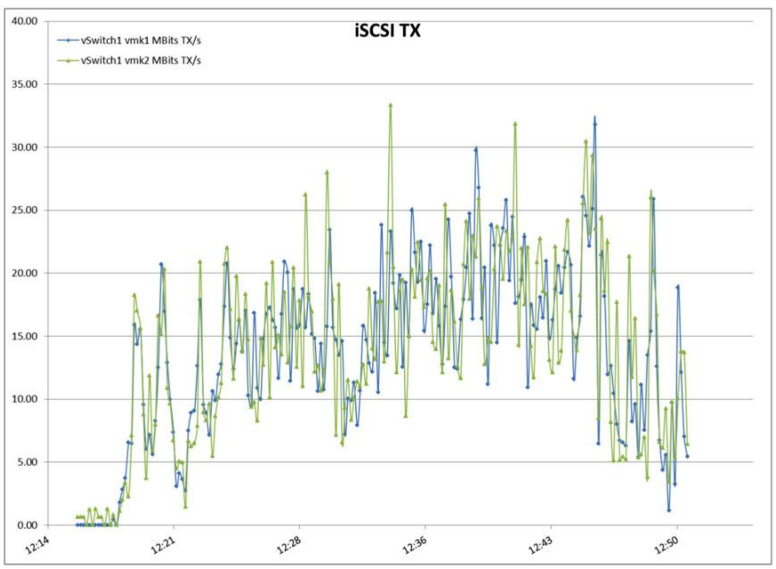


Figure 18: Boot Storm iSCSI Receive (MBps) MPIO

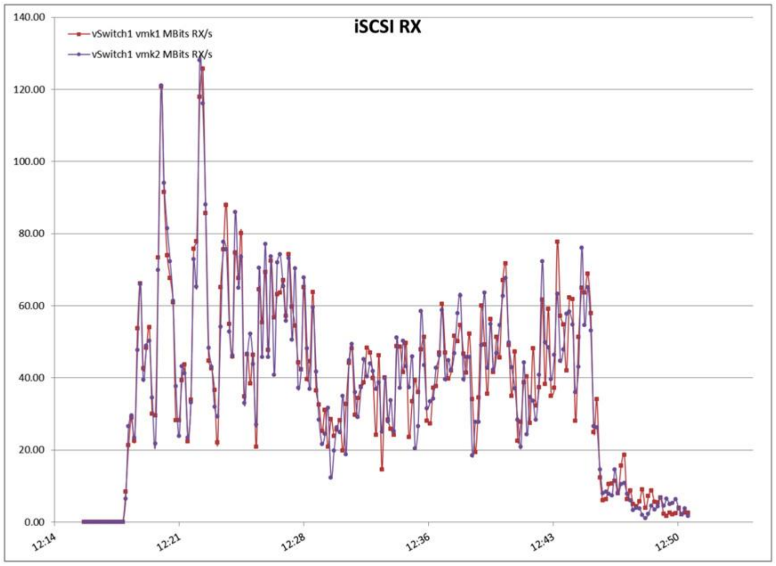


Figure 19: Boot Storm Virtual Machine Network Transmit Operation (MBps)

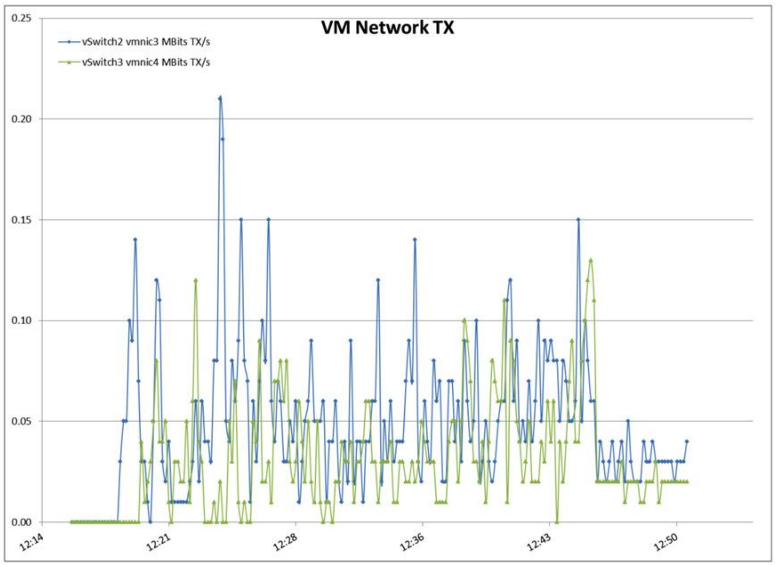
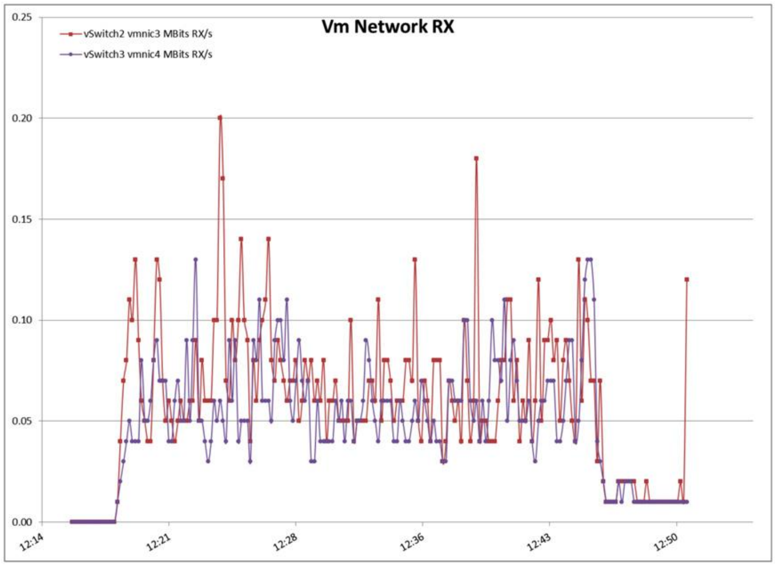


Figure 20: Boot Storm Virtual Machine Network Receive Operation (MBps)



Steady-State Cisco UCS Performance Graphs

Approximately 2 hours, including rollout of the test work load on 1000 desktops, were sampled with VMware esxtop on the Cisco UCS B230 M2 Blade Server (Figures 21 through 26).

Figure 21: Steady-State Cisco UCS CPU Utilization: Percentage of Core Utilized (Total)

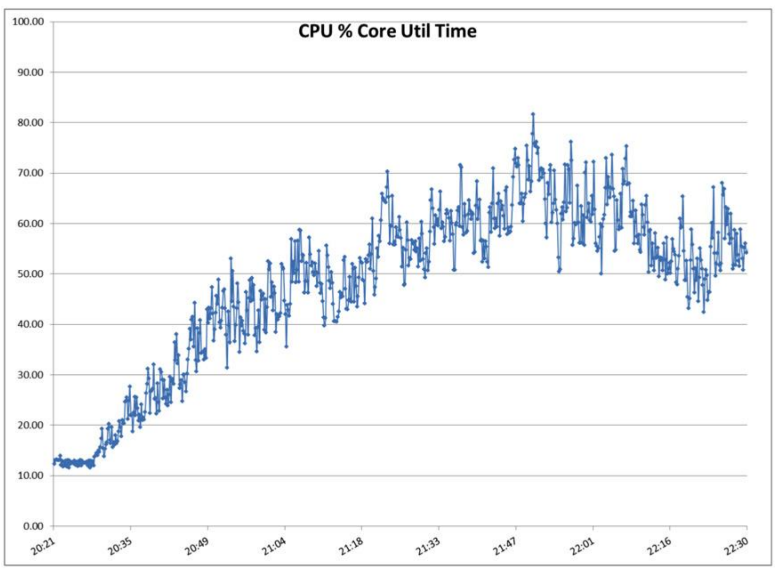


Figure 22: Steady-State Cisco UCS Nonkernel Memory Use

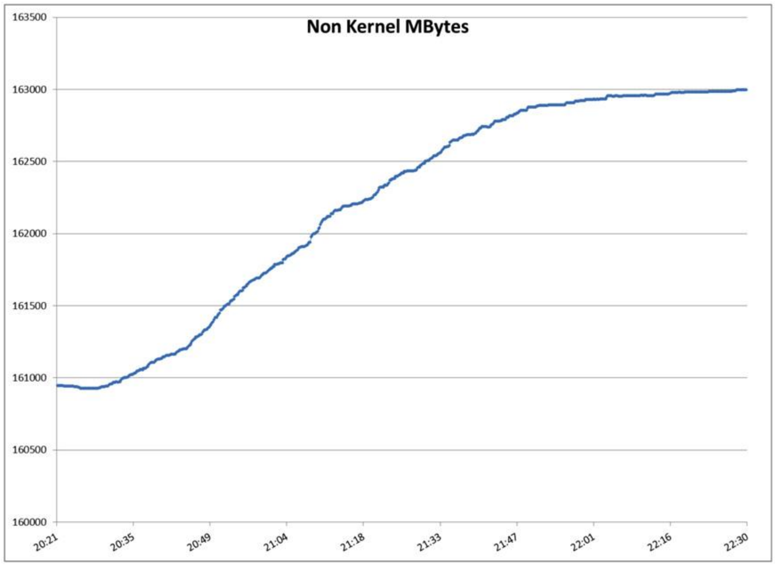


Figure 23: Steady-State iSCSI Transmit Operations (MBps): MPIO

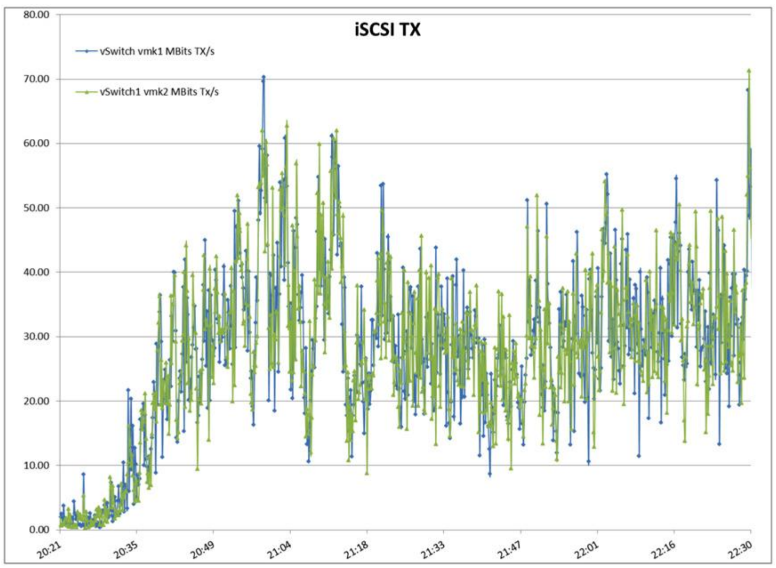


Figure 24: Steady-State iSCSI Receive Operations (MBps): MPIO

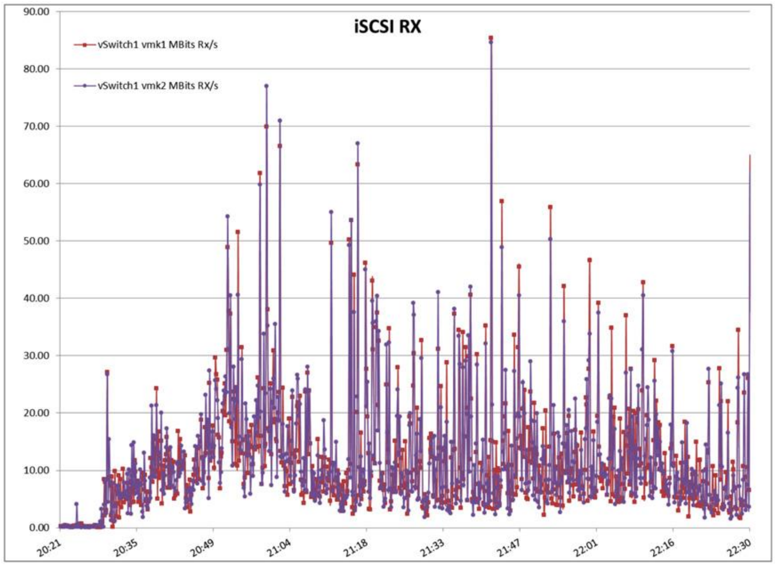


Figure 25: Steady-State Virtual Machine Network Transmit Operations (MBps)

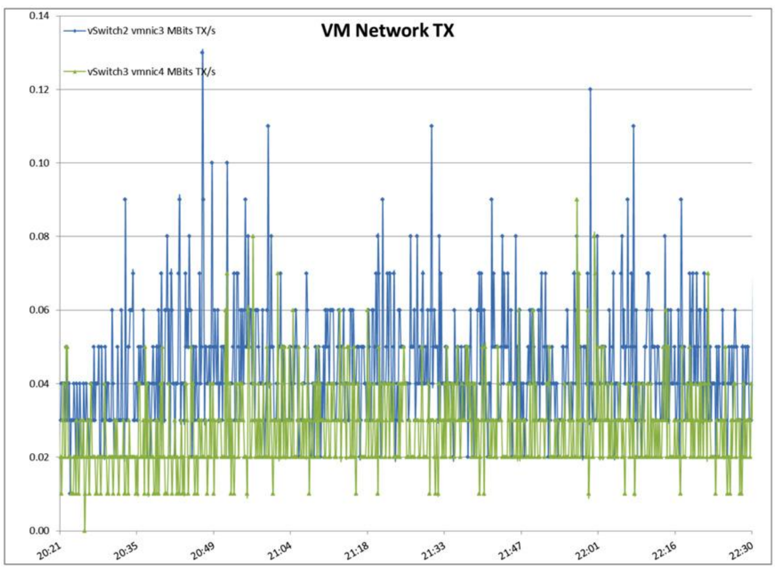
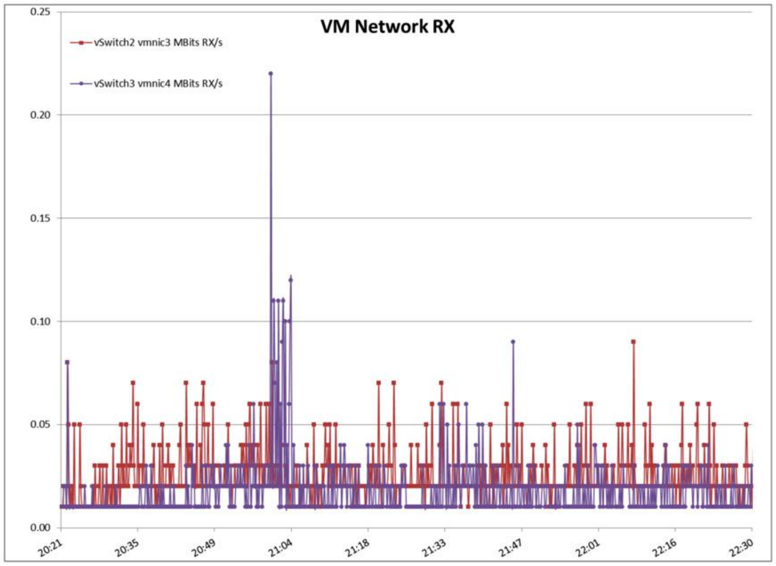


Figure 26: Steady-State Virtual Machine Network Receive Operations (MBps)



Appendix C: Nimble Storage Performance Graphs

Boot Storm Storage Performance Graphs

Approximately 30 minutes were needed to boot and log in 1000 desktops (Figures 27 through 30).

Figure 27: Boot Storm Storage Processor (CPU) Utilization

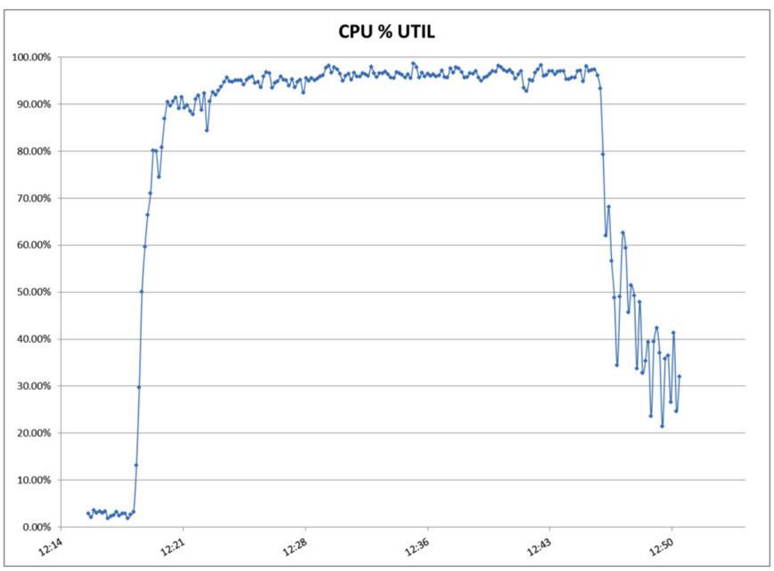


Figure 28: Boot Storm Storage IOPS

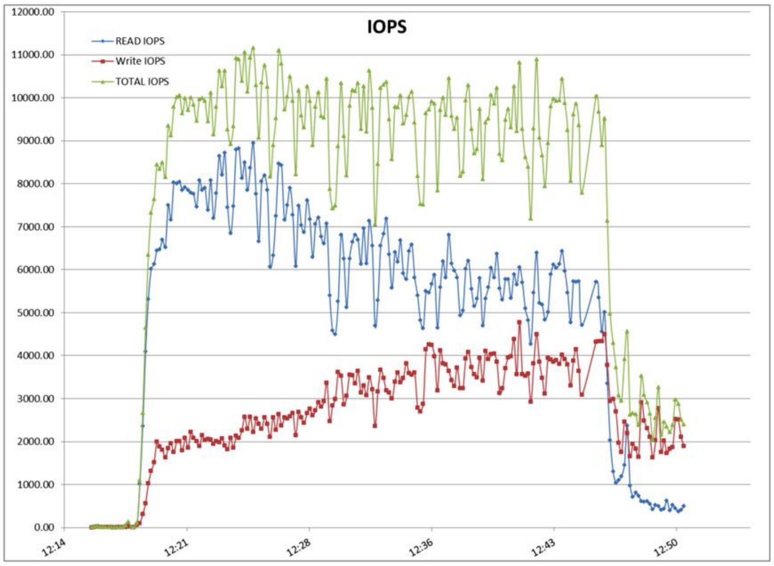


Figure 29: Boot Storm Average Read Latency

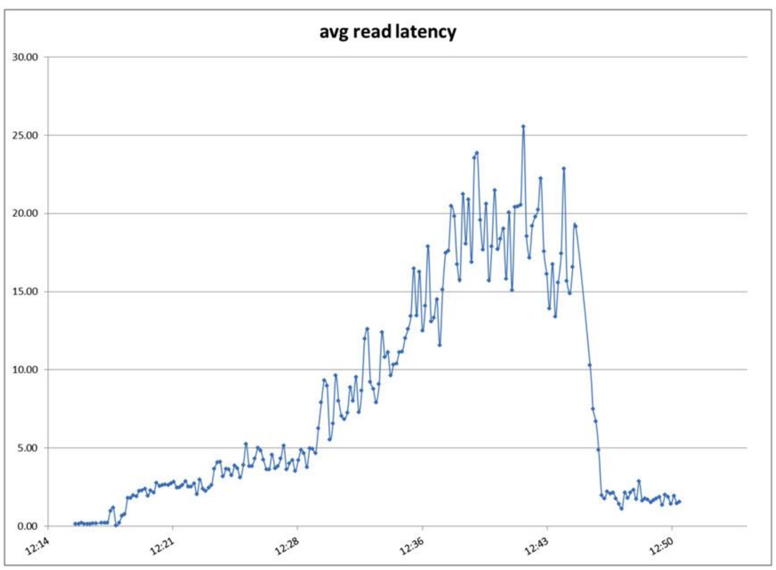
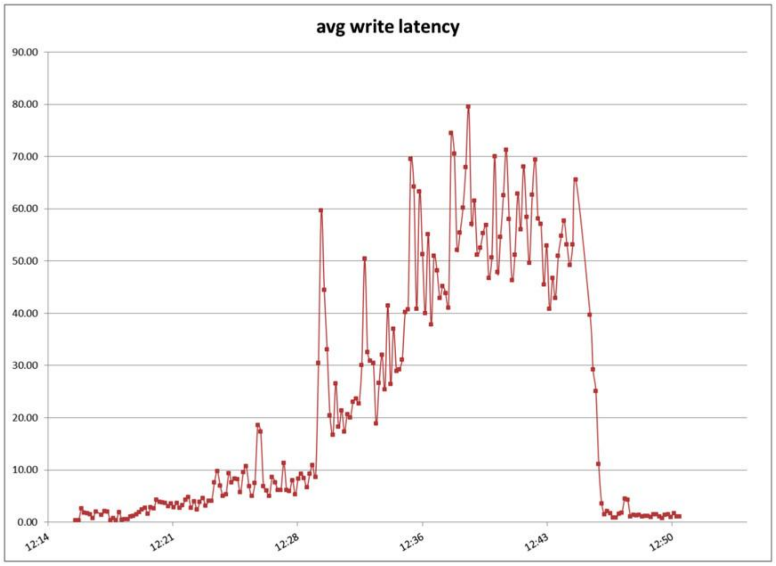


Figure 30: Boot Storm Average Write Latency



Steady-State Storage Performance Graphs

Approximately 2 hours, including rollout of the test work load on 1000 desktops, were monitored (Figures 31 through 34).

Figure 31: Steady-State Storage Processor (CPU) Utilization

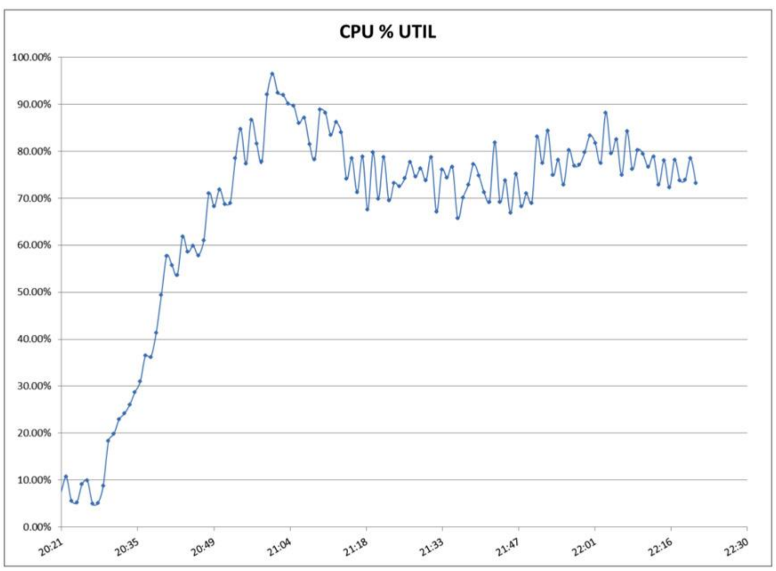


Figure 32: Steady-State Storage IOPS

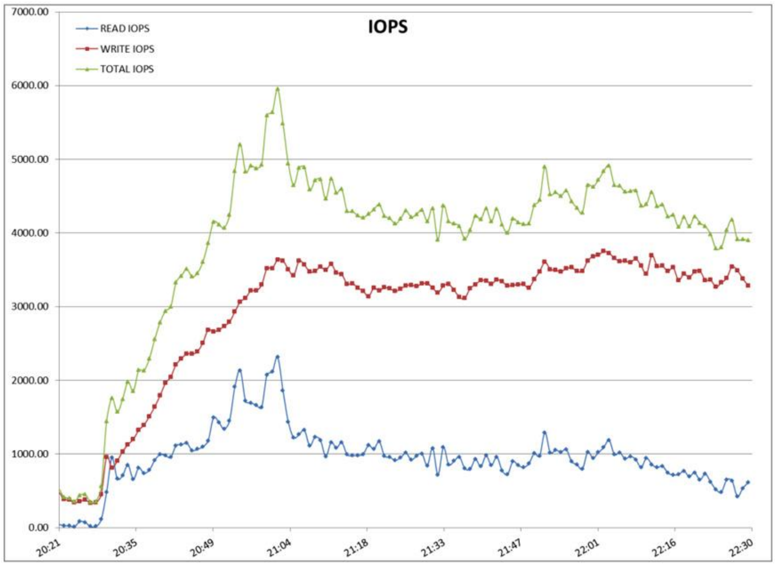


Figure 33: Steady-State Average Read Latency

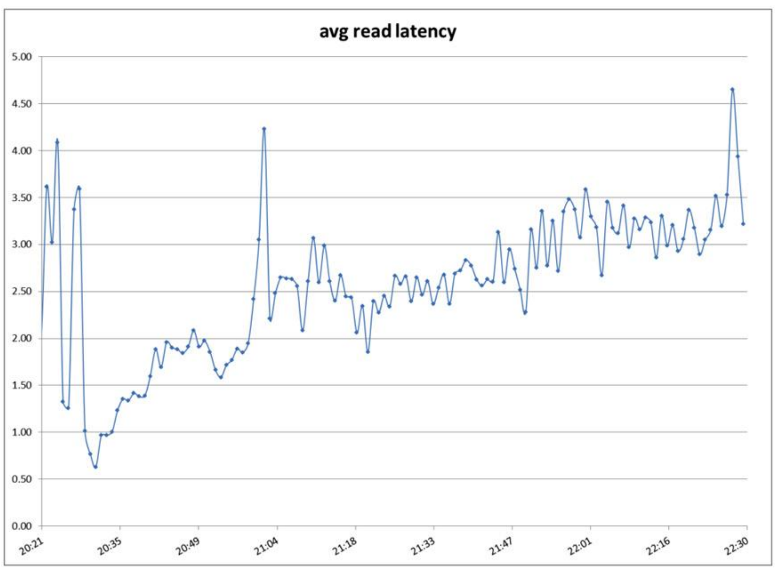
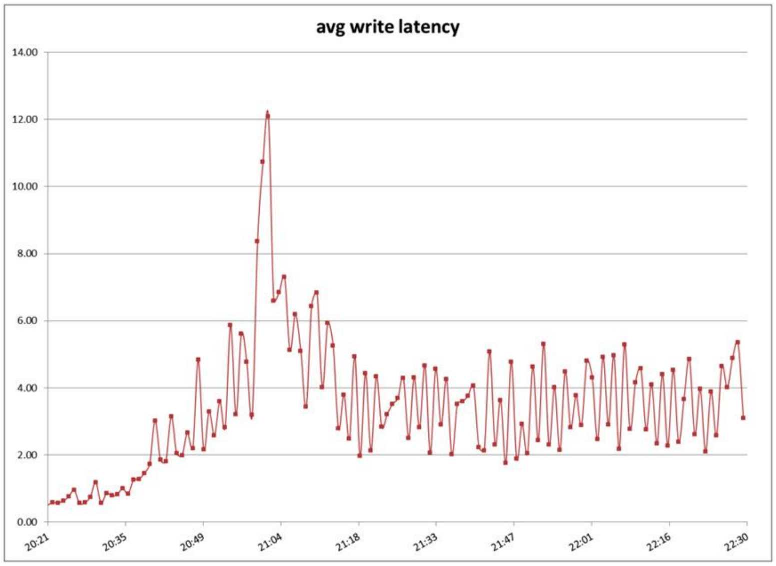


Figure 34: Steady-State Average Write Latency



Appendix D: VMware View Pool Details

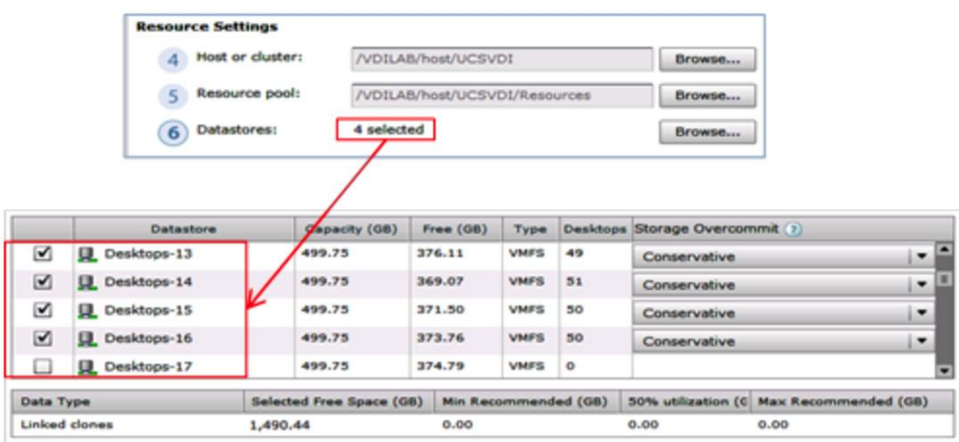
The VMware View pools were configured as automated, linked-clone, and floating pools. To test 1000 desktops, five VMware View pools of 200 desktop virtual machines were created in each pool (Figure 35).

Figure 35: VMware View Pool Configuration

ID	Display Name	Type	Source	User ...	vCenter Server	Ent...	En...	Sessions
VDI-1000-Pool-1	VDI-1000-Pool-1	Automated Pool	vCenter (linked clone)	Floating	vdivc5.vdi.lab	1		200 Remote
VDI-1000-Pool-2	VDI-1000-Pool-2	Automated Pool	vCenter (linked clone)	Floating	vdivc5.vdi.lab	1		200 Remote
VDI-1000-Pool-3	VDI-1000-Pool-3	Automated Pool	vCenter (linked clone)	Floating	vdivc5.vdi.lab	1		200 Remote
VDI-1000-Pool-4	VDI-1000-Pool-4	Automated Pool	vCenter (linked clone)	Floating	vdivc5.vdi.lab	1		200 Remote
VDI-1000-Pool-5	VDI-1000-Pool-5	Automated Pool	vCenter (linked clone)	Floating	vdivc5.vdi.lab	1		200 Remote

Each pool had four separate datastores provisioned to it from the Nimble Storage volumes presented to the VMware ESXi hosts. The replica and OS disks were placed on the same datastore (Figure 36).

Figure 36: View Pool Storage Configuration



All desktops were provisioned at the start and created during a separate provisioning period before the testing was performed. Disposable disks were not selected for the particular test cases.

The VMware View 5.1 VSA function was also selected. During the testing phases, blackout times were used to avoid interfering with other test and measurement activities (Figure 37).

Figure 37: VMware View Storage Accelerator Selection

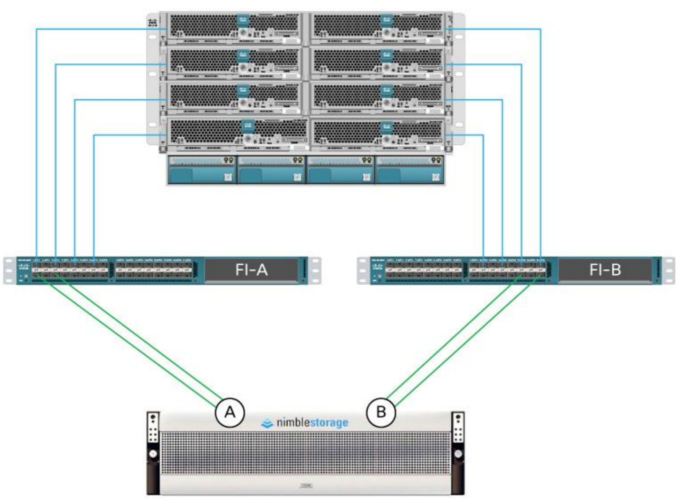
All other VMware View pool settings were default values or those specified in the VMware View Planner Installation and Users Guide.

Appendix E: Nimble Storage Connectivity Options with Cisco UCS

Option 1: Controller to Fabric Interconnect Connection Method

Connect each Nimble Storage controller (A and B) to a separate Cisco UCS fabric interconnect (A and B). This setup enables the Nimble Storage array to support fully redundant MPIO, but it requires manual intervention in the event of either fabric interconnect or array controller failure. The configuration of iSCSI vNICs is simple. The solution looks like Figure 38.

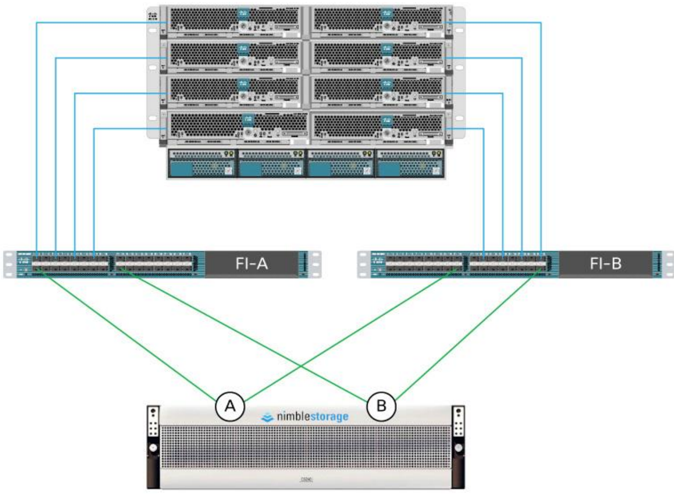
Figure 38: Controller to Fabric Interconnect Connection Method



Option 2: Controller to Fabric Interconnect Cross-Connection Method

Connect one path from each Nimble Storage controller (A and B) to a separate Cisco UCS fabric interconnect (A and B). This setup enables support for a reduced level of path failover, but slightly reduces the capability to use MPIO for the Nimble Storage array. The configuration of iSCSI vNICs is a little more complicated. The solution looks like Figure 39.

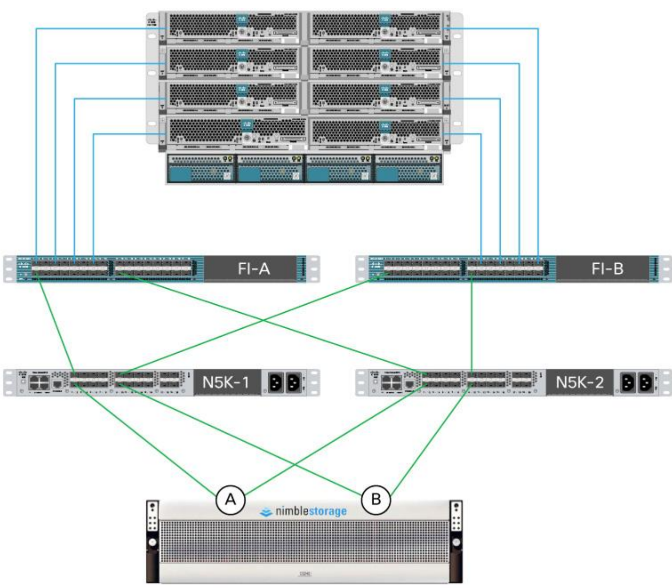
Figure 39: Controller to Fabric Interconnect Cross-Connection Method



Option 3: Access-Layer Switch Connection Method

Connect one path from each Nimble Storage controller (A and B) to a separate access-layer switch (1 and 2). Then connect the access-layer switches to the Cisco UCS fabric interconnects (A and B). This setup provides the most robust solution, and it also supports path failover and the full use of MPIO for the Nimble Storage array. The configuration of iSCSI vNICs is simple. The solution looks like Figure 40.

Figure 40: Access-Layer Switch Connection Method



C07-719522-00 11/12