White Paper

Cisco Integrated Desktop Virtualization Solution With Tegile Zebi Storage

VMware View 5.1 with VMware vSphere 5 for 1000 Virtual Desktops Using Cisco UCS, Cisco Nexus Switching, and Tegile Zebi Storage

Contents

What You Will Learn

This document describes the reference architecture of the Cisco® Desktop Virtualization solution with shared storage for 1000 virtual desktops based on VMware View 5.1 and VMware vSphere 5. The Cisco Desktop Virtualization solution includes Cisco UCS® B-Series Blade Servers, Cisco Nexus® Switching 5500 Series platform, and Tegile Zebi HA2100 storage array. This reference architecture is based on Cisco's "scalable architecture" deployment model for desktop virtualization.

Cisco Desktop Virtualization Solutions

Cisco Desktop Virtualization solutions transform user desktops into workspaces that require reduced initial capital outlay with lower operating costs, offering rapid provisioning and simplified management. Built with an ecosystem of industry-leading technology partners like Tegile, IT environments of all sizes benefit from a portfolio of scalable architectural approaches that deliver consistently high-performance with an uncompromised user experience as business demand grows.

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

Storage is a critical element in the deployment of virtual desktop infrastructure (VDI). VMware provides the VMware View Planner tool to enable its partners to help assess and plan the appropriate compute, network, and storage configuration for VMware View environments.

With VMware vSphere 5 and View 5.1, 1000 Microsoft Windows 7 virtual desktops were deployed on the Cisco UCS B-Series server platform connected to a single 3 rack unit (3RU) multiprotocol Tegile Zebi HA2100 storage array. Details of the configuration are described in this document.

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

Summary of Findings

- The combination of the Cisco Unified Computing System™ (Cisco UCS), Cisco Nexus switching, and Tegile Zebi storage hardware with VMware ESXi 5.1, VMware View 5.1 software produces a high density per blade and chassis virtual desktop delivery system.
- Cisco maintains its industry leadership with the new Cisco UCS Manager 2.1 software, which makes scaling and maintenance simple and helps ensure consistency. The advanced networking and storage functionality provide various configuration options to deploy desktop workloads.
- The Cisco 10-Gbps unified fabric architecture has also been validated on second-generation Cisco UCS 6200 Series Fabric Interconnects and second-generation Cisco Nexus 5500 Series Switches, processing more chal-lenging workloads and maintaining unsurpassed user response times.
- The entry-level, multiprotocol Tegile Zebi HA2100 storage array can run 1000 virtual desktops, with in-line de-duplication and compression enabled to significantly reduce the amount of storage required to host the virtual desktops. The test meets boot, login, and steady-state requirements specified by VMware View Planner, while providing an 83 percent reduction in storage capacity as a result of the integrated in-line de-duplication and compression functionality of the storage array.

Business Value

The benefits of VDI have been well documented. However, performance concerns, as well as the cost and complexity associated with storage, can become inhibitors to VDI adoption.

Customers require a scalable, tiered, and highly available infrastructure on which to deploy their virtual desktop environments. There are several new technologies available to assist them in designing a virtual desktop solution, but they need to know how to use these technologies to maximize their investment, support service-level agreements, and reduce their total cost of ownership (TCO).

The reference architecture described in this guide builds a replica of a common customer virtual desktop infrastructure (VDI) environment and validates the environment for performance, scalability, and functionality. Customers achieve:

- Increased control and security of their global, mobile desktop environment, which is typically their most at-risk environment
- Better end-user productivity through a more consistent environment
- Simplified management, with the environment contained in the data center
- Better support for service-level agreements 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 combined with platform modularity provides a simplified, secure, and scalable desktop virtualization platform.

- Simplified
  - Virtual desktop density per sever
  - Unified management, providing a 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 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 ROI and lower TCO) with the industry's highest virtual desktop density per server. This means that fewer servers are needed, reducing both capital expenditure

(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 react to new opportunities by simply deploying virtual desktops whenever and wherever needed. The high-performance Cisco UCS system and network deliver a near-native end-user experience, allowing users to be productive anytime and anywhere.

Sample Questions for Project Planning and Solution Sizing

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 required to execute 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?

Here is a short 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? How many in production? Will all virtual desktops use Microsoft Windows 7?
- How much memory will be needed per desktop in the target desktop group?
- Are there any multimedia, Adobe Flash, or graphics-intensive workloads?
- What is the end point 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 anti-virus software a part of the image?
- Is user profile management (nonroaming-profile-based management) part of the solution?
- What are the fault tolerance, failover, and disaster recovery plans?
- Are there additional desktop subgroup=specific questions that need to be addressed?

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

The Cisco 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 Cisco UCS computing platform includes:

- UCS 6200 Series Fabric Interconnects
- UCS 2200 Series IO Modules
- UCS 5108 Blade Chassis
- 7 UCS B200 M3 Blade Servers for Virtual Desktop hosting
- 1 UCS B200 M3 Blade server for virtual infrastructure management

The solution also includes:

- Cisco Nexus 5500 Series Switches
- Hypervisor: VMware ESXi 5.1 booted from local drives
- Virtual Desktop Connection Broker: VMware View 5.1
- Tegile Zebi HA2100 storage array

Cisco Unified Computing System

Cisco UCS is the first truly unified data center platform that combines an 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), and Cisco UCS 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 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

Cisco Nexus 5500 Series

Cisco Nexus 5500 Series Switches deliver an innovative architecture to simplify data center transformation by enabling a high-performance, standards-based, multiprotocol, multipurpose, Ethernet-based fabric. They help consolidate separate LAN, SAN, and server cluster network environments into a single 10 Gigabit Ethernet fabric. This unification enables network consolidation and greater utilization of previously separate infrastructure and cabling, reducing by up to 50 percent the number of adapters and cables required and eliminating redundant switches. This infrastructure displacement also lowers power and cooling costs significantly.

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 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 provide 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 numbers of virtual desktops boot simultaneously) by using host-side memory
- **VMware PCoIP Optimization Controls:** Deliver protocol efficiency and enable IT administrators to control 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 sup-port 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 applications 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, so that 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 enables the use of the latest functions of the leading cloud infrastructure platform for highly available, scalable, and reliable desktop services.

Tegile Zebi Storage

Tegile Zebi storage arrays balance performance, capacity, features, and price. The hybrid arrays are architected from the ground up to use flash storage in an intelligent and optimal manner. Tegile Zebi storage arrays are significantly faster than legacy arrays and considerably less expensive than solid-state disk-based arrays. Featuring multiprotocol network attached storage (NAS) and storage area network (SAN) connectivity, these virtual data storage systems are easy-to-use, fully redundant, and highly scalable. Additionally, they come complete with built-in snapshot, replication, near-instant recovery, and virtualization management features.

Tegile's patented MASS technology accelerates performance to solid-state speeds without sacrificing the capacity or cost advantage of hard disk storage. Additionally, this technology enables on-the-fly de-duplication and compression so that its usable capacity is far greater than its raw capacity.

The portfolio of Tegile Zebi storage arrays scale to accommodate the various capacity and performance requirements of customers. The Zebi product line includes HA2100, HA2100EP, HA2400 and all-flash HA2800 storage arrays, which provide progressively increasing performance along the product line. The product line also includes storage expansion shelves to add capacity to the storage arrays. The expansion shelves include a mix of solid-state and hard disk drives (SSDs and HDDs).

The benefits resulting from the Tegile Zebi balanced approach to storage include:

- Performance acceleration through intelligent use of DRAM, SSD, and metadata acceleration
- Reduced costs through efficient use of storage capacity with in-line, variable-block de-duplication, compression and thin provisioning
- Flexibility resulting from integrated multiprotocol support, including Fibre Channel, iSCSI, Network File System (NFS), and Common Internet File System (CIFS)

- Enhanced data protection and availability through silent data corruption detection and correction, a rich set of RAID options, snapshots, cloning, and remote replication
- Ease of use through application and VM-aware provisioning and reporting, as well as customizable dashboards

Solution Overview and Benefits

This solution uses Cisco UCS, Cisco Nexus 5548UP Switches, Tegile Zebi storage, and VMware vSphere 5 to provide resources for a VMware View 5.1 environment of Windows 7 32-bit virtual desktops provisioned by VMware View Composer.

Planning and designing the server, networking, and storage infrastructure for 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. In addition, the networking infrastructure should be provisioned to handle bursts of data traffic, and finally the shared storage must be able to absorb large bursts of input/output (I/O) that occur over the course of a workday.

To provide 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 increase in the number of virtual desktops
- Rapidly provision a scale-out infrastructure
- Provide low latency and high bandwidth for the clustering, provisioning, and storage interconnect networks
- Handle the peak I/O load from clients while maintaining quick response times

Solution Benefits

Cisco UCS with Tegile Zebi storage delivers:

- **High performance:** The success of VDI deployments is largely determined by end-user satisfaction. Users expect response times in a VDI environment to be on par with dedicated desktop and laptop computers. The Cisco Nexus 5500 Series and Cisco UCS B200 M3 Blade Servers and the virtual interface card (VIC) pro-vide a high-performance, low-latency network and compute platform. Tegile Zebi storage is architected to deliver high I/O throughput and IOPS for virtualized environments through the intelligent use of flash storage and hard disk drives. The joint Cisco and Tegile solution provides a high-performance compute, network, and storage platform required to deploy the rich set of virtual desktop features and functions delivered by VMware View.
- **Storage capacity reduction:** The integrated, in-line de-duplication, compression and thin provisioning technologies in Tegile Zebi storage arrays dramatically reduce physical storage consumption. Customers using Tegile Zebi storage have reported up to 83 percent storage capacity reduction with the use of in-line de-duplication and compression. These data reduction features are provided at no extra cost and are in-cluded in the price of the array.
- **Reduced server and storage footprint:** Both Cisco UCS and Tegile Zebi storage have been designed with virtualization in mind. The high compute, memory, and network capacity provided by Cisco UCS enables a high density of virtual desktops in a compact footprint with fewer physical components. The

reduced number of components enabled by Cisco UCS and efficient storage use through data reduction enabled by Tegile Zebi storage directly result in lower CapEx and OpEx for the VMware View virtual desktop deployment.

- **Availability:** Cisco UCS and Tegile Zebi storage arrays are designed with redundant components and no single points of failure. Both systems provide proactive monitoring and alerts. Tegile Zebi storage arrays also come integrated with a rich set of RAID options, snapshots, cloning and remote replication features for increased data availability. The overall solution enables a VMware View deployment with fewer disruptions to end users.
- **Single platform for multiple workloads:** Cisco UCS and Tegile Zebi storage support multiple protocols for storage access. Both support NAS and SAN protocols. While this particular solution has been tested with NFS for storage access, the integrated multiprotocol support in Cisco UCS and Tegile Zebi storage provides customers with flexibility and protocol choice. Desktop images can be deployed using NFS, iSCSI or Fibre Channel protocol, while data folders for the Microsoft Windows virtual desktops can be provisioned using CIFS on the same Tegile Zebi storage array and Cisco UCS system.

Architecture and Design of VMware View 5 on Cisco Unified Computing System and Tegile Storage Solution

This section describes the topology and reference architecture for the deployment of 1000 virtual desktop users using Cisco UCS, Tegile Zebi storage, and VMware View. The solution has been validated using VMware View Planner 2.1, following the VMware recommended test guidelines. The test configuration consists of 1000 linked clone Windows 7 32-bit desktop virtual machines using Remote Desktop Protocol (RDP). The solution processes a steady state workload of 7 to 10 IOPS per VM, simulating a Windows 7 task user profile. The solution passed the View Planner test criteria and met the VMware requirements to deliver the application response times required for virtual desktop deployments.

Figure 1 shows the server, storage, and network topology. The solution was configured for high availability:

- One Cisco UCS 5108 Blade Chassis with four Redundant Power Supplies, four redundant Fans and two redundant Cisco IO Modules
- Eight UCS B200 M3 Blade Servers providing server-based N+1 Fault tolerance
- Two Cisco UCS 6248UP Fabric Interconnects
- Two Cisco Nexus 5548UP 10 Gigabit Ethernet, Fibre Channel and FCoE Switches
- One Tegile Zebi HA2100 SSD hybrid storage array with active-active storage controllers
- The eight blade servers shared eight 10 Gigabit Ethernet ports, with four links connected to Fabric Intercon-nect A and the other four links connected to Fabric Interconnect B
- Each Cisco Fabric Interconnect was connected to both Cisco Nexus 5548UP Switches
- The Tegile HA2100 storage array was connected to both Cisco Nexus 5548UP Switches with fully redundant 10 Gigabit Ethernet links from both storage controllers
- The two Cisco Nexus switches were also connected together with redundant 10 Gigabit Ethernet interswitch links
- The Tegile Zebi HA2100 storage array was shared among all the blade servers using NFS over 10 Gigabit Ethernet

- NFS shares from the Zebi storage array are accessed across dual ports on both controllers using virtual IP addresses
- In the event of a single path failure on a controller, or a single controller failure, the NFS shares will continue to be accessible in a transparent manner to the hosts

Figure 1. Solution Topology

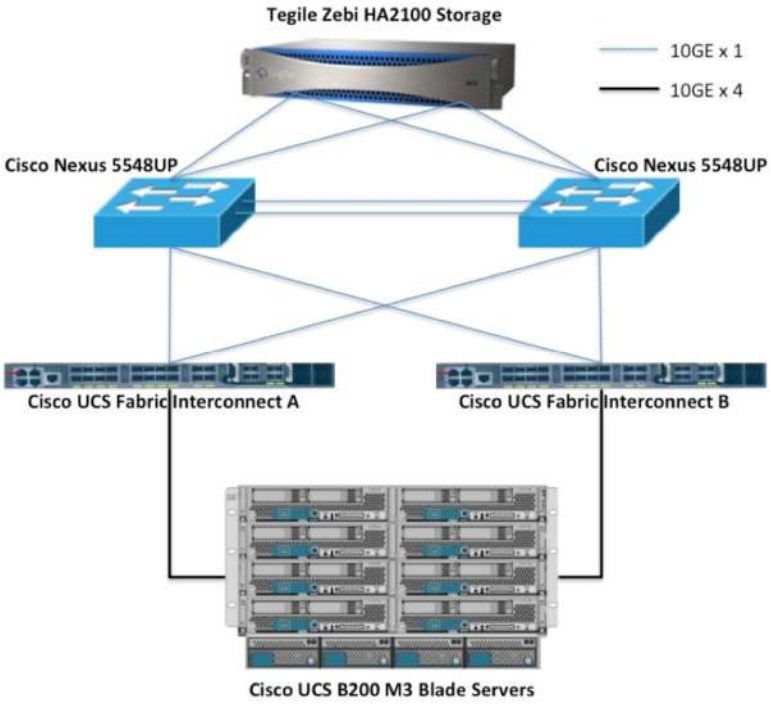
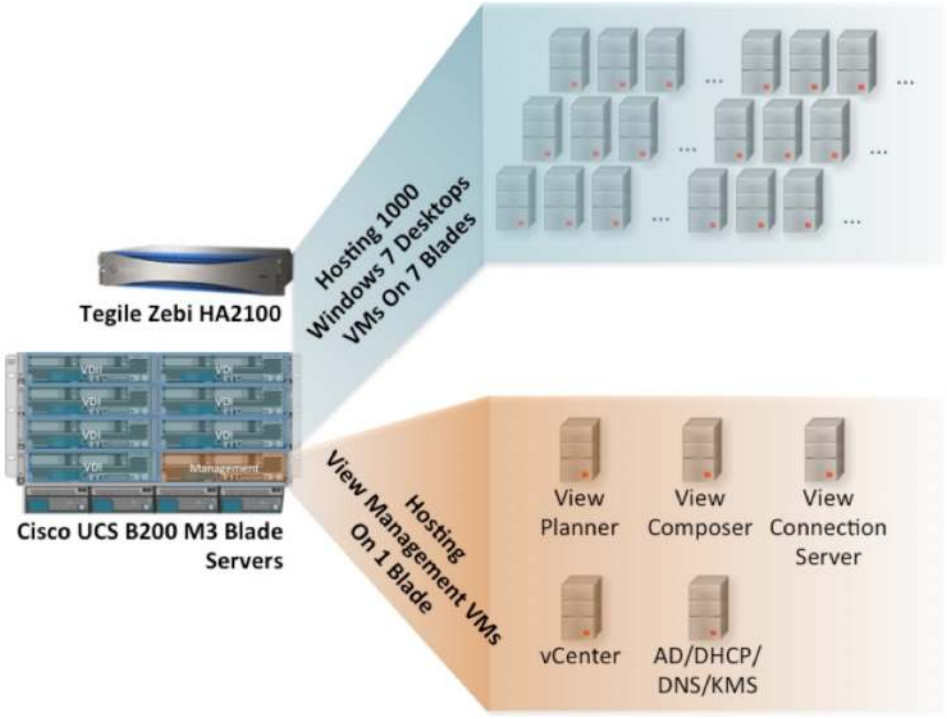


Figure 2 shows a high-level architecture of the 1000 VMware View virtual desktop solution using Cisco UCS blade servers and the Tegile Zebi HA2100 storage array.

Figure 2. VMware View Virtual Desktop Architecture



The components of the virtual desktop architecture are:

- 1000 Windows 7 32-bit virtual desktops were configured.
- Each virtual desktop was configured with:
  - 1 vCPU
  - 1.5-GB vMemory
  - 25-GB provisioned virtual disk space
  - 1 vNIC
  - Max display resolution: 1920 x 1200
  - Each Windows 7 desktop was installed with several desktop applications such as Microsoft Office 2007 Word, Excel, Power Point and Outlook, Internet Explorer, Firefox, Adobe Reader, 7Zip, and Windows Media Player.
- The 1000 virtual desktops were hosted on seven Cisco UCS B200 M3 Blade Servers.
- 143 virtual desktops were hosted on each blade server, while the server is capable of hosting more than 150 desktops.
- VMware ESXi 5.1 was installed on the blade servers.
- One Tegile Zebi HA2100 storage array was used to store all 1000 virtual desktops.
- One Cisco UCS 200 M3 Blade Server was used to host the following infrastructure virtual machines:
  - VMware vCenter 5.1
  - VMware View Connection Server 5.1

- VMware View Composer 3.0
- VMware View Planner 2.1
- Microsoft Active Directory Domain Controller hosting DHCP, DNS and KMS licensing

Solution Validation

This section details the configuration and tuning that was performed on the individual components to produce a complete, validated solution.

Server Configuration: Cisco UCS B200 M3 Blade Server

This section provides the detailed configuration of the Cisco UCS Blade Servers.

Each UCS B200 M3 blade server was configured with:

- Two Intel Xeon E5-2690 8-core processors (total 16 cores)
- 256 GB of RAM
- Cisco Virtual Interface Card 1240 Converged Network Adapter
- Two 600-GB 10K RPM 2.5-inch SAS HDD local drives

Figure 3 shows the equipment view of the Cisco UCS B-Series chassis. It contains eight blade servers and two Cisco UCS Fabric Interconnect modules (A and B). Fabric Interconnect A serves as the primary interconnect and B serves as the subordinate interconnect.

Figure 3. Cisco UCS Manager: Equipment View

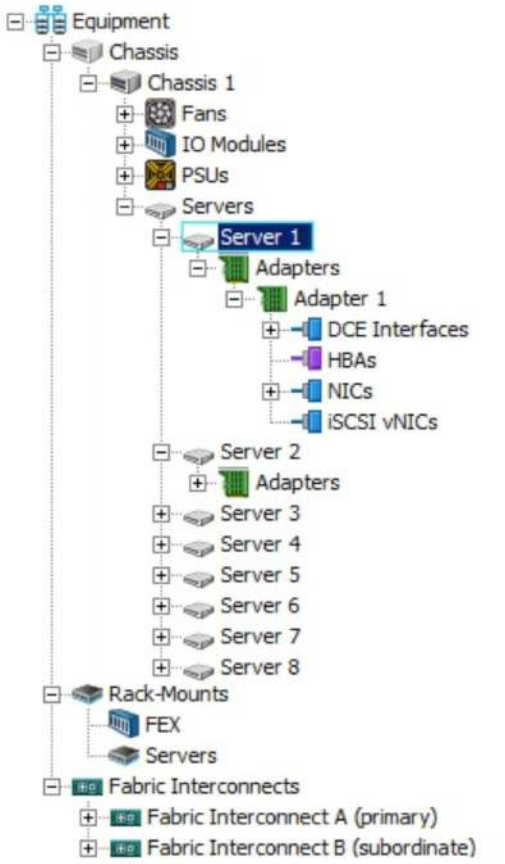


Figure 4. Cisco UCS Manager: Fabric Interconnects

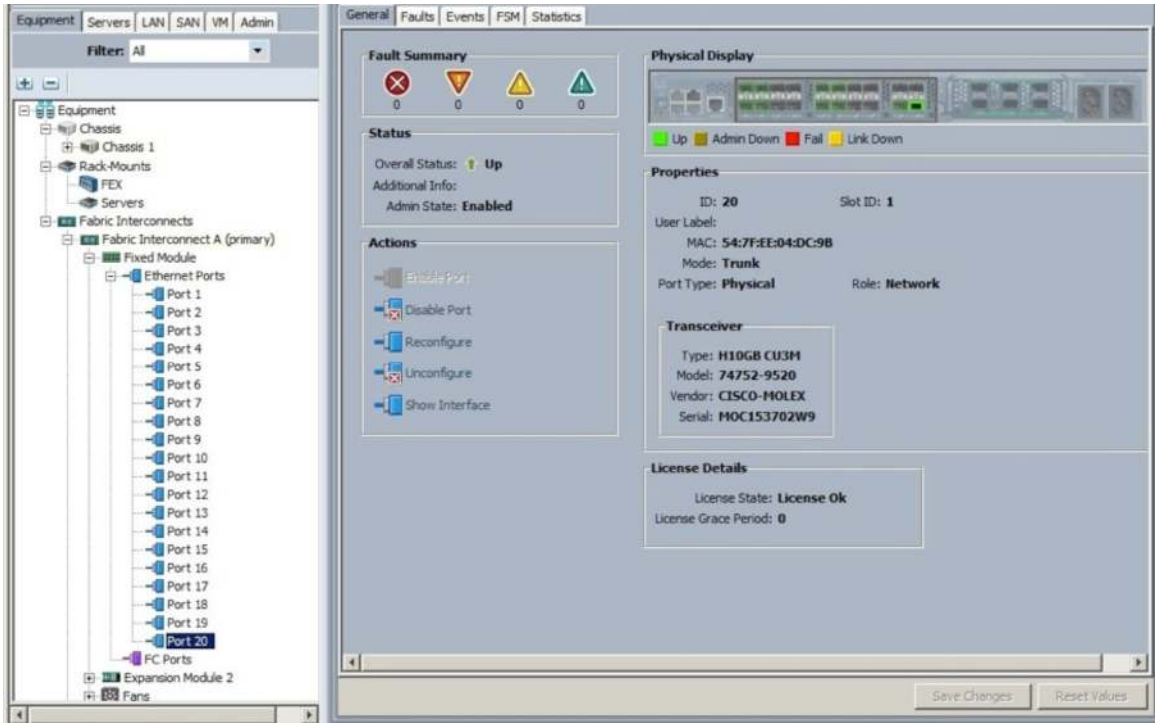
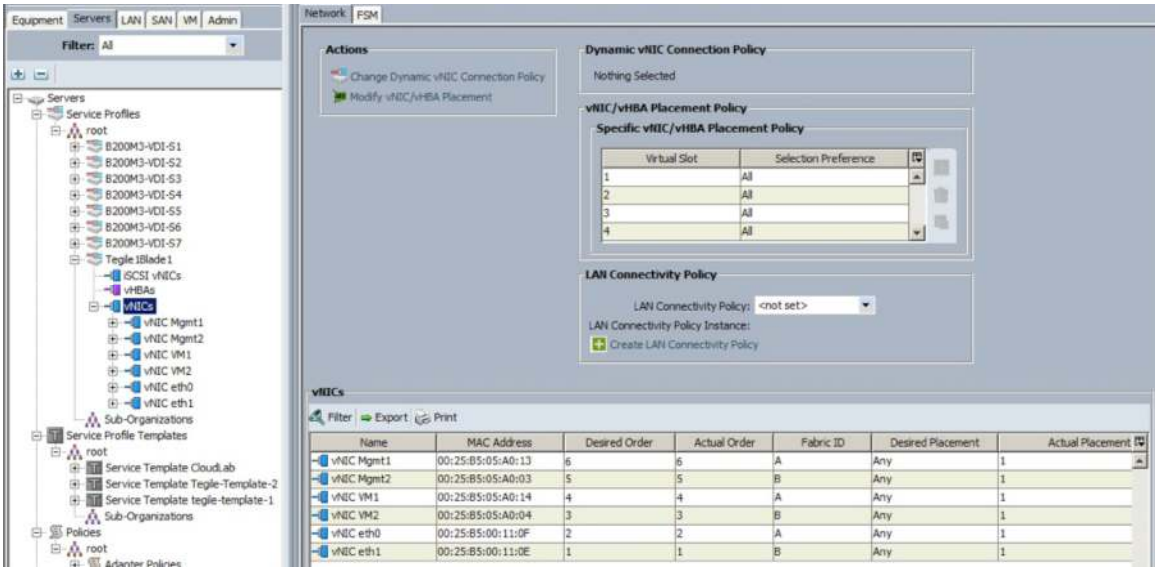


Figure 5 shows vNIC configuration on the Cisco UCS blade server.

Figure 5. UCS Manager: Blade vNIC Configuration



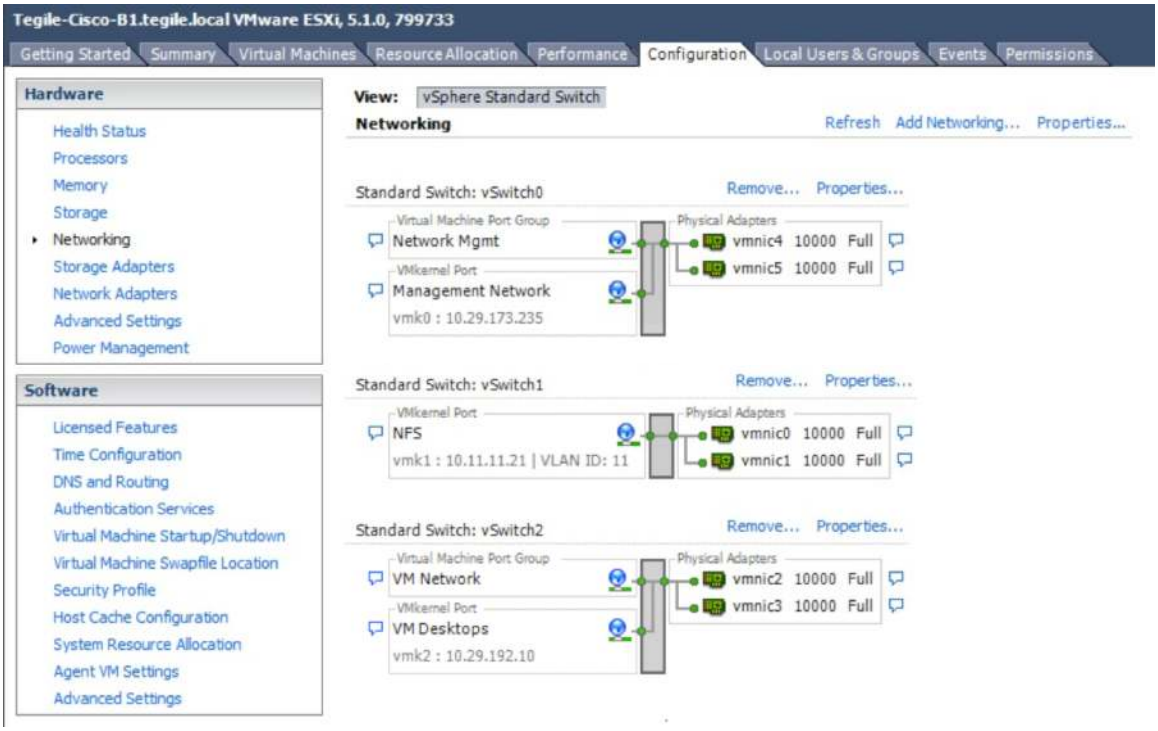
Each blade server is configured with six vNICs in three groups:

- **Group 1:** vNIC Mgmt1 and vNIC Mgmt2 were used for virtual infrastructure management and vMotion.
- **Group 2:** vNIC VM1 and vNIC VM2 were used for the desktop virtual machines.
- **Group 3:** vNIC eth0 and vNIC eth1 were used for NFS.
- In each group, one vNIC was connected to Fabric A and the other to Fabric B, providing dual-redundant network paths for all three functions.

Server Configuration: VMware vSphere 5

Figure 6 shows the network configuration on the ESX host.

Figure 6. ESX Networking Configuration



Corresponding to the three groups of vNICs configured on each Cisco UCS blade, three virtual switches were configured on each ESX host:

- vSwitch0 for virtual infrastructure management
  - The vmnic4 and vmnic5 physical adapters were configured to provide dual-redundant paths.
- vSwitch1 for NFS storage access
  - The vmnic0 and vmnic1 physical adapters were configured to provide dual-redundant paths.
- vSwitch2 for virtual desktop VMs
  - The vmnic2 and vmnic3 physical adapters were configured to provide dual-redundant paths.

Figure 7 shows the vSwitch network configuration. The Number of Ports parameter was increased from 120 to 248 to support 150 virtual desktops on a single ESX host.

Figure 7. ESX vSwitch Configuration

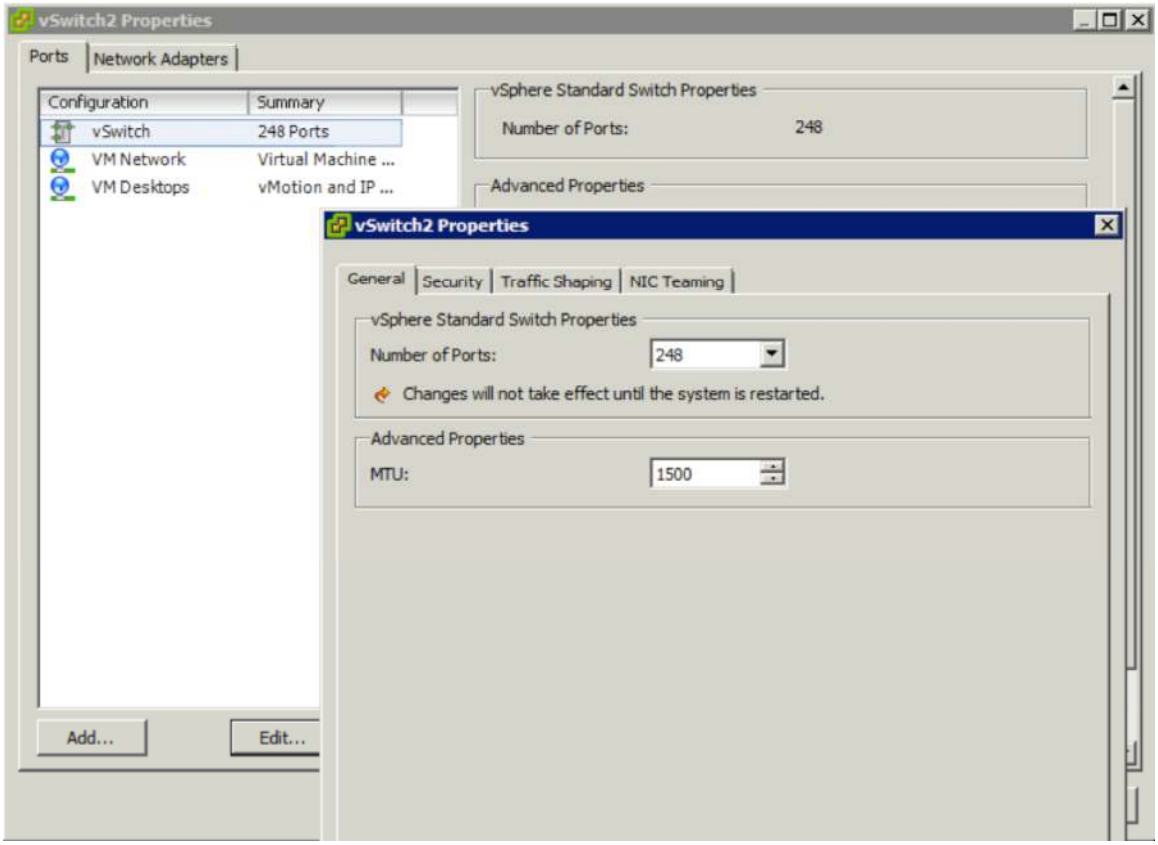
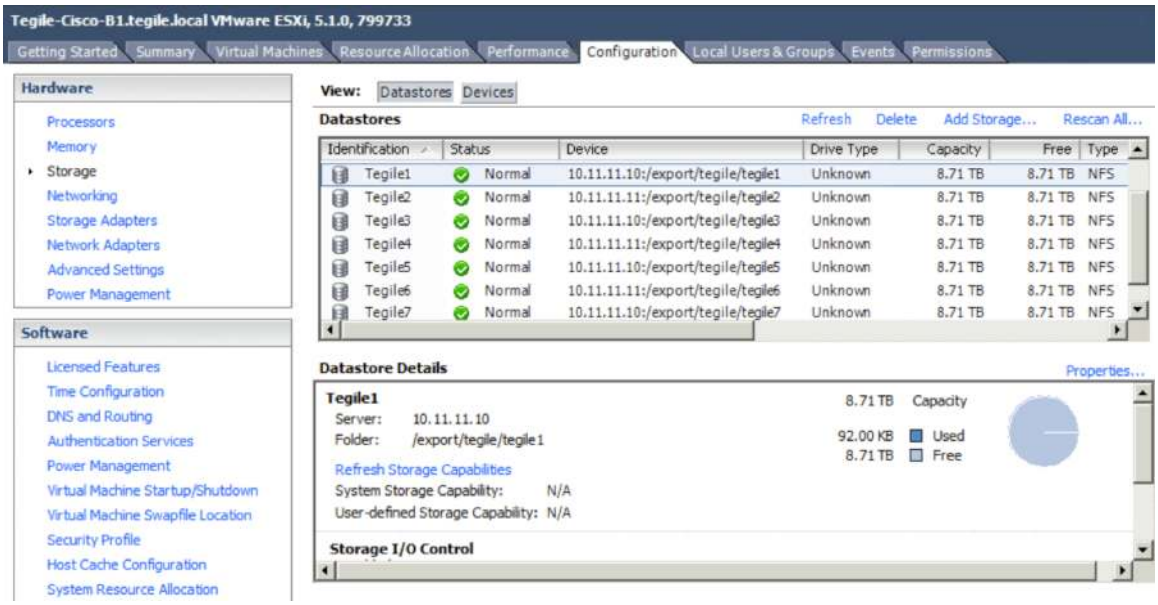


Figure 8 shows the storage configuration on the ESX hosts. Seven NFS datastores, tegile1 through tegile7, were configured on each ESX host. The corresponding NFS shares were exported by the Tegile Zebi HA2100 storage appliance, configured with floating IP addresses 10.11.11.10 and 10.11.11.11, and shared by Ethernet ports on both storage controllers for redundancy and load balancing.

The NFS MaxQueueDepth parameter was set to 128 on each ESX host.

Figure 8. ESX Storage Configuration



Switch Configuration: Cisco Nexus 5500 Series

The Cisco Nexus 5500 Series Switch was configured as follows:

- The inter-switch link ports, and the ports connected to the Cisco UCS Fabric Interconnects, were configured as trunk ports.
- The ports connected to Tegile Zebi HA2100 storage array were configured as access ports.
- VLAN 11 was used for NFS.

Storage Configuration: Tegile Zebi HA2100

This section provides details of the Tegile Zebi HA2100 storage array configuration. The 3RU Tegile Zebi HA2100 storage array used for this test had 22 TB of raw capacity, with 600 GB of SSD flash storage, and two redundant active-active controllers with two 10 Gigabit Ethernet ports on each controller. The array was configured with seven NFS shares over the 10 Gigabit Ethernet ports across the two redundant controllers. The integrated, in-line de-duplication and compression functionality were enabled for this test.

Figure 9 shows storage configuration for the Tegile Zebi HA2100 storage array.

Figure 9. Tegile Zebi Storage Configuration

Disk	Vendor	Size	Pool	Type
0	SEAGATE	1.82T	ZebiSystem	System HDD
1	SEAGATE	1.82T	Peer:ZebiSystem	System HDD
2	SEAGATE	1.82T	VDIPool	Data HDD
3	SEAGATE	1.82T	VDIPool	Data HDD
4	SEAGATE	1.82T	VDIPool	Data HDD
5	SEAGATE	1.82T	VDIPool	Data HDD
6	SEAGATE	1.82T	VDIPool	Data HDD
7	SEAGATE	1.82T	VDIPool	Data HDD
8	SEAGATE	1.82T	VDIPool	Data HDD
9	SEAGATE	1.82T	VDIPool	Data HDD
10	SEAGATE	1.82T	VDIPool	Data HDD
11	SEAGATE	1.82T	VDIPool	Data HDD
12	SEAGATE	1.82T	VDIPool	Hot-Spare HDD
13	HITACHI	186.31G	VDIPool	META SSD
14	HITACHI	186.31G	VDIPool	META SSD
15	HITACHI	186.31G	VDIPool	RW-Cache SSD

Note the following about the storage configuration:

- One storage pool, called VDIPool, was configured on the Tegile Zebi HA2100 storage array.
- The storage pool consisted of 10 2-TB 7200 RPM SAS HDDs in a RAID10 configuration.
- One additional HDD was configured as a hot spare for the storage pool.
- Three eMLC SSDs in the storage pool were used for meta data and read/write cache.
- The storage pool was configured with thin provisioning, with in-line compression and de-duplication enabled, and with the file share block size set to 32 KB.
- Seven 9-TB thin-provisioned NFS shares were configured as part of the VDIPool for virtual desktop storage.

Figure 10 shows the Tegile Zebi NFS share configuration. Seven NFS shares, tegile1 through tegile7, were configured in the storage pool (VDIPool).

Figure 10. Tegile Zebi: NFS Configuration

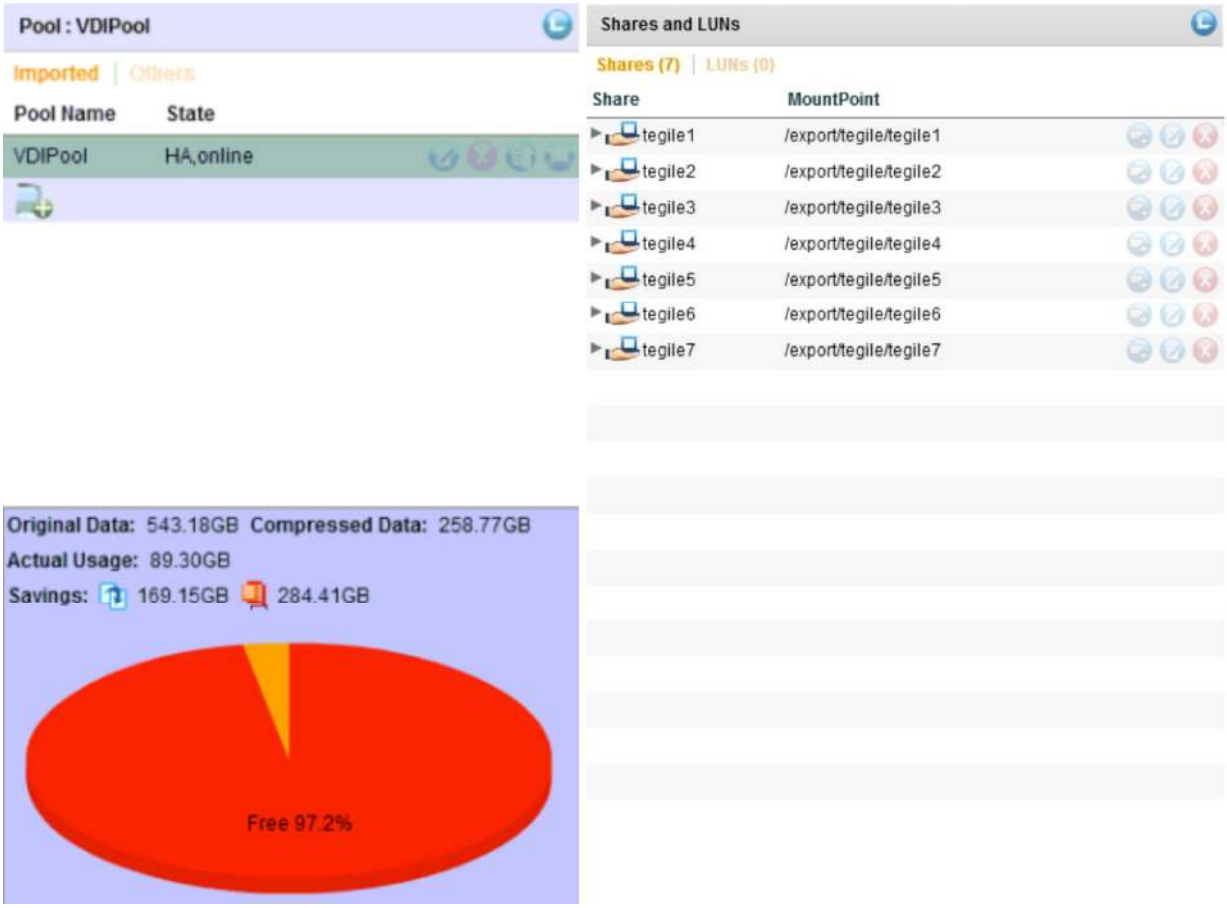


Figure 10 also shows storage space utilization and storage capacity reduction resulting from the integrated, in-line de-duplication and compression features of the Tegile Zebi storage array after 1000 Windows 7 virtual desktop linked clones were provisioned. The original data for 1000 virtual desktops was ~543 GB, but the actual storage capacity used was only 89.3 GB. Storage capacity reduction was ~83 percent, with ~31 percent reduction from in-line de-duplication and 52 percent reduction from compression.

The NFS queue depth on the Tegile Zebi storage appliance was set to 896 to enable concurrent I/O requests from all seven VDI blades with an NFS queue depth of 128 on each host.

VDI Configuration: Server and Storage

Figure 11 shows the vCenter cluster configuration for the VDI infrastructure. The cluster contains seven ESXi hosts on seven UCS B200 M3 Blade Servers. The 1000 Windows 7 32-bit virtual desktops were evenly spread across the seven ESXi hosts. Storage for the 1000 virtual desktops was evenly spread across the seven NFS shares configured on the Tegile Zebi HA2100 storage array. The server and storage configuration resulted in an even distribution of ~150 virtual desktops per ESXi host and ~150 virtual desktop linked clones per NFS share.

Each Windows 7 32-bit virtual desktop was configured with 1 vCPU, 1.5 GB vMemory, and 25 GB of provisioned virtual disk space.

Figure 11. VMware vCenter Cluster Configuration for VDI

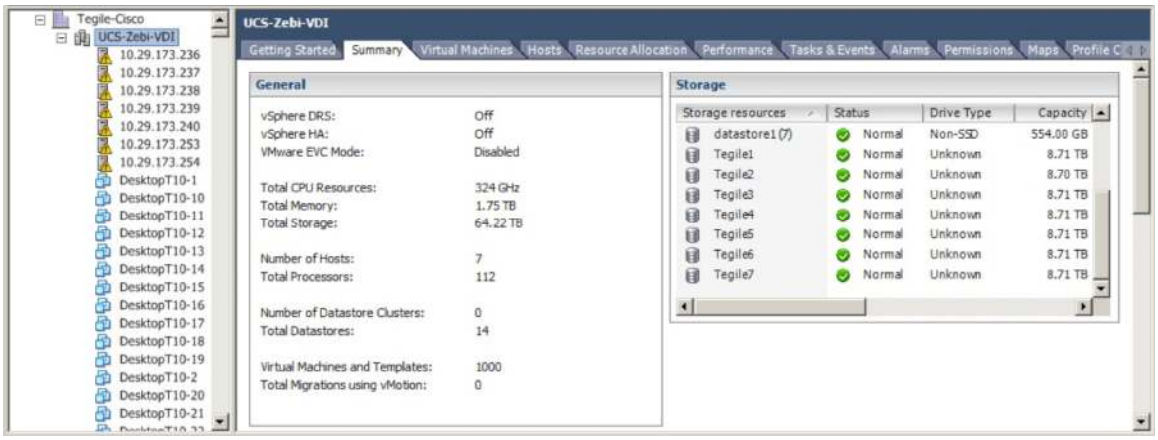


Figure 12 shows the aggregate storage array level and per-VM real time analytics displayed on the Tegile Zebi web-based management interface.

Figure 12. Tegile Zebi: Virtual Machine Analytics

Testing Methodology and Results

To perform the test, the VMware View Planner 2.1 tool was used to run a representative workload on each of the 1000 Windows 7 virtual desktops. The test was performed according to the guidelines provided in the VMware View Planner 2.1 Installation and User Guide.

Testing Methodology and Success Criteria

VMware View Planner is a tool designed to simulate a large-scale deployment of virtualized desktop systems and study its effects on an entire virtualized infrastructure. View Planner assists in the setup and configuration of the testing infrastructure, runs a set of application operations selected to be representative of real-world user applications, and reports data on the latencies of those operations.

When the test starts, View Planner powers on all the virtual desktop VMs, and waits for them to fully boot up, log in, and register with the View Planner. It then goes into the workload run stage by launching the selected

applications and performing a predefined set of operations on all the VMs to simulate real-world usage. It runs the workload for several iterations and reports the latencies of application operations. For a compliant run, it requires the workload to run at least five iterations. including ramp up, steady state iterations, and ramp down. At the end of the test, View Planner waits for the VMs to upload the test results. To determine a test pass or fail, View Planner checks the application response time in steady state. If at least 95 percent of the application operation latencies are 1.5 seconds or less, View Planner reports the test as “Pass”; otherwise, it reports the test as “Failed.”

View Planner User Operations

The standardized View Planner workload consists of nine applications performing a combined total of 44 user opera-tions. These user operations are separated into three groups, shown in Table 1. The operations in Group A are used to determine quality of service (QoS), while the operations in Groups B and C are used to generate additional load.

Table 1. View Planner 2.1 User Operations

Group A	Group B	Group C
AdobeReader: Browse	AdobeReader: Open	7□Zip: Compress
AdobeReader: Close	Excel_Sort: Open	PowerPoint: SaveAs
AdobeReader: Maximize	Excel_Sort: Save	Video: Play
AdobeReader: Minimize	Firefox: Open	
Excel_Sort: Close	IE_ApacheDoc: Open	
Excel_Sort: Compute	IE_WebAlbum: Open	
Excel_Sort: Entry	Outlook: AttachmentSave	
Excel_Sort: Maximize	Outlook: Open	
Excel_Sort: Minimize	PowerPoint: Open	
Firefox: Close	Video: Open	
IE_ApacheDoc: Browse	Word: Open	
IE_ApacheDoc: Close	Word: Save	
IE_WebAlbum: Browse		
IE_WebAlbum: Close		
Outlook: Close		
Outlook: Maximize		
Outlook: Read		
Outlook: Restore		
PowerPoint: AppendSlides		
PowerPoint: Close		
PowerPoint: Maximize		
PowerPoint: Minimize		
PowerPoint: ModifySlides		
PowerPoint: RunSlideShow		
Video: Close		
Word: Close		
Word: Maximize		
Word: Minimize		
Word: Modify		

View Planner Test Configuration

The View Planner workload and test profiles were configured as shown in Figure 13 and Figure 14.

Figure 13. View Planner Workload Profile

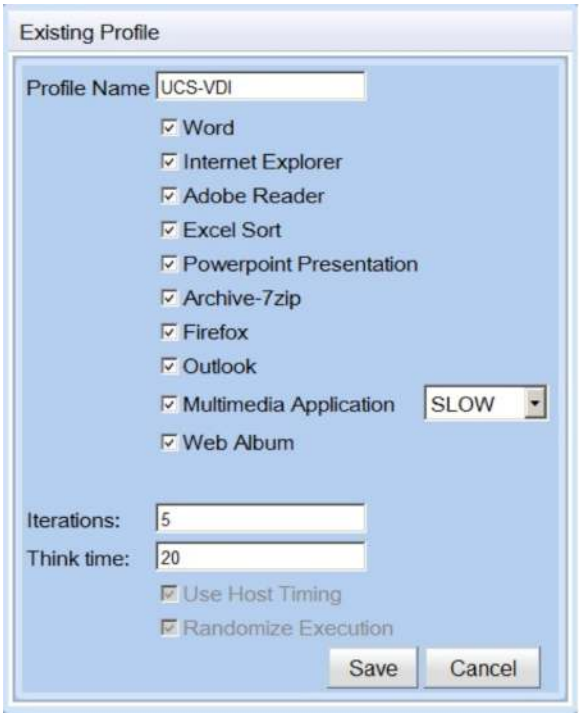
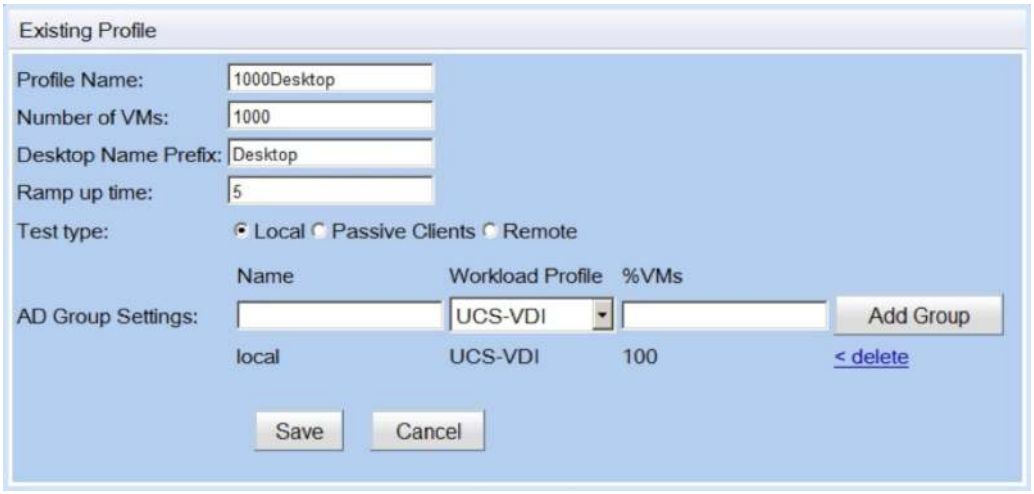


Figure 14. View Planner Test Profile



Based on the VMware View Planner 2.1 compliance guidelines, the workload and test profiles were configured with Iterations set to 5, Think Time set to 20, and Ramp Up time set to 5. The workload represents approximately 7 to 10 IOPS per virtual desktop, a representative workload for a Windows 7 knowledge user..

Test Results

The goal of the test was to validate that the solution architecture can provide the required application QoS for the targeted 1000 Windows 7 virtual desktop users based on VMware View 5.1, Cisco UCS B200 M3 Blade Servers, and the Tegile Zebi HA2100 storage array under the test guidelines of VMware View Planner 2.1.

Two different View Planner 2.1 tests were performed using the architecture shown in Figure 1:

- The first test was performed to verify that a single UCS B200 M3 Blade Server could support 150 virtual desktops.
- The next test was performed with seven UCS B200 M3 Blade Servers to validate the reference solution for 1000 virtual desktops.

Both tests completed successfully.

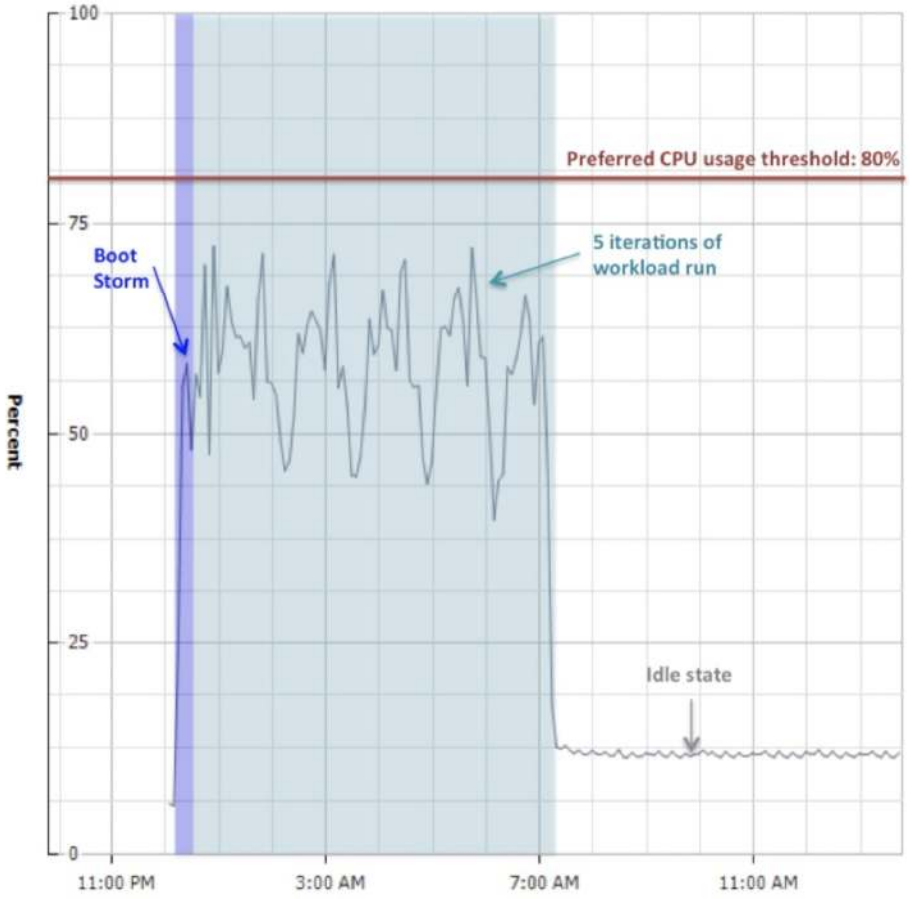
Single Server 150 VDI Users Test Results

The purpose of this test was to verify that each blade server was capable of handling 150 VDI users of the targeted profile.

In this test, a single Cisco UCS B200 M3 blade was used to host 150 Windows 7 32-bit virtual desktops on the configuration shown in Figure 1, using the View Planner workload and test profiles described in the previous section.

Figure 15 shows the CPU utilization, with 150 virtual desktops on a single Cisco UCS B200 M3 Blade Server. The CPU utilization peaked around 72 percent, showing that a single UCS B200 M3 Blade Server was able to support 150 virtual desktops.

Figure 15. Single Server 150 VDI Users: CPU Usage

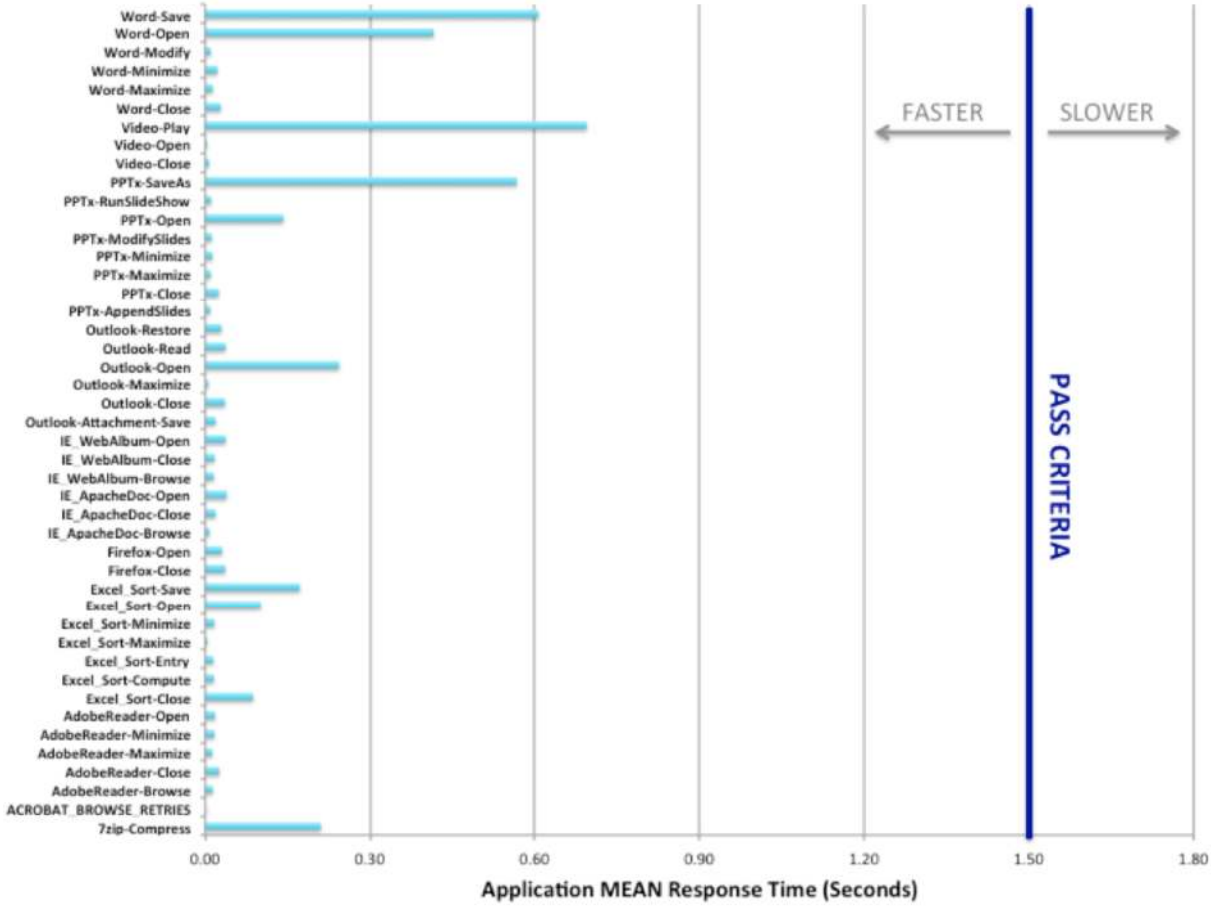


1000 VDI Users Test Results

The purpose of this test was to show that the reference solution was able to support 1000 VDI users of the targeted profile. The validation test bed was provisioned with seven VMware View pools, with approximately 150 linked clones per pool, as nonpersistent desktops. The desktops were evenly distributed across seven NFS shares from the Tegile Zebi HA2100 storage array. The 1000 desktops were also evenly distributed on the seven ESXi hosts on seven UCS B200 M3 Blade Servers, with an average of 143 virtual desktops per blade server.

Figure 16 illustrates the Application MEAN Response Time. For all the applications, the MEAN response time was far below the required 1.5 second threshold.

Figure 16. View Planner Application MEAN Response Time



Boot and Login Scenarios

The total time to boot 1000 desktops and for the VMware View Planner Agent to log in was approximately 30 minutes.

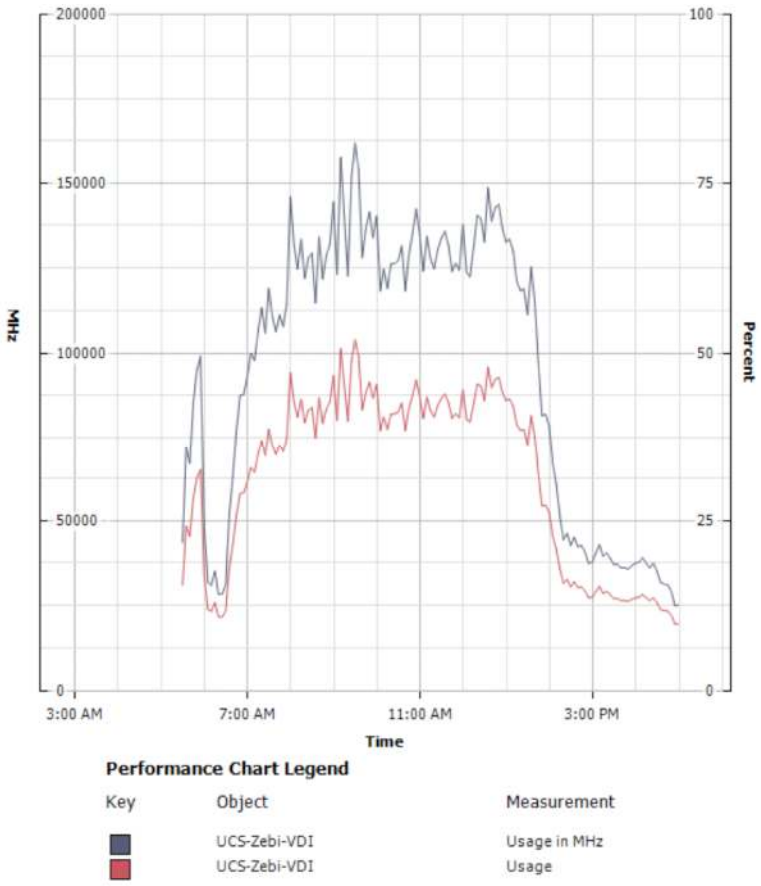
Distributing the 1000 desktops across the seven ESXi hosts inside one ESX cluster, as well as across the seven NFS shares from the Tegile Zebi storage array, ensured that the load was balanced across the server, storage, and net-work resources during the boot and login process.

Figure 17 shows the average CPU utilization over the entire test period for a representative blade server.

Read operations were dominant during the boot and login process, with a storage cache hit ratio of around 90 per-cent (For detailed analytics from the Tegile Zebi storage array for the duration of the test, see Figure 19 at the end of this document.)

Server CPU

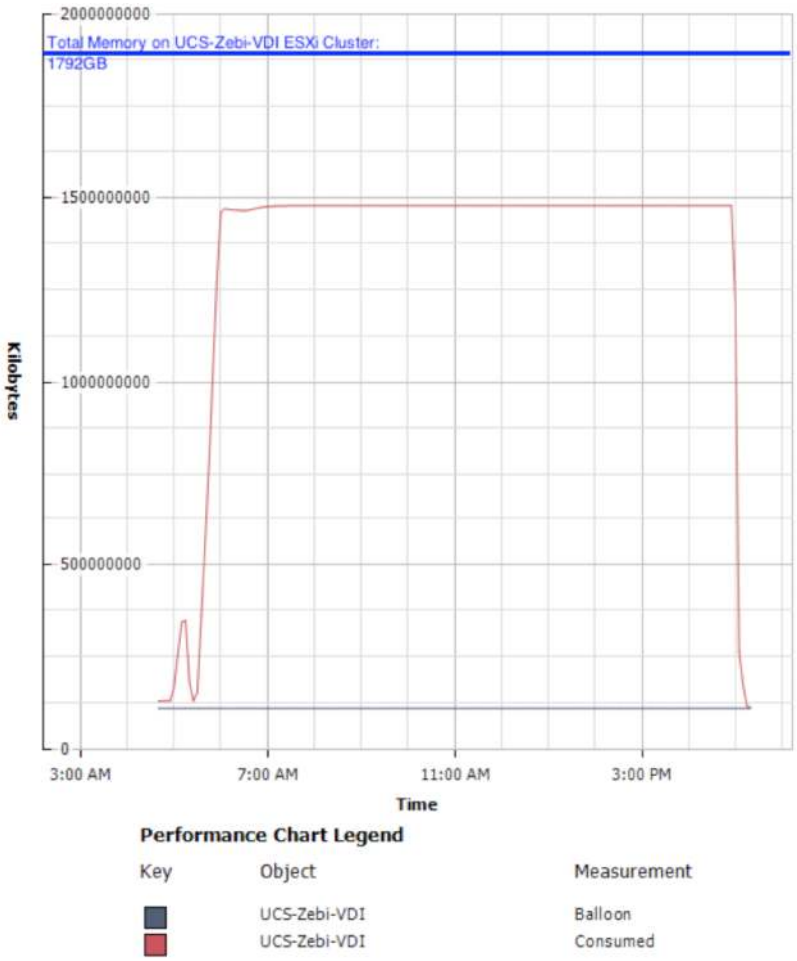
Figure 17. ESX Cluster Overall CPU Usage of 1000 VDI Users Test



Server Memory

Figure 18 shows a steady increase in memory consumption during the boot and login process. Memory consumption stayed flat at around 80 percent for the rest of the test period, and began to decrease towards the end after the com-pletion of the test, when the VMs were shutting down.

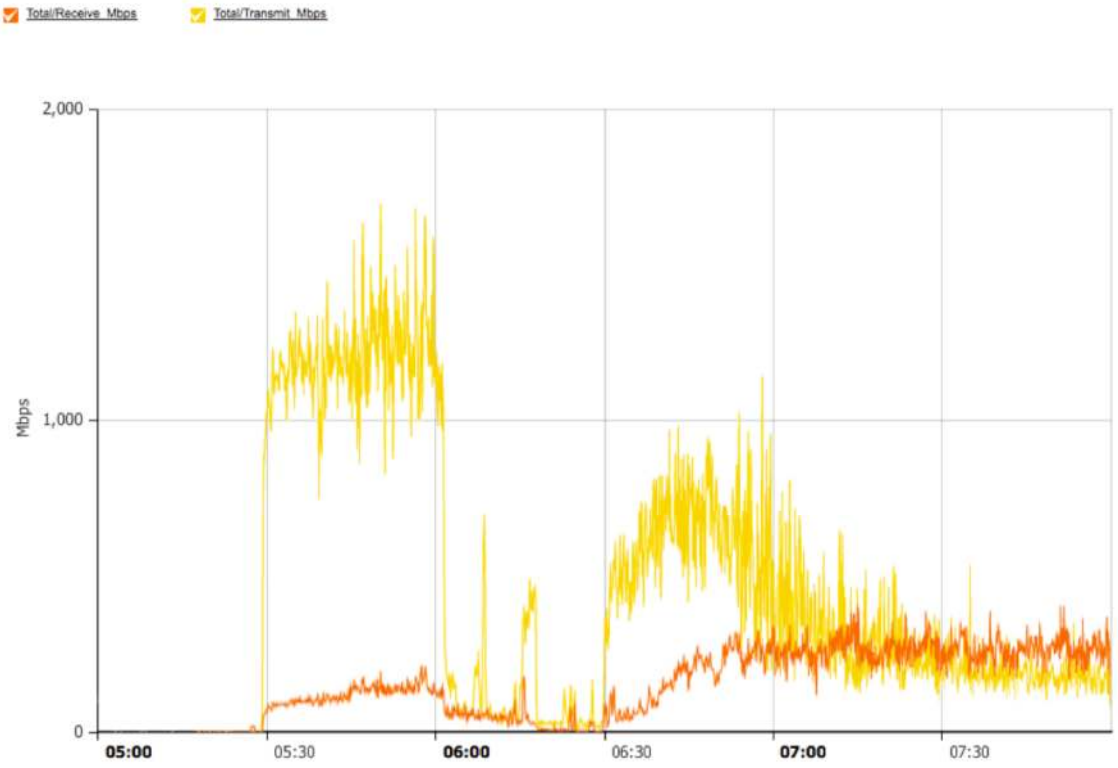
Figure 18. Memory Consumption on ESX Cluster for 1000 VDI Users Test



Network

The network load for storage access appeared to be much higher during the boot storm when compared with the load during steady-state operations. Figure 19 shows that the storage network load during the boot and login process was well below the allocated bandwidth, confirming that the reference architecture provides adequate bandwidth to sup-port 1000 virtual desktop users.

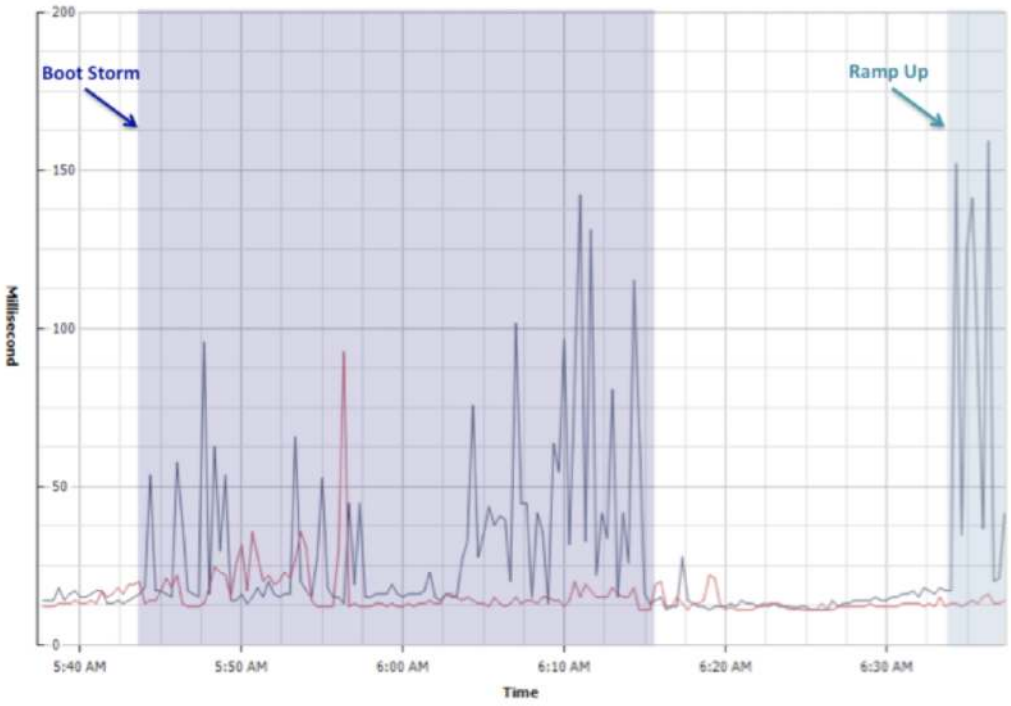
Figure 19. Tegile Zebi Network Load during Boot Storm and Ramp Up



Storage

Figure 20 shows datastore performance on a virtual desktop host. The Zebi NFS share average read latency is around 20 ms and the average write latency is below 100 ms.

Figure 20. ESXi Datastore Latency



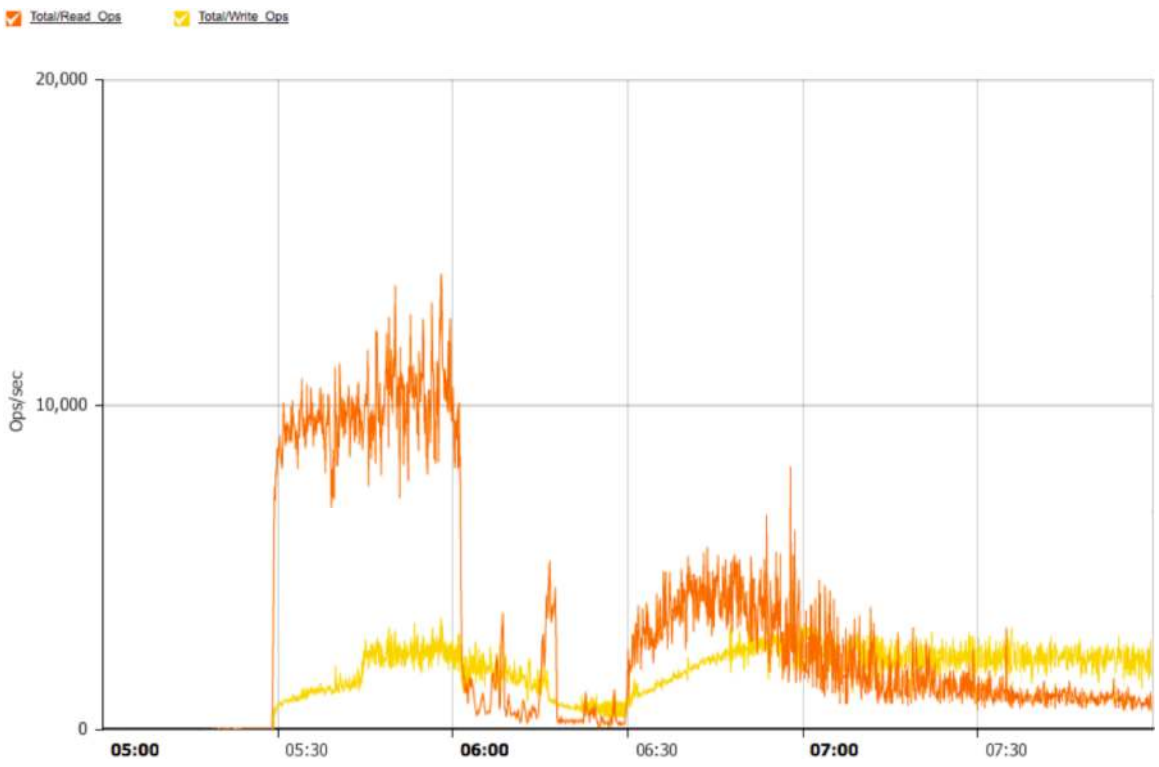
Results showed that the I/O load generated by the test was well within the capabilities of the Tegile Zebi HA2100 storage array.

Figure 21 shows analytics from the Tegile Zebi storage array for the duration of the test from boot and login, through ramp up, and at steady state. In Figure 19, the NFS R/W IOPS chart shows that the IOPS peaked at 20,000, and that the I/O was dominated by read operations during the boot and login process. During steady state, the overall I/O load went down and the workload had a higher percentage of write operations. The test workload for 1000 virtual desktops is well within the performance and capacity capabilities of the Tegile Zebi HA2100, which is capable of providing 20,000 to 30,000 IOPS for mixed I/O workloads.

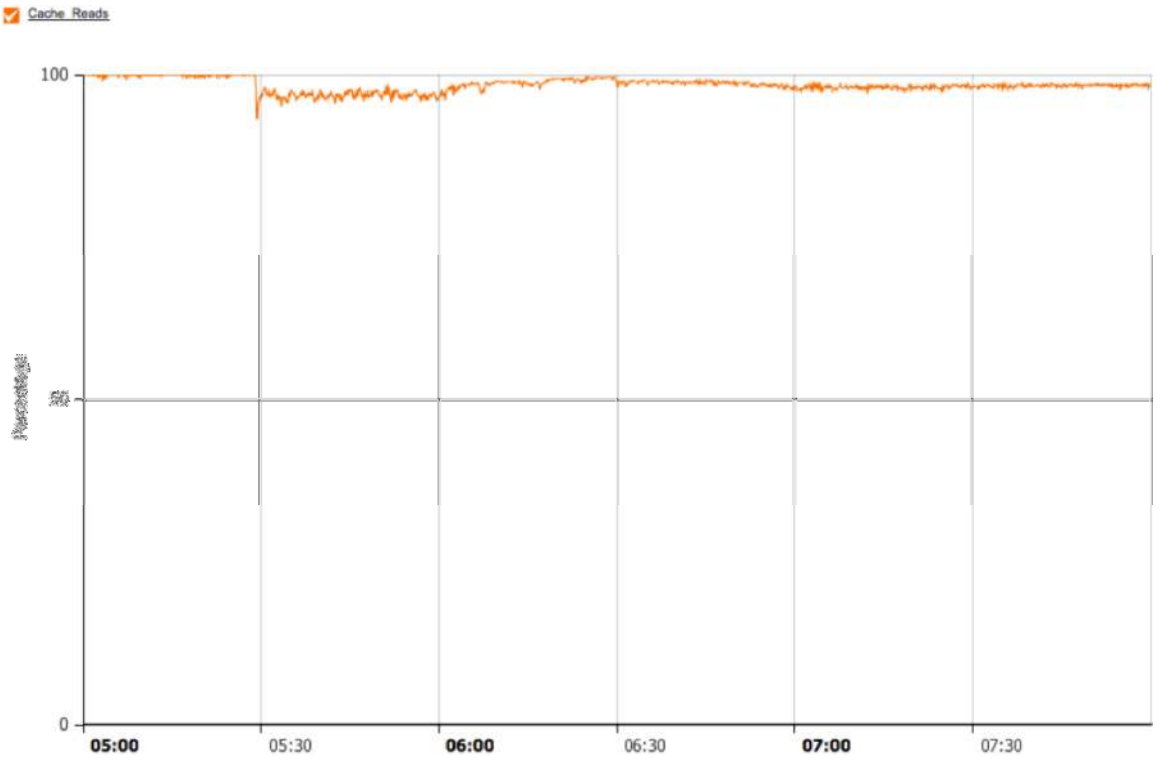
The Cache Hit chart shows that the storage cache hits were consistently above 90 percent over the duration of the test.

Utilization for the CPUs in the storage array was under the 80 percent threshold.

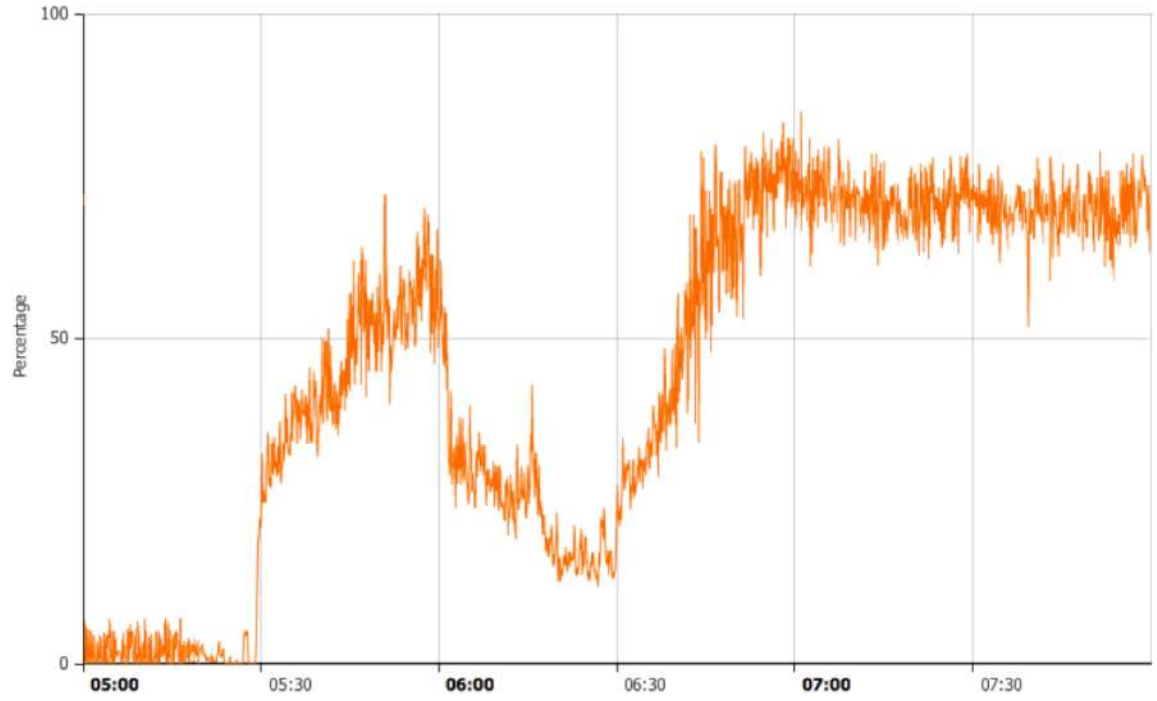
Figure 21. Tegile Zebi Analytics during Boot Storm and Ramp Up



Cache Hit



CPU Usage



Conclusion

The VDI test performed with the Cisco UCS B200 M3 Blade Servers, Tegile Zebi HA2100storage array, and VMware View 5.1 showed that the reference architecture detailed in this document is capable of supporting 1000 virtual desk-tops running average desktop user workloads.

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References

VMware View Planner Installation and User Guide, Version 2.1

VMware View Architecture Planning, View 5.1 View Manager 5.1 View Composer 3.0

VMware Server and Storage Sizing Guide for Windows 7

Cisco UCS B200 Blade Server Installation and Service Note

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