FUJITSU

White paper

Fujitsu Virtual Desktop Infrastructure (VDI) using iSCSI and VMware with Automated Storage Tiering (AST)

The flexible and scalable VDI iSCSI VMware® solution combines all aspects of a virtual desktop environment, based on reliable technologies and best practice solutions, with simple implementation and operation. This document is provided for those interested in understanding the performance characteristics of smaller VDI solutions, coupled with the benefits of Automated Storage Tiering (AST).

TESTED WITH LOGINVSI

Table of Contents

Table of Figures

1 Introduction

A Virtual Desktop Infrastructure (VDI) provides an effective and economical solution to a general business issue of providing staff with suitable, supported computer applications for them to be successful in their various roles within the organization. In the business operations environment today, with the expanding use of various mobile devices and staff usage requirements, equipping all staff with fully capable devices and with access to the data they need, puts a severe strain on all IT departments. Through VDI, the different devices, from a notebook to a tablet to a thin client, can be provided to each of the staff members enabling efficient access to the applications and data that they need. At the same time, resources within the data center and the IT center staff can be much more effectively deployed.

VMware provides one of the most widely used VDI environments through their VMware Horizon View family of products. It includes a number of components to support operational environments on a wide variety of end user devices, also known as client devices or clients. Provisions are made to ensure the security of each client, and to provide each client with a unique customizable desktop interface, with the services the client needs for their responsibilities. VMware environments often support large complements of clients ranging from 1,000 to 20,000, but they can also be configured for smaller environments as well.

The responsiveness of the storage supporting the client data is important for supporting the users. In this paper we provide a summary of tests conducted with the Fujitsu Automated Storage Tiering feature to optimize the use of the storage within the ETERNUS storage array to meet the demands of the VMware VDI environment.

2 Executive Summary

This paper provides test results for 500 VMware VDI users with the storage supported on high density 10krpm HDDs and SSDs attached through a 10Gbps iSCSI SAN. The testing indicates that for this level of traffic, the iSCSI SAN provides more than adequate capability to support the load. Detailed charts provide insight into the impact that assignment of portions of the storage have on the performance. This testing shows that using AST can correct for gross misplacement of the storage within the array. Initially all of the storage was assigned to the Low Tier (HDDs) and one set of VDI tests were run. Then AST was enabled and it moved much of the used storage area from the Low Tier to the High Tier (SSDs) and the improved performance is illustrated. The industry standard tool "Login VSI" is used to provide measured realistic VDI loads on the tested configurations.

3 Fujitsu PRIMERGY and ETERNUS for VMware

The PRIMERGY RX servers used in this configuration are the convincing choice for the server pool of the Fujitsu architectures. These servers are the solution for cutting data center infrastructure costs through the use of tried-and-tested data center technology. Investments in the modular PRIMECENTER® racks supports seamless integration of PRIMERGY servers and SAN storage subsystems plus the infrastructure components including the SAN and LAN switches as well as the KVM switches necessary for operational control.

The ETERNUS DX storage arrays are the building blocks for the SAN storage that is part of the architecture. The third generation of Fujitsu ETERNUS DX storage systems, the ETERNUS DX S3, is The Flexible Data Safe for Dynamic Infrastructures. Enterprise proven capabilities protect data assets across all types of IT infrastructure. Redundant components, RAID protection and built-in data protection provide the highest system reliability to ensure business continuity is maintained. ETERNUS DX S3 models provide comprehensive disk storage and state-of-the-art connectivity across the entire model range and delivers maximum configuration flexibility allowing choice in performance and TCO. Data-in-place upgrade options are also available throughout the system's lifecycle to ensure maximum investment protection.

The ETERNUS SF software components provide unparalleled complementary capability within the ETERNUS family of products. ETERNUS SF Storage Cruiser provides the management for the Flexible Tiering feature within the ETERNUS DX S3 models through the AST facility. Policies are established for moving extents within the Virtual Logical Volumes between the different performance tiers within the Flexible Tiering Pool (FTRP), based on the traffic demands on the extents. This feature enables effective use of limited amounts of very high speed storage offered by SSDs, while minimizing the response time for the high traffic sections of the total storage. Less active sections within the same Virtual Logical Volumes are moved to the lower speed, lower cost HDDs within the storage pool.

3.1 Desktop Virtualization with VMware products

3.1.1 VMware Horizon View

Simplify desktop and application management while increasing security and control with VMware Horizon View (formerly known as VMware View). VMware Horizon View enables delivery of a personalized high fidelity experience for end users across sessions and devices. It enables higher availability and agility of desktop services unmatched by traditional PCs while reducing the total cost of desktop ownership up to 50%. With VMware Horizon View end users can enjoy new levels of productivity and the freedom to access desktops from more devices and locations while giving IT greater policy control. VMware Horizon View version 5.5 was used in the testing included in this report.

3.1.2 VMware vSphere Desktop

Designed specifically for desktops, this VMware vSphere edition provides a highly scalable, reliable and robust platform for running virtual desktops and applications, with built-in business continuity and disaster recovery capabilities to protect desktop data and availability without the cost and complexity of traditional solutions.

3.1.3 VMware vCenter Server Desktop

The VMware vCenter Server, which is the central management hub for vSphere, provides complete control over and visibility into clusters, hosts, virtual machines, storage, networking and other critical elements of the virtual infrastructure. The operating system used is Windows Server® 2008 R2. With every VMware vCenter license a Microsoft SQL Server® Express license is included. VMware supports up to 5 nodes with SQL Server 2008 Express. If the installation requires more than 5 nodes within one VMware vCenter an additional database or separate instance of an existing VMware vCenter supported database is required.

3.1.4 VMware Horizon View Manager

VMware Horizon View Manager streamlines the management, provisioning and deployment of virtual desktops. IT administrators can centrally manage hundreds of desktops from a single console. End users connect through VMware Horizon View Manager to securely and easily access Horizon View virtual desktops.

3.1.5 VMware ThinApp

VMware ThinApp is an agentless application virtualization solution that streamlines application delivery while eliminating conflicts. As part of VMware Horizon View, VMware ThinApp simplifies repetitive administrative tasks and reduces storage needs for virtual desktops by maintaining applications independently of the underlying OS.

3.1.6 VMware Horizon View Persona Management

VMware Horizon View Persona Management dynamically associates the user persona with stateless floating desktops. Administrators can easily deploy pools of lower-cost stateless, floating desktops and enable users to maintain their designated settings between sessions.

3.1.7 VMware Horizon View Composer

VMware Horizon View Composer lets customers easily manage pools of "like" desktops by creating master images that share a common virtual disk. By updating a master image with VMware Horizon view Manager, all the cloned desktops linked to the master image can be patched or updated without affecting the users' settings, data or applications. In addition VMware Horizon View Composer saves up to 80% of storage capacity.

3.1.8 VMware Horizon View Client

VMware Horizon View Client enables access to centrally hosted virtual desktops from Windows® PCs, Macs, thin clients, zero clients and iOS® and Android®-based mobile devices. VMware Horizon View Client with Local Mode enables access to virtual desktops running on a local Windows-based endpoint, regardless of network availability.

3.1.9 VMware vShield Endpoint

VMware vShield Endpoint offloads and centralizes anti-virus and anti-malware (AV) solutions, eliminating agent sprawl and AV storm issues while minimizing the risk of malware infection and simplifying AV administration in virtualized environment.

4 Tested VDI Environment

4.1 General

The test environment included the following elements:

- **Datacenter infrastructure**: Active Directory, DNS and DHCP on Windows Server 2008 R2
- **VDI infrastructure**: VMware Horizon View 5.5 with VMware vCenter Server, vComposer Server and vConnection Server on Windows Server 2008 R2
- **Virtualization Host nodes for VDI Desktops**: VMware ESXi 5.5.0 hypervisor running on PRIMERGY RX600 S5. The servers were each configured with four Intel® Xeon® E7542 CPUs @ 2.659GHz (24 cores, 48 threads) and 64GB of memory. The servers used SAN storage only (ETERNUS DX100 S3 via 2x10Gbps iSCSI links) Ten host node servers were used for this set of tests to measure the areas of interest – 10Gbps iSCSI SAN to ETERNUS storage array with AST.
- **ETERNUS DX100 S3 storage array**: configured with 1x RAID1(1+1) 400GB SSDs, 1x RAID1(1+1) 800GB SSD and 6x RAID5(3+1) 600GB/10k HDDs. The storage array was configured using the Automated Storage Tiering (AST) feature with two active tiers, the High Tier included the SSD groups and the Low Tier included the HDD groups. The storage array was connected to the ESXi servers with 4 x 10Gbps iSCSI host ports.
- **Desktop VM**: Windows 7 Professional 32-bit English virtual desktops with 1vCPU and 1GB vRAM. All desktops were created using linked-clone technology.
- **Login VSI**: Load generation for VDI benchmark testing, release 4.1.0RC2

4.2 Testing Objectives and Methodology

There were two objectives in this testing:

- Evaluate the use of 10Gbps iSCSI for the Storage Area Network interconnecting the ESXi servers with the ETERNUS storage array.
- Evaluate the use of Automated Storage Tiering (AST) to optimize the placement of the active storage within the Flexible Tier Pool defined in the ETERNUS storage array.

A series of test runs were made to address these two objectives. First a series of tests were run with all of the VMware VDI storage elements defined in the Low Tier (HDD) portion of the pool. Then AST was enabled and further tests run to establish the active portions of the storage, and to move those active portions from the Low Tier to the High Tier. As a final portion of the testing, another series of tests were run after AST had completed moving the active portions of the storage to the High Tier. The results of these test runs are presented in the following sections of this paper.

To ensure that the ESXi server nodes did not limit the number of users, more were included in the configuration than necessary. This is reflected in the relatively low loading seen on the CPUs during these tests. This was done to ensure that the focus of measurements met the two objectives without limitations within the upper levels of the environment. It is recognized that this is not a normal configuration, where the number of server nodes required is not nearly as many as were used in this set of tests.

4.3 Tested Configuration Detail

Datacenter & VDI Infrastructure	VMware vCenter Server	v5.5.0	PRIMERGY RX300 S6 Intel® Xeon® L5630@2.13GHz; 48GB Ram
	VMware Horizon View Composer	v5.3.0	
	VMware vConnection Server	v5.5.0	PRIMERGY RX300 S3 Intel® Xeon® 3.00GHz; 8GB Ram
	DHCP Server	Microsoft Windows Server 2008 R2 Enterprise; Service Pack 1	PRIMERGY RX300 S3 Intel® Xeon® 3.00GHz; 8GB Ram
	AD Server		
	DNS Server		
	VMware Horizon View Administrator	v5.3.0	PRIMERGY RX300 S6 Intel® Xeon® L5630@2.13GHz; 48GB Ram
	ETERNUS SF Server	v16.1	
Login VSI Benchmark Infrastructure	Login VSI Control	v4.1	PRIMERGY RX300 S7 6 x Intel® Xeon® E5-2630@2.3GHz
	Launchers 16-20	v4.1	
	Launchers 11-15	v4.1	PRIMERGY RX600 S5 24 x Intel® Xeon® X7542@2.67GHz
	Launchers 6-10	v4.1	PRIMERGY RX300 S7 8 x Intel® Xeon® E5-2603@1.8GHz
	Launchers 1-5	v4.1	PRIMERGY RX300 S7 8 x Intel® Xeon® E5-2603@1.8GHz
Virtualization Host Nodes:	VMware ESXi hypervisor	v5.5.0	10 x PRIMERGY RX600 S5 24 x Intel® Xeon® X7542@2.67GHz; 64GB; 2 x 10Gbps iSCSI SAN Ports
	vCenter Pool [i14y_001] Options	Manual Pool, Dedicated User Assignment with Automatic Assignment Enabled, vCenter virtual machines, No Connection Server restrictions, No power action, do not auto logoff nor allow users to reset desktops, PCoIP Default display protocol & allow users to select protocol, Number of Monitors 2 (1920x1200)	
SAN Switches			2 x Cisco® Catalyst 4900 Ethernet Switches; 10Gbps
VDI Client Environment	Clone Type	Linked Clone	500 VDI Users
	Client VDI Package	Microsoft Windows® 7 Professional Microsoft Office 2010 Professional	1vCPU; 1GB Memory; 47GB Disk per VDI User
Login VSI Workloads	Task Worker	v4.1	
	Knowledge Worker	v4.1	
SAN Storage Array	ETERNUS DX100 S3 with Flexible Tier Pool & 4 x 10Gbps iSCSI Host Ports	High Tier: 2,358.5 GB	2 x RAID1 400GB SSD 2 x RAID1 800GB SSD
		Low Tier: 21,105.5 GB	6 x RAID5(3+1) 600GB/10krpm HDD

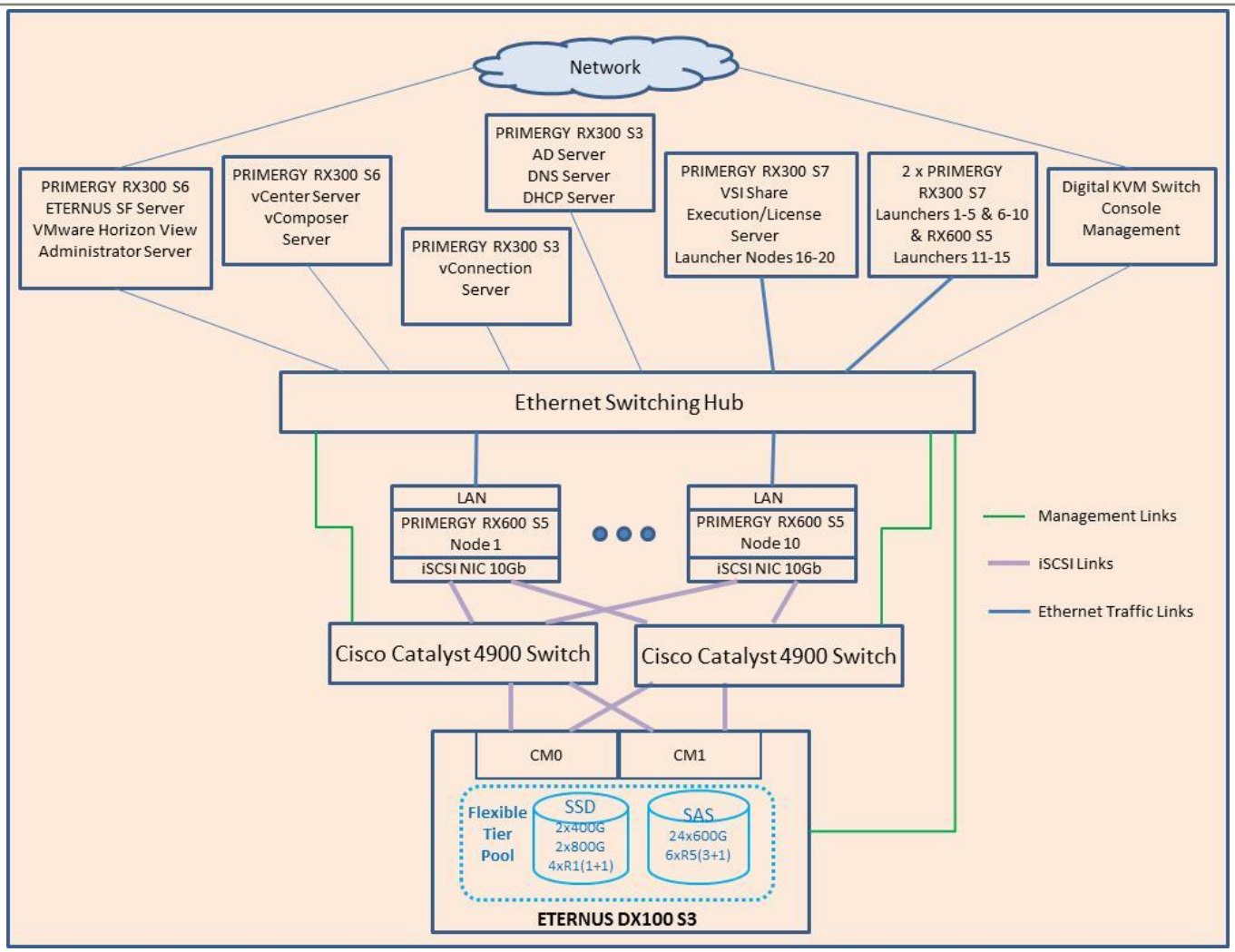

Figure 1 – VMware 500 Users iSCSI Test Environment

5 Login VSI Testing

5.1 Login VSI

Login VSI (www.loginvsi.com) is an industry accepted benchmarking tool for establishing the operating capabilities of a VDI configuration. It has been used to provide the performance information within the tested environment. Two test profiles were used and results reported herein:

- **Task Worker workload** – includes segments with Microsoft Outlook®, Excel®, and Internet Explorer; Adobe Acrobat® and PDF Writer. The Task Worker workload does not place a very severe demand on the environment and represents a number of users that are not accessing the system very heavily.
- **Knowledge Worker workload** – includes segments with Microsoft Outlook, Word, PowerPoint®, and Excel; Adobe Acrobat, FreeMind®, PhotoViewer, Doro® PDF Writer; and includes viewing several 360p movies. The Knowledge Worker workload places a more severe demand on the environment and represents a number of users that are accessing the system more heavily.

These tests are executed from a separate set of servers that run the Login VSI Launchers to provide the test load for the environment. They record the performance seen from their position within the environment, which is the position from which normal VDI users see the behavior of the system. Login VSI reports several measures of the operations within the system under test:

- **Active Sessions** records the maximum number of sessions that successfully completed their test sequences.
- **VSI base** provides a measure of the basic response level within the system.
- **VSImax v4 Average** provides a measure of the average response time for all the active user sessions throughout the test sequence.
- **VSImax v4 Threshold** establishes a measure of the maximum acceptable response time for the active user sessions in the test sequence.
- **VSImax Result** indicates if the VSI Max v4 Threshold was reached during the test, and if so, the number of active user sessions at which it was reached.

These reported results are provided for each of the sets of Login VSI tests that were conducted, and are reported in the following sections.

5.2 Login VSI Test Results

The two Login VSI test Scenarios provide data on the performance seen by the benchmark tool kit launchers.

LoginVSI Workload	Number of Users	Successful Sessions	Stuck Sessions	VSI Baseline	VSImax v4 Average	VSImax v4 Threshold	VSImax Result
Low Tier Test Set							
Task Worker	500	492	2	1165	1318	2166	not reached
Knowledge Worker		470	20	1161	1533	2161	not reached
High Tier Test Set							
Task Worker	500	496	2	1141	1313	2142	not reached
Knowledge Worker		488	9	1152	1415	2152	not reached

Figure 2 – Login VSI Results for 500 User Tests

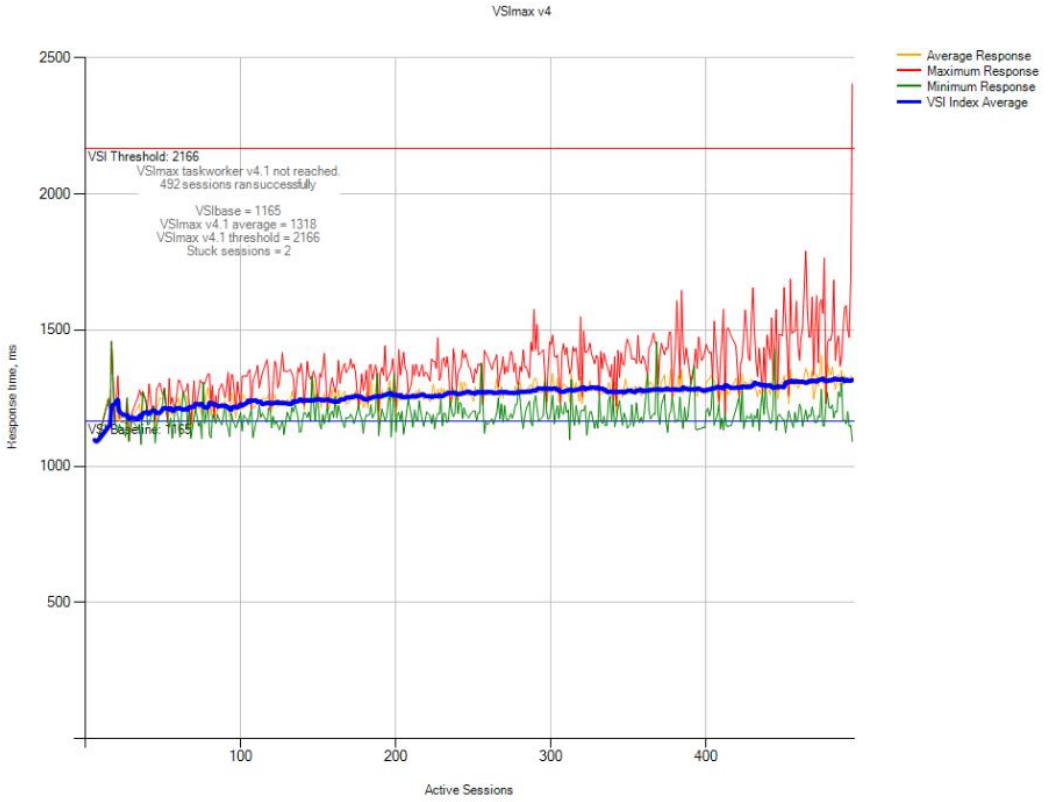

Figure 3 – Login VSI Response with storage in Low Tier – Task Worker workload

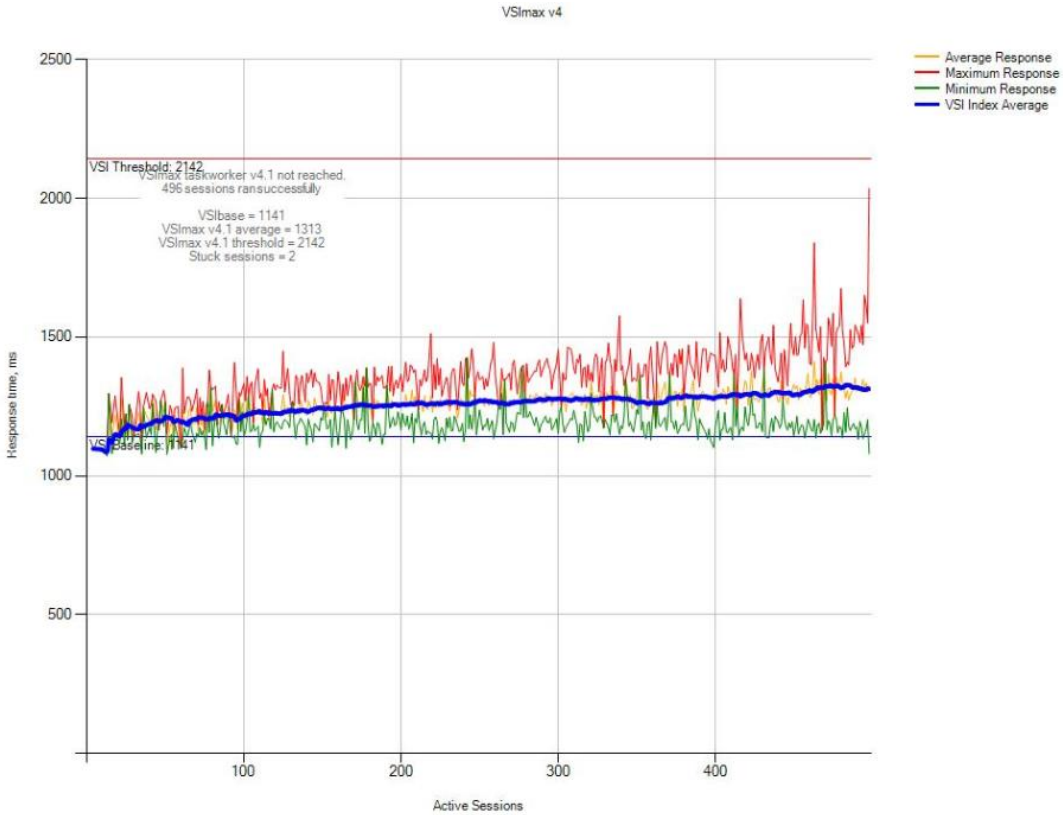

Figure 4 – Login VSI Response with storage in High Tier – Task Worker workload

Notice that, with the light Task Worker workload, there is very little difference in the Login VSI Response between the Low Tier and High Tier storage location. Even though the storage for the Low Tier is provided by 10krpm HDDs, there are a sufficient number of drives to provide adequate response time to support this workload.

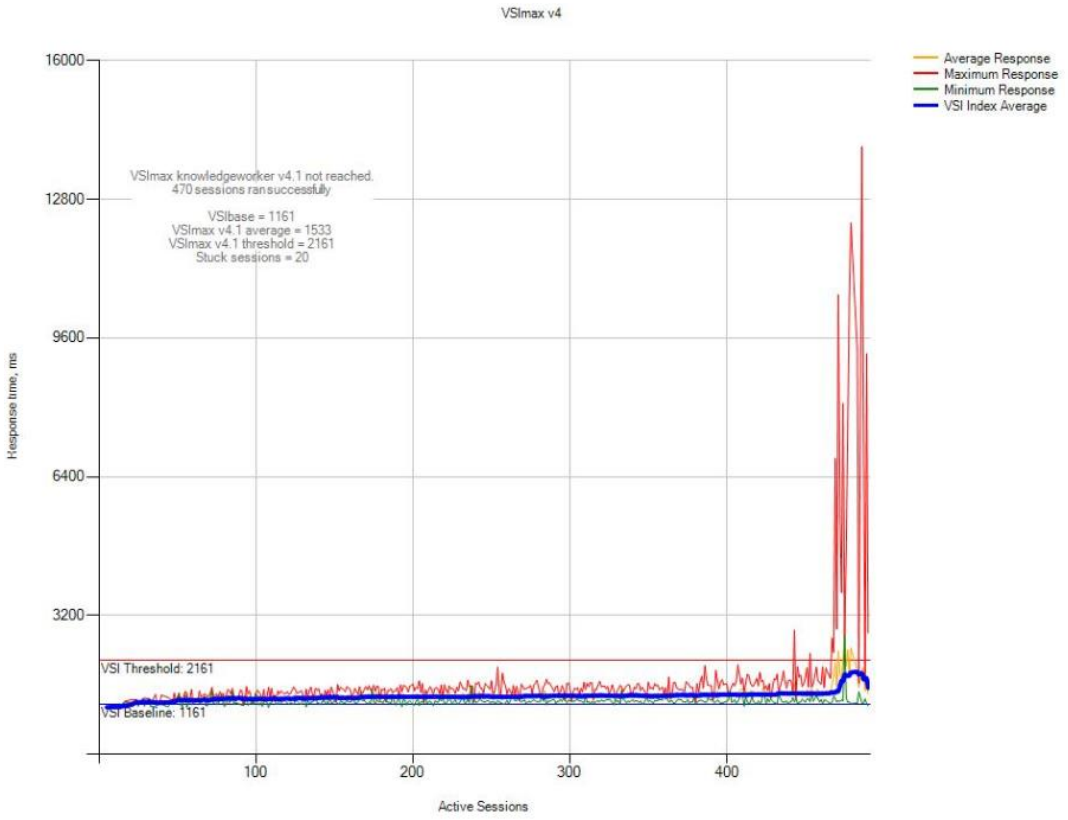

Figure 5 – Login VSI Response with storage in Low Tier – Knowledge Worker workload

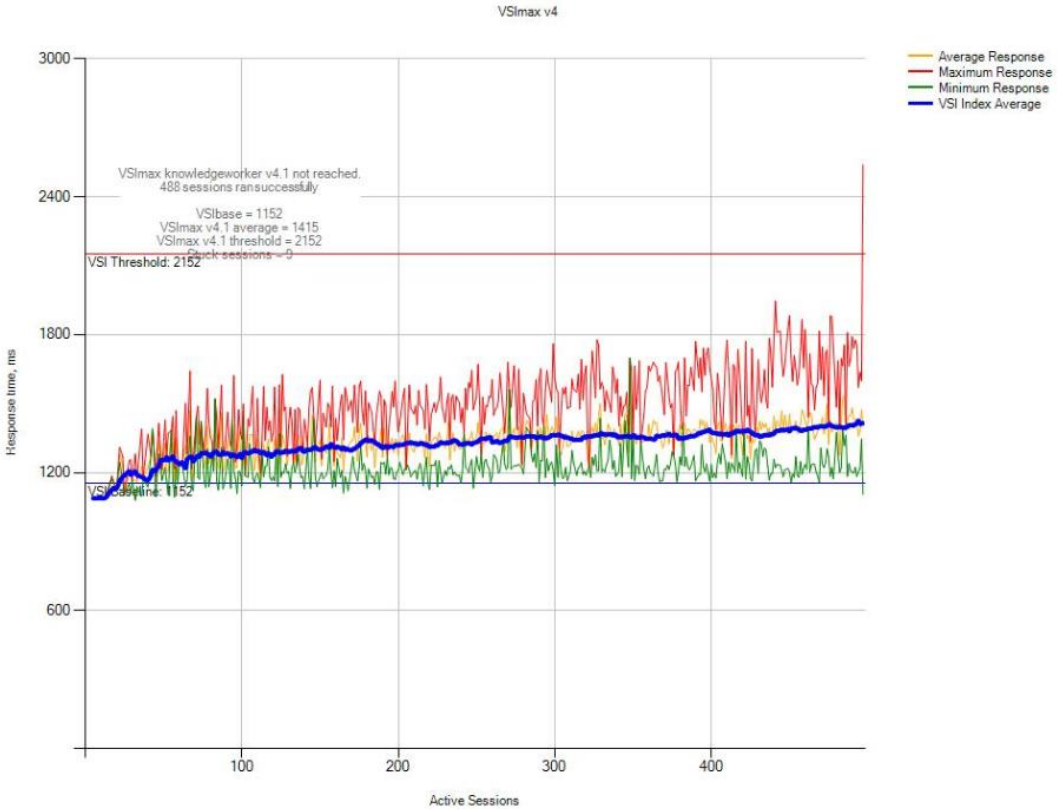

Figure 6 – Login VSI Response with storage in High Tier – Knowledge Worker workload

Notice that with the heavier workload of the Knowledge Worker, the scales for the Login VSI Response charts are quite different between the Low Tier and High Tier. It is clear that with the storage moved to the High Tier, the Knowledge Worker load is handled more effectively. Both are viewed as successful tests within the Login VSI criteria for support of 500 Users.

6 VMware ESXi Server Loading

The performance factors within the ten ESXi servers provide a view of the loading within this test environment as seen in the following charts.

6.1 CPU Loading

With the overprovisioning of the ESXi servers, it is not expected that the loading on the CPUs will be very high. This is seen in these charts.

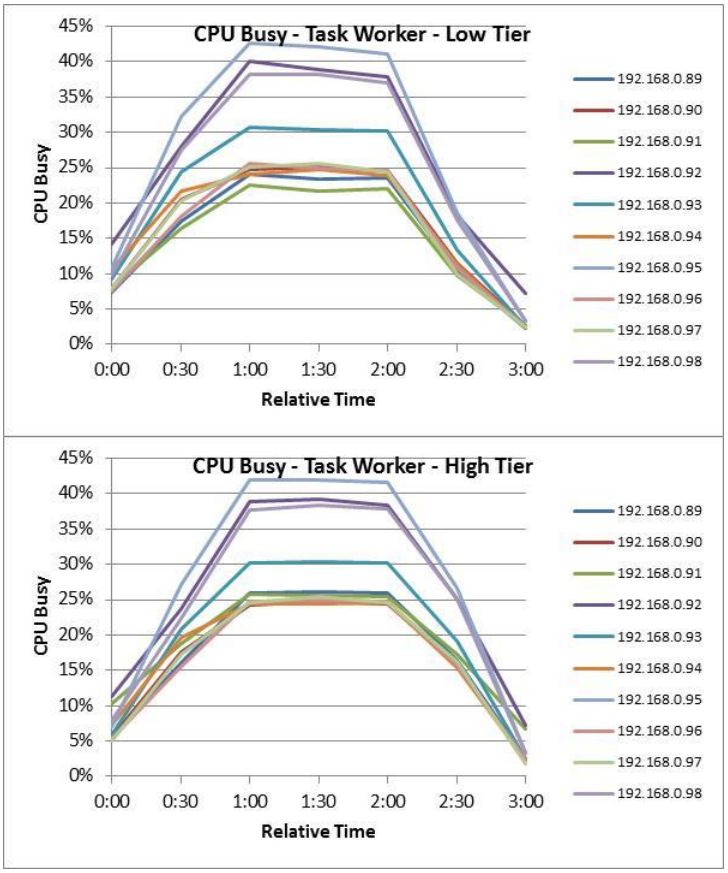

Figure 7 – CPU Loadings – Task Worker workload

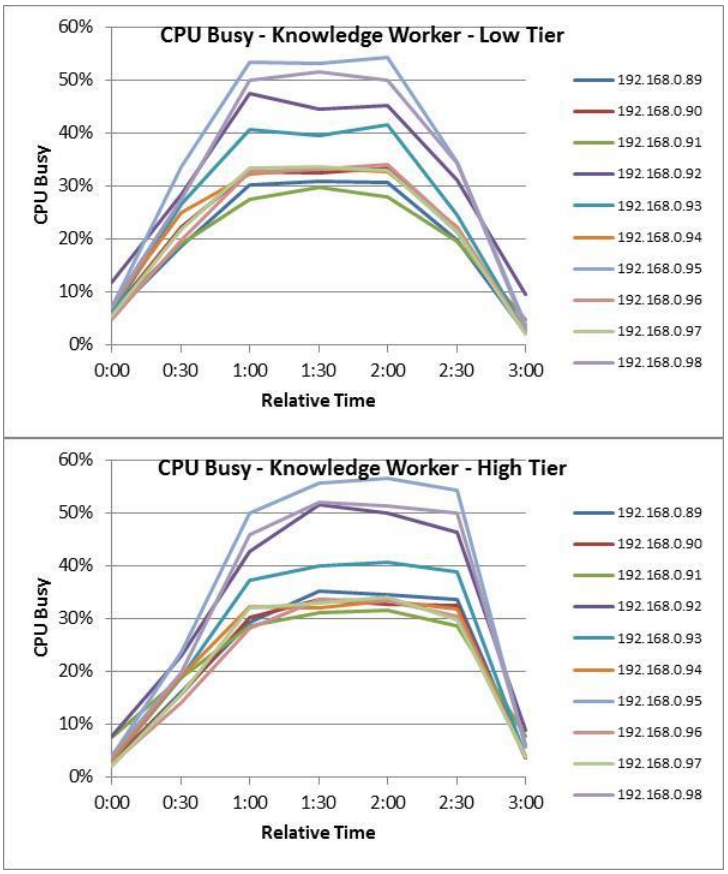

Figure 8 – CPU Loadings – Knowledge Worker workload

It is clear from these CPU loading charts that the ESXi servers are not being stressed in this configuration. This is not the normal case as extra servers were included purposely to ensure that there would not be a limitation on the VDI performance imposed by the servers. This is because of the focus of this work on the iSCSI SAN and the ETERNUS storage array performance.

6.2 Disk Response Time

The primary area where it is expected that the shorter response times associated with SSD storage is seen in the Disk Response Time viewed from the ESXi servers. Although the differences are small, due to the high number of HDDs used in the configuration, it is still clear from these charts that the High Tier provides the servers with better response times.

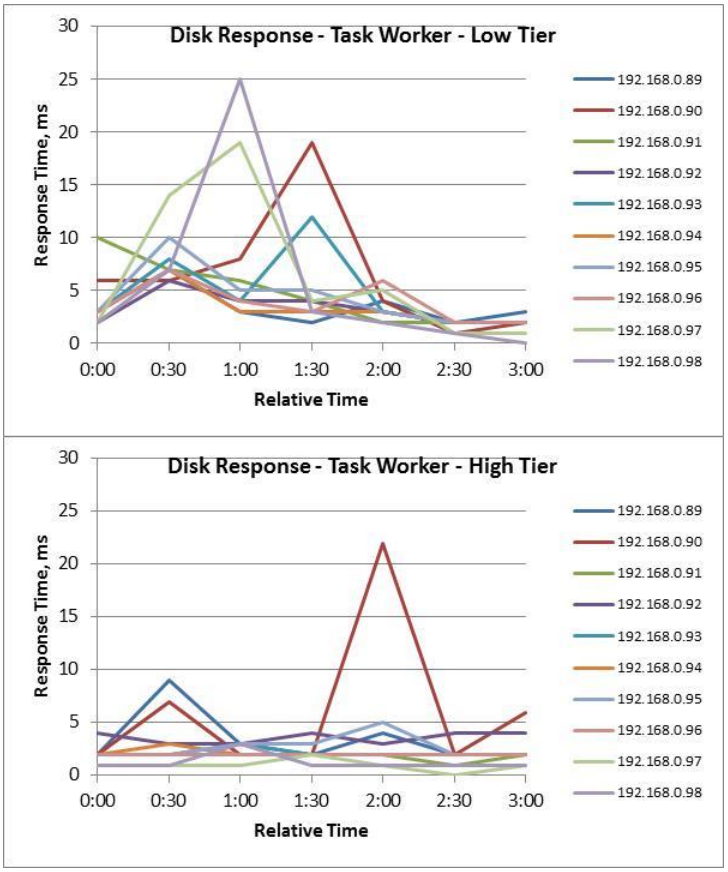

Figure 9 – Disk Response Times – Task Worker workload

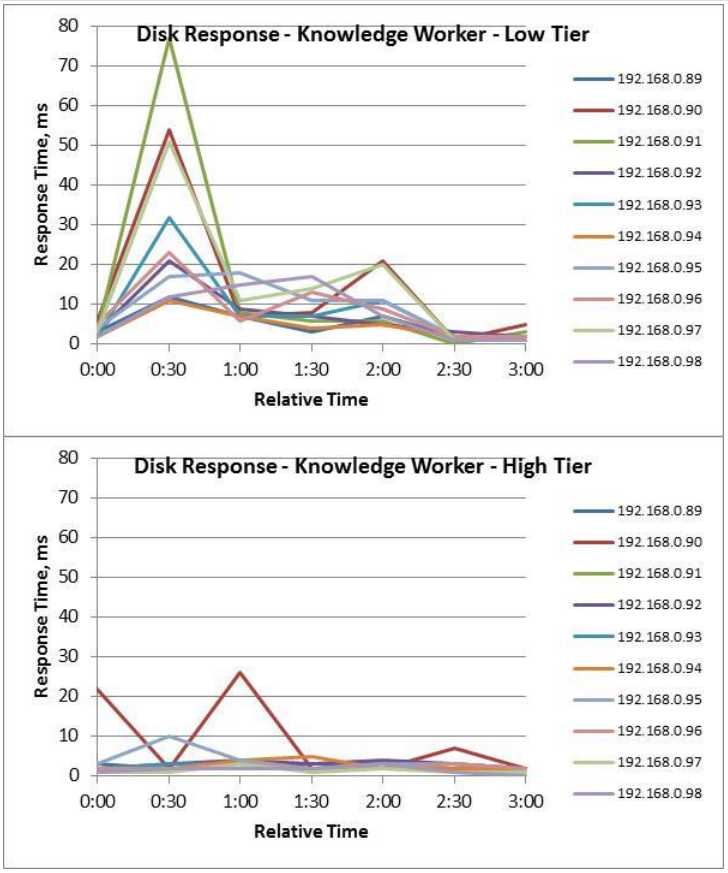

Figure 10 – Disk Response Times – Knowledge Worker workload

With the greater traffic on the storage demanded by the Knowledge Worker workload, it is clear that moving the active storage from the Low Tier to the High Tier improved the response time seen by the ESXi servers. However with the lighter loading from the Task Worker workload, the change is not as clearly evident, but it is still showing, especially during the early period of heaviest demand.

6.3 Disk Traffic

As all of the ESXi servers are running similar workloads, it is expected that the traffic each is demanding of the storage will be very much the same. These charts provide insight into the traffic between the servers and the storage, as viewed from the servers. These charts show that there can be as much as a 2:1 ratio of traffic on some of the servers versus others, but this does not appear to cause any issues with the operations.

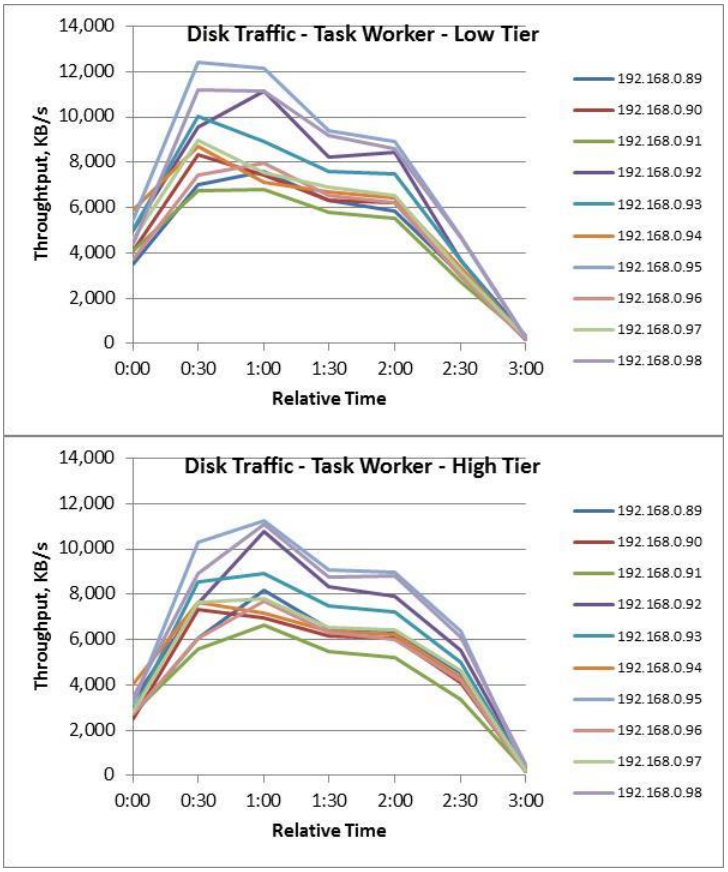

Figure 11 – Disk Traffic – Task Worker workload

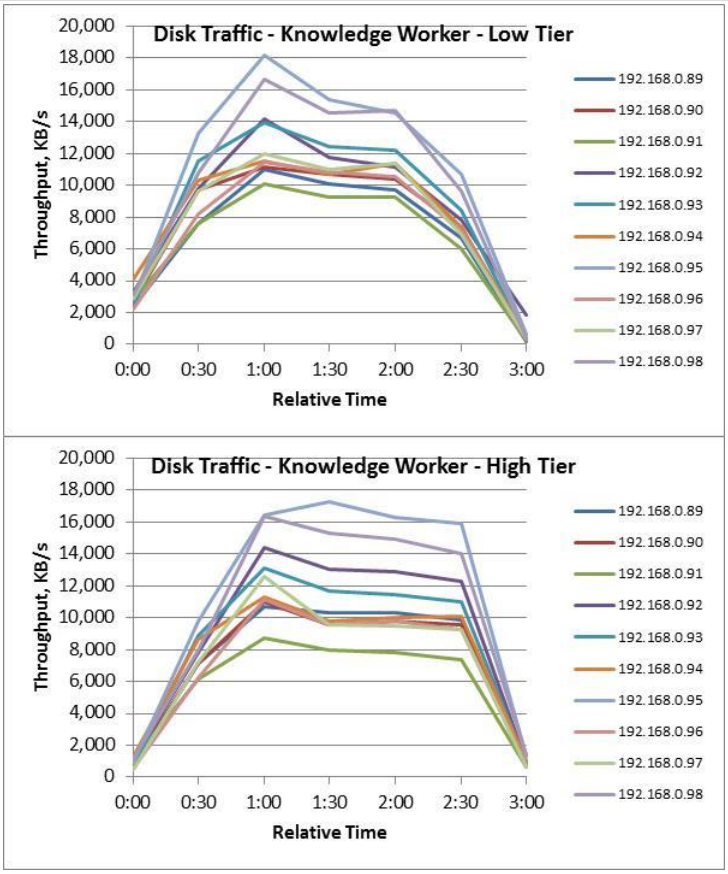

Figure 12 – Disk Traffic – Knowledge Worker workload

7 ETERNUS Performance

The other aspect of performance that was part of the objective of these tests is the performance measured within the ETERNUS storage array. This performance view enables direct comparison between operations when the active data storage is located in the Low Tier versus when it is located in the High Tier. Where possible the charts are scaled the same, but in some instances the differences are so great that it was necessary to scale the charts differently.

7.1 ETERNUS Throughput

This throughput measurement represents the total load demanded by all ten of the ESXi servers shown in the previous charts, and is separated into the Read Traffic and the Write Traffic for clarity in the nature of the workload demand on the storage.

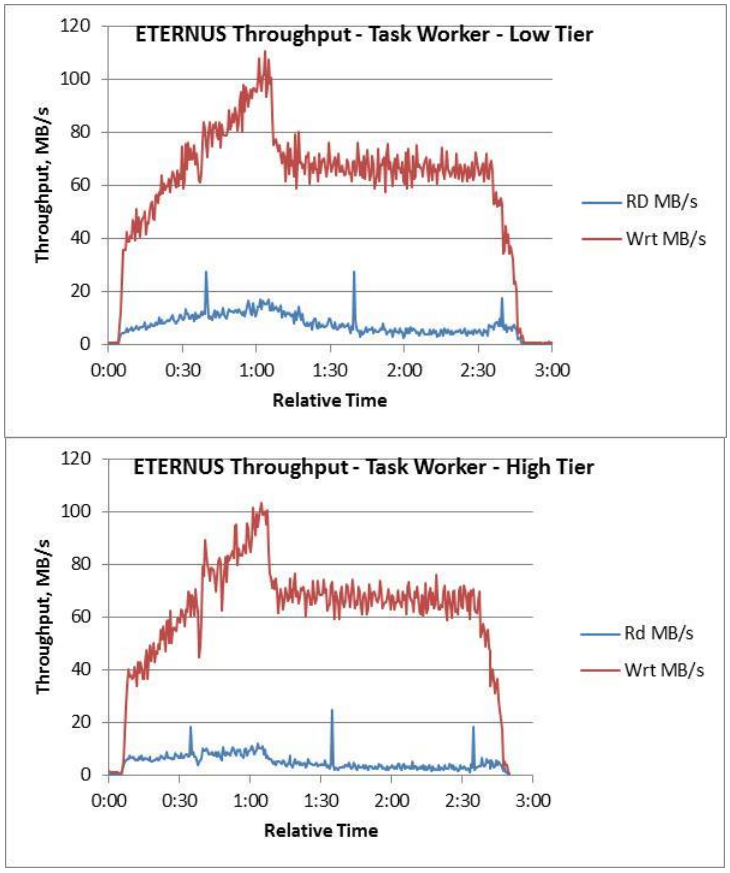

Figure 13 – ETERNUS Throughput – Task Worker workload

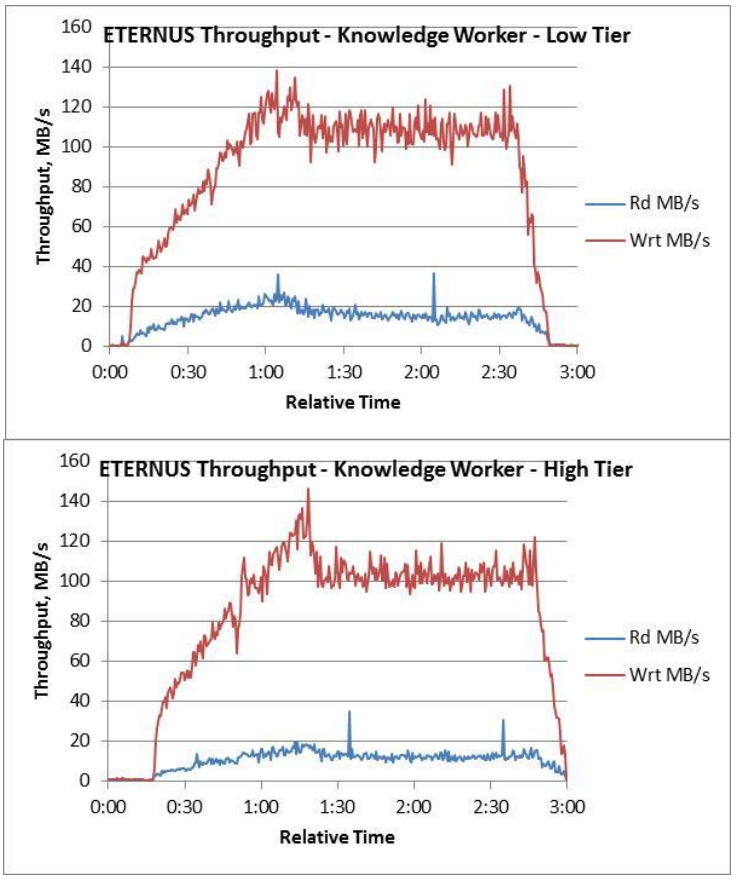

Figure 14 – ETERNUS Throughput – Knowledge Worker workload

The peak throughput reached ~160 MB/s in these test runs, which with four 10Gbps iSCSI host connections active, results in a peak of only 40 MB/s per host channel on the ETERNUS storage array, well within the capability of the iSCSI host connection capabilities.

Clearly visible in these charts is the one hour time interval when the requested numbers of VDI users are becoming active. Each session is started by the Login VSI Launchers during this first one hour period, and then all run at their prescribed load level until their operations are complete, at which point they shut down. This operational profile is established by the Login VSI method of testing and provides a clear indication of the ability of the system to support the requested number of users.

7.2 ETERNUS Response Time

These charts provide a view of the response times provided by the ETERNUS storage array in support of the throughput shown on the previous charts.

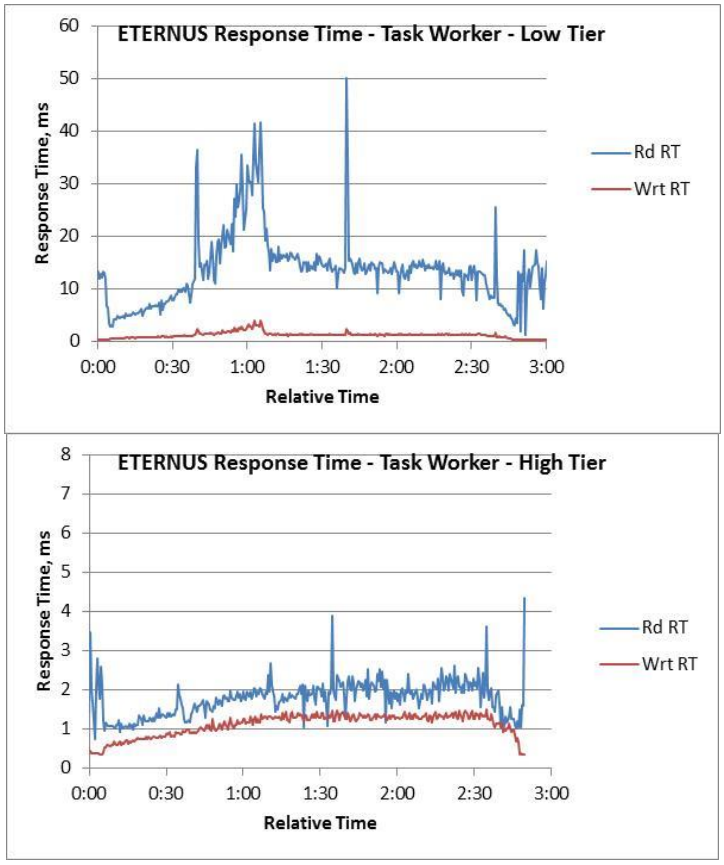

Figure 15 – ETERNUS Response Time – Task Worker workload

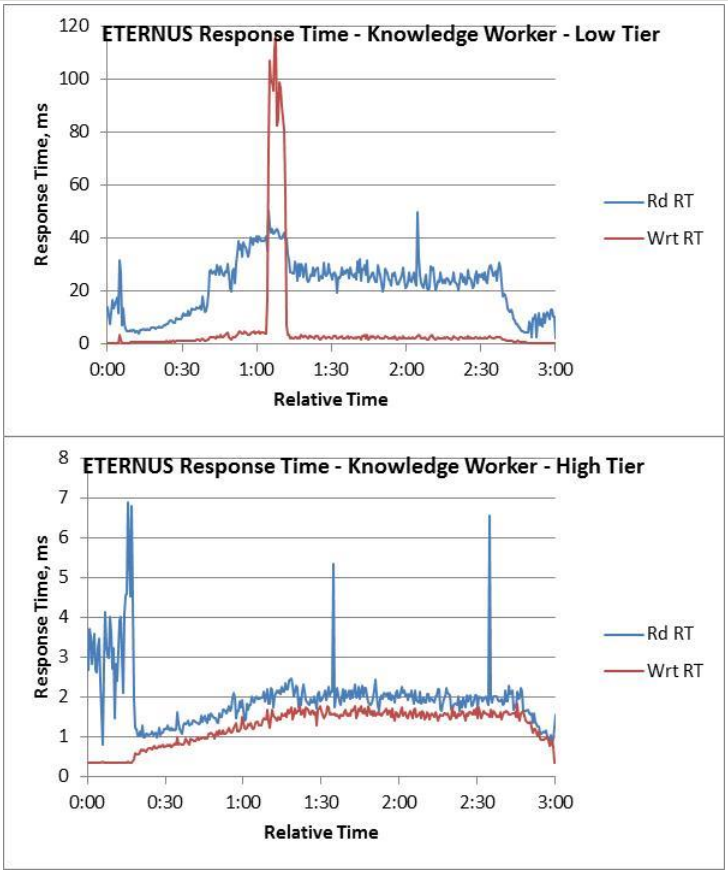

Figure 16 – ETERNUS Response Time – Knowledge Worker workload

Notice that the scales on the throughput are different between the Low Tier and the High Tier on these charts to clearly show the fast response time provided when the data is in the High Tier SSD portion of the storage pool. Read response is nearly 10 times greater when the data is in the Low Tier than when it has been moved to the High Tier. Although it is difficult to discern from the charts, the Write response is about 2 times greater when the data is in the Low Tier than when it has been moved to the High Tier.

7.3 ETERNUS Host Channel Throughput

One of the objects of the testing is to evaluate the effectiveness of the 10Gbps iSCSI host connection channels. These charts provide the traffic carried by each of the four iSCSI host channels in use during these tests.

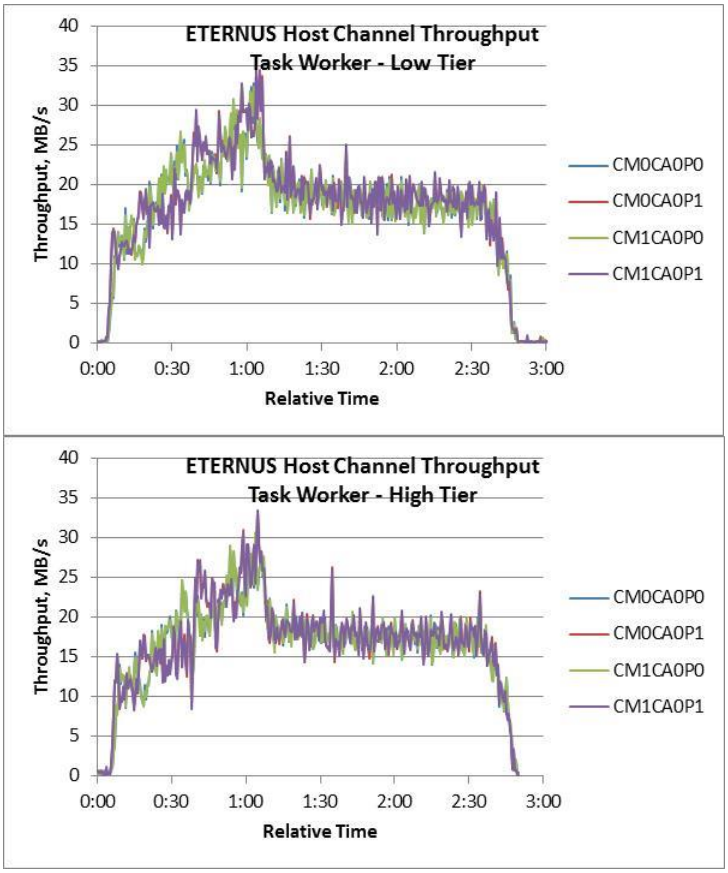

Figure 17 – ETERNUS Host Channel Throughput – Task Worker workload

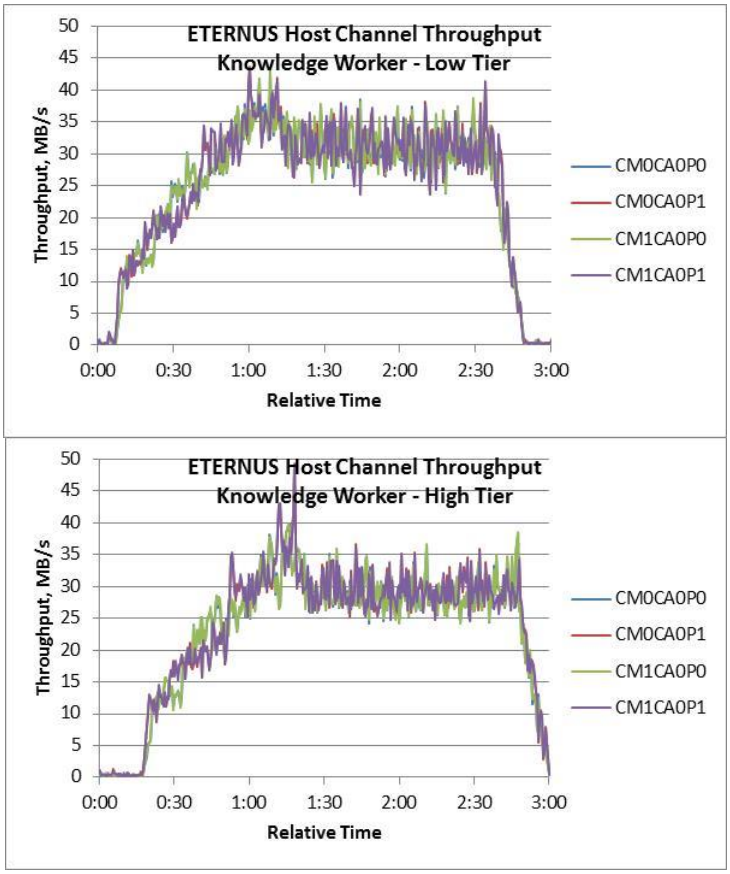

Figure 18 – ETERNUS Host Channel Throughput – Knowledge Worker workload

These charts illustrate two aspects of the host interface traffic during these test runs. First, the traffic is well balanced across all four of the channels, which is important for effective use of the storage. Second, the level of traffic is well below the maximum traffic that 10Gbps iSCSI links can be expected to support, indicating that this is a good match at a good price point for smaller VDI requirements.

7.4 ETERNUS CM Busy

The Control Module (CM) in the ETERNUS provides the processing power within the storage array and can limit throughput under some workload demands. These charts show that the two CMs in the ETERNUS are not stressed by the workloads presented in this environment.

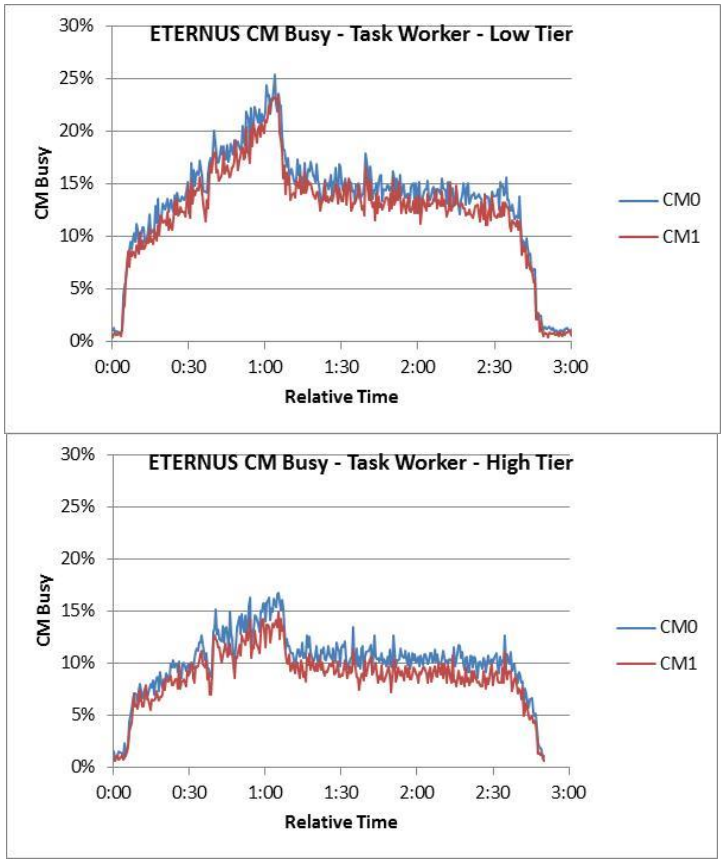

Figure 19 – ETERNUS CM Busy – Task Worker workload

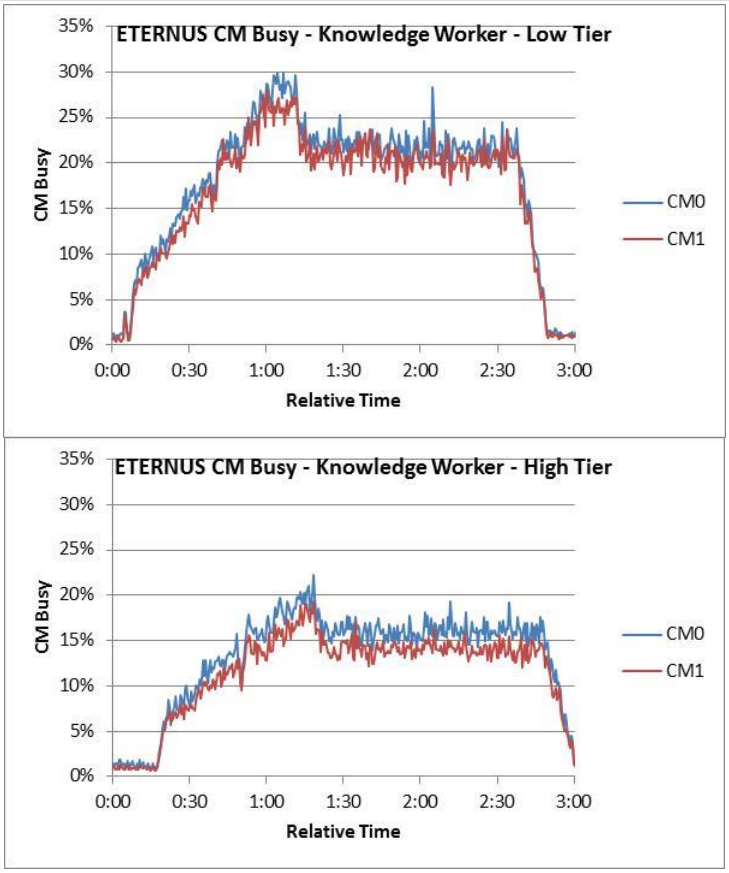

Figure 20 – ETERNUS CM Busy – Knowledge Worker workload

The heavier demands of the Knowledge Worker workload are clearly evident in these charts, where a different scale is used to reveal the differences more clearly. Notice that in both cases, it takes about 5% more CM power to support the load with the storage located on the HDDs. This is due to the much greater number of drives over which the storage is spread, coupled with the inherently slower response time of the HDDs versus the SSDs.

7.5 ETERNUS Operations during AST Relocation

As a part of this test series, Automated Storage Tiering was initially inactive. After the first series of Login VSI tests with the data in the Low Tier of the storage array, AST was enabled. Two runs of the Login VSI Knowledge Worker loading were made during the time that AST was relocating the storage data from the Low Tier to the High Tier. The operations within the ESXi servers were very much the same as during the test runs reported previously in this report. However the operations within the ETERNUS storage array are quite interesting, and are included here for supplementary review.

LoginVSI Workload	Number of Users	Successful Sessions	Stuck Sessions	VSI Baseline	VSImax v4 Average	VSImax v4 Threshold	VSImax Result
AST Moving Test Set							
Knowledge Worker started before AST move	500	489	6	1179	1468	2179	not reached
Knowledge Worker finished after AST move	500	488	8	1158	1687	2158	not reached

Figure 21 – Login VSI Results for 500 Users during AST data relocation

There is a direct relationship between the Throughput measured in MB/s and the Throughput measured in IOPs. For this review, we are using the IOPs measured within the ETERNUS storage array, divided into two sources. There are the operations requested by the Login VSI launched VDI instances on the ESXi servers, which appear to the storage array as Host System IO requests. There are also the operations requested by AST to move the active data from the Low Tier HDDs to the High Tier SSDs. These charts show the relationships between these activities within the storage array as the data is relocated.

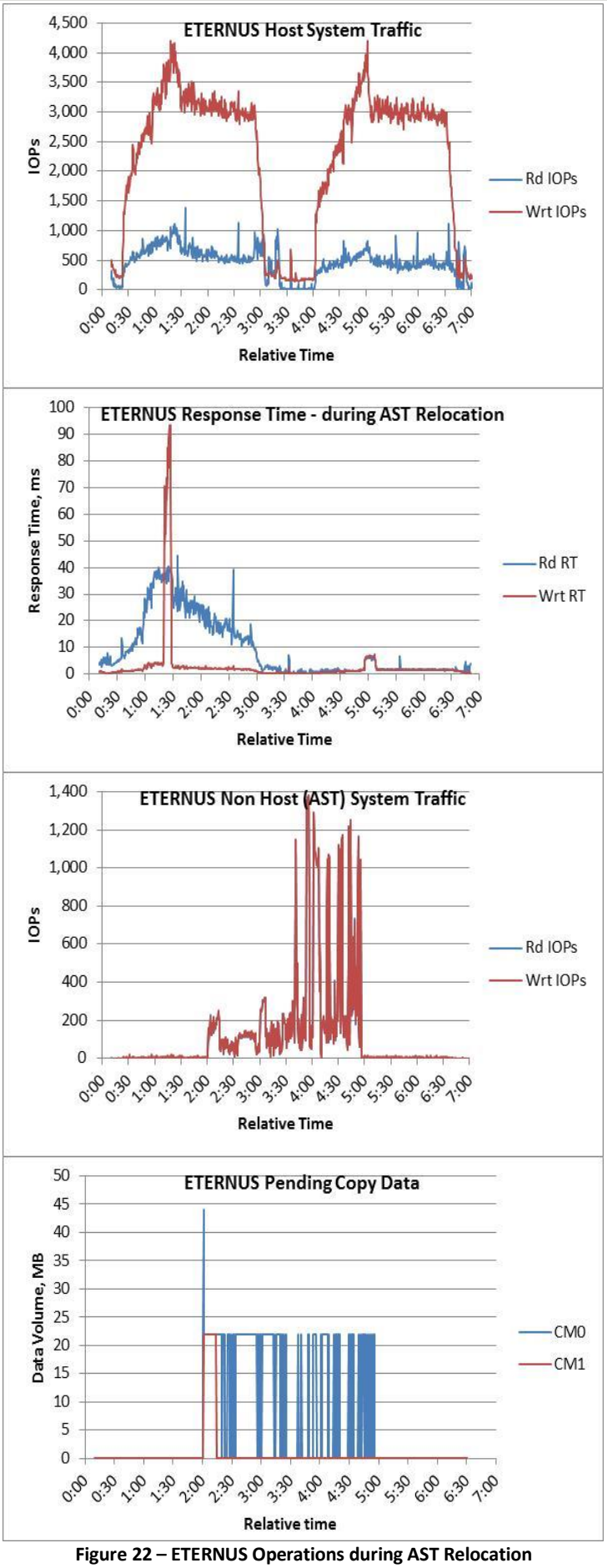

Figure 22 – ETERNUS Operations during AST Relocation

Notice the reduction in Read Response time after 2:00 when AST data movement started moving the active portions from the Low Tier HDDs to the High Tier SSDs. Even though the traffic load remained relatively constant from 2:00 to 3:00, the response time dropped from 30ms down to less than 10ms. This drop is evident, even though only part of the data movement had been completed, then the response time in the second run of the Knowledge Worker was at the very low level.

8 Test Analysis

As noted in section 4.2, there were two objectives in this testing effort.

8.1 Evaluation of use of 10Gbps iSCSI for SAN between ESXi Servers and ETERNUS storage array

As illustrated in Figure 1, the configuration was established using two Cisco switches between the set of PRIMERGY ESXi servers and the ETERNUS storage array. Each server has a connection into each of the switches – two paths per server. There were four connections from the switches, one from each switch to each CM. This proved to be more than adequate as illustrated in the throughput charts shown in Figure 13 and Figure 14, where the maximum throughput of ~160 MB/s does not approach the maximum capability of the four paths. Figure 17 and Figure 18 provide further detail showing each of the four paths between the ETERNUS storage array and the switches. It can be seen that the traffic on all of these are less than the typical saturation level of 300-500 MB/s that 10Gbps iSCSI is capable of supporting. Furthermore, all four of the paths are carrying very close to the same level of traffic under all of the test workload profiles.

8.2 Evaluation of the use of Automated Storage Tiering to optimize the active storage within the ETERNUS storage array

As shown in Figure 9 and Figure 10, it is clear that the response times seen by the ESXi servers are reduced, once the active data has been moved from the Low Tier to the High Tier in the ETERNUS storage array. Figure 15 and Figure 16, which show the response time profiles within the ETERNUS storage array also show this improved response time – the response time for Read requests when the data has been moved to the High Tier is only about 10% of what it is when the same data was located in the Low Tier. And the response time for Write requests when the data has been moved to the High Tier is less than 50% of what it was when that same data was located in the Low Tier.

Section 7.5 provides a view of the performance during the active operation of Automated Storage Tiering (AST). Two separate Knowledge Worker Login VSI tests were run during the time that AST was moving the active VDI test data from the Low Tier to the High Tier. Figure 21 shows the Login VSI results for the two runs during the relocation of the data by AST, which are very similar to the Knowledge Worker results in Figure 2. This shows that the relocation activity by AST did not interfere with the Read and Write accesses from the VDI operations. In addition, a review of the response time during the AST relocation, shown in Figure 22, dramatically illustrates the reduction in Read Response Time as the data is moved from the Low Tier to the High Tier during the last part of the first Knowledge Worker test run.

About Fujitsu Americas

Fujitsu America, Inc. is the parent and/or management company of a group of Fujitsu-owned companies operating in North, Central and South America dedicated to delivering the full range of Fujitsu products, solutions and services in ICT to our customers in the Western Hemisphere. These companies are collectively referred to as Fujitsu Americas. Fujitsu enables clients to meet their business objectives through integrated offerings and solutions, including consulting, systems integration, managed services, outsourcing and cloud services for infrastructure, platforms and applications; data center and field services; and server, storage, software and mobile/tablet technologies. For more information, please visit: http://solutions.us.fujitsu.com/ and http://twitter.com/fujitsuamerica.

FUJITSU AMERICA, INC.
Address: 1250 East Arques Avenue Sunnyvale, CA 94085-3470, U.S.A.
Telephone: 800 831 3183 or 408 746 6000
Website: http://solutions.us.fujitsu.com
Contact Form: http://solutions.us.fujitsu.com/contact

Have a question? Email us at: AskFujitsu@us.fujitsu.com

About Login VSI

Login VSI provides proactive performance management solutions for virtualized desktop and server environments. Enterprise IT departments use Login VSI products in all phases of their virtual desktop deployment–from planning to deployment to change management–for more predictable performance, higher availability and a more consistent end user experience. The world's leading virtualization vendors use the flagship product, Login VSI, to benchmark performance. With minimal configuration, Login VSI products works in VMware Horizon View, Citrix XenDesktop and XenApp, Microsoft Remote Desktop Services (Terminal Services) and any other Windows-based virtual desktop solution. For more information, download a trial at www.loginvsi.com.

FPC65-7273-01 02/15