



# Cost Efficient VDI

XenDesktop 7 on  
Commodity Hardware



# Introduction

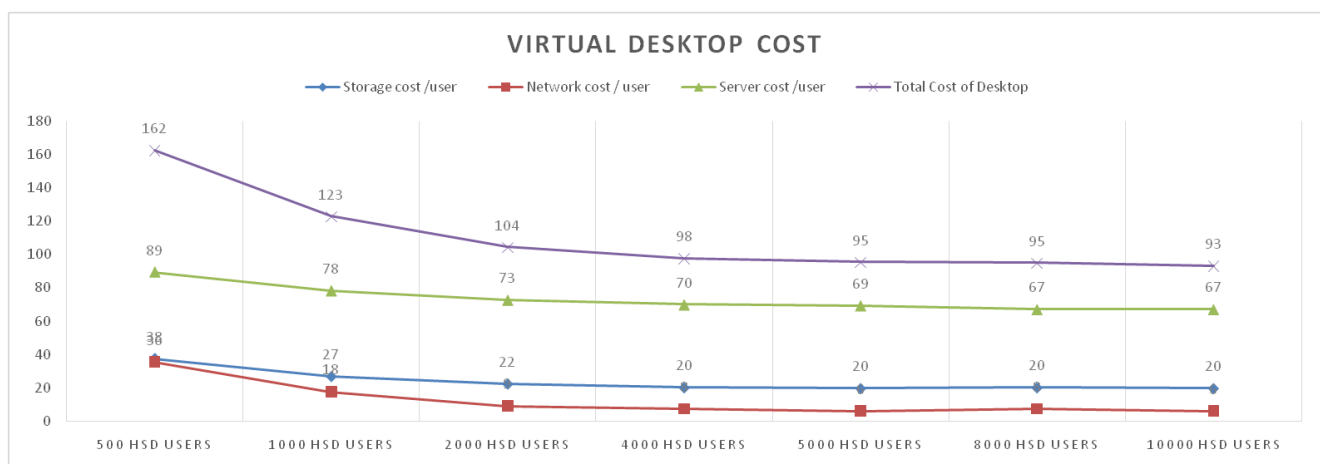
An increasing number of enterprises are looking towards desktop virtualization to help them respond to rising IT costs, security concerns, the user demands of BYOD and mobile working strategies. But can a desktop virtualization solution have a lower or equivalent Total Cost of Ownership (TCO) when compared to the traditional approach of procuring physical desktops? Is there a solution which delivers all the benefits of scalability and performance while maintaining a lower TCO?

**Leveraging commodity hardware is the answer** – by enabling the delivery of a desktop virtualisation infrastructure that modernises the workforce and enhances user productivity while maintaining a lower TCO. Citrix has collaborated with Boston Limited to leverage their Supermicro based commodity hardware stack to design a robust and scalable XenDesktop architecture.

The solution works using software components such as Citrix XenDesktop 7.1 in combination with Microsoft Hyper-V 2012 R2 and Windows Storage Spaces. The hardware stack includes rack based servers equipped with SATA 6Gb/s 7mm 2.5" SSD for hosting the IOPS hungry Write Cache and four AMD 12 Core Opteron processors for servicing the Hosted Shared Desktop workloads; catering for heavy task based and knowledge workers. The architecture does away with the need for SAN and relies on traditional JBOD managed by Windows Server 2012 R2 clustered file services for hosting user data.

## Solution Objective

The objective of this guide is to validate a Citrix XenDesktop Hosted Shared Desktop architecture on commodity hardware whilst keeping in consideration the business needs of an organization. The solution is designed to deliver performance and reliability at par with enterprise class hardware yet keeping the per user capital expenditure for storage, compute and network well within the range of **\$125 USD** for concurrency greater than **1000 users**.



# The Relevance of Commodity Hardware

‘Commodity Hardware’ is hardware that is easily and affordably available. A device that is said to use “commodity hardware” is one that uses components that were previously available or designed and are thus not necessarily unique to that device. Commodity hardware are often employed and used as file servers or are clustered together by enterprises to provide large-scale computing power, or to maximize savings in IT design.

Based on ongoing research efforts, and the continuing advancements of computing and networking technology, it is believed that use of commodity hardware is vital in creating a cost effective and easily scalable cloud solution. And this is poised to have a major impact on our society’s data centric commercial and scientific endeavours.

So applying the same concept, Citrix and Boston Limited have built a cost-effective yet powerful and scalable virtual desktop infrastructure at a price point lower or equivalent to that of a traditional PC.

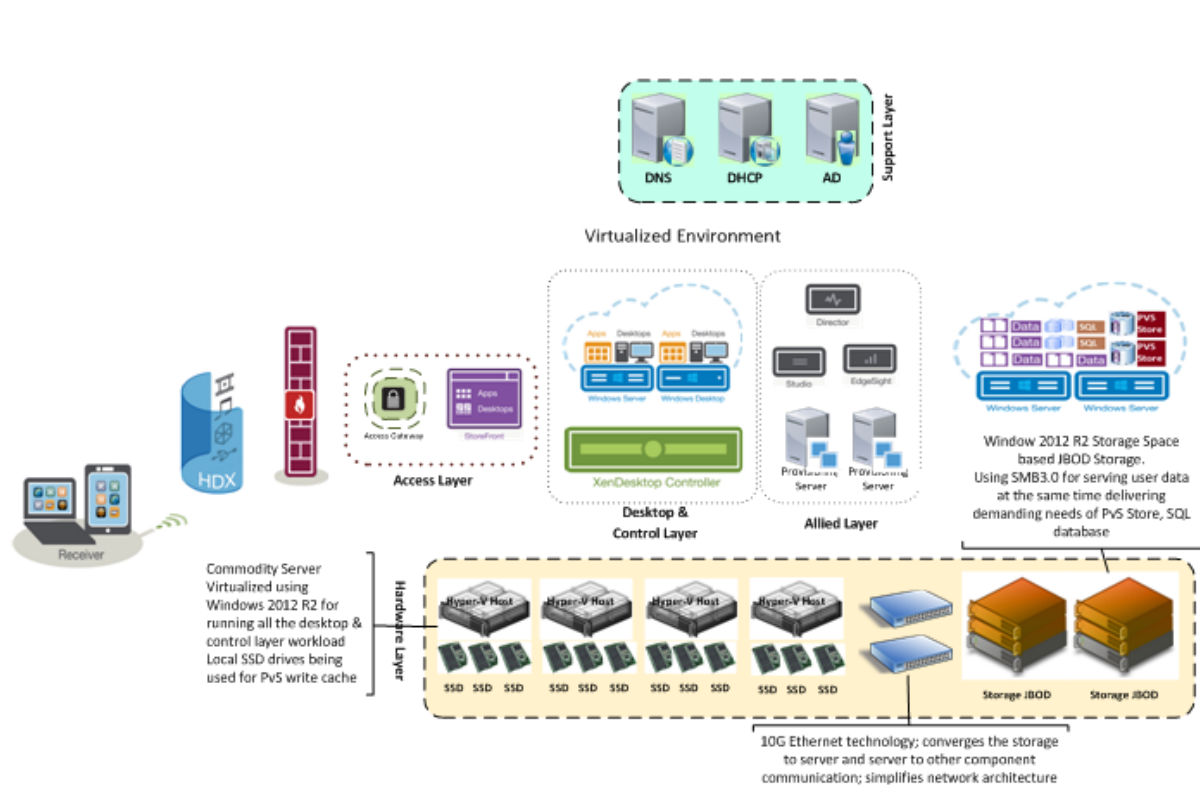
## XenDesktop 7 on Commodity Hardware

Each of the desktop class servers is equipped with 48x 2.8 GHz AMD Opteron processor cores and 256GB RAM to satisfy the compute needs of shared desktop workloads for up-to 200 users. A key differentiator is the use of enterprise class SATA Solid State Drives which provide excellent endurance from low-cost 19nm NAND. The cost of these drives is 1/3 that of SLC NAND based SAS SSDs. Each server is equipped with 3 x SanDisk CloudSpeed 1000 series SSDs. Two of these drives configured with Windows Server 2012 R2 Storage Spaces are utilized to host the volatile Write Cache and can service write IOPS in the range of 100 per user thus effectively managing boot / login storms and IO intensive operations such as antivirus scanning.

The construct of this Citrix Validated Solution is based on many decisions that were made during validation testing. Testing was carried out using the Login VSI 4.0 virtual Session Indexer (VSI), an industry standard tool for user / session benchmarking. Login VSI allows comparisons of platforms and technologies under the same repeatable load. The “Medium” VSI workload is expected to approximate the average office worker during normal activities and was the workload used throughout testing.

The testing was conducted on a scaled down replica of the expected production environment. Only the Hosted Shared Desktop FlexCast model workloads were tested using the XenDesktop Template Policy “High Server Scalability” running in “Legacy Graphics mode”. Therefore the Bill of Materials described within this document is extrapolated based on single server scalability test results with these policy settings in place. Using these Citrix Policies allows the greatest host density for each FlexCast model.

The following figure depicts the solution architecture that make up the requirements for delivering a XenDesktop 7 Hosted Shared Desktop solution onto commodity hardware.

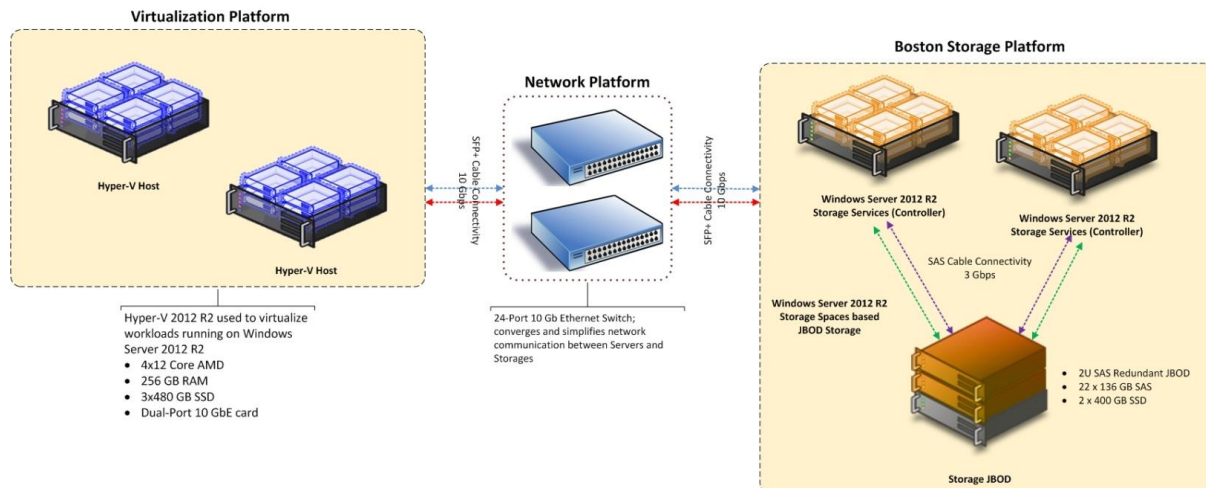


The following Citrix and Microsoft components are required to deploy the reference architecture:

- Citrix XenDesktop 7.1: Hosted Shared Desktop and App virtualization platform
- Citrix Provisioning Server 7.1: Workload delivery platform
- Citrix StoreFront Services 2.1: Desktop and app resource enumeration
- Microsoft SQL 2012 SP1: Database Platform
- Microsoft Hyper-V Windows Server 2012 R2: Hypervisor platform
- Microsoft Windows Storage Server 2012 R2: Storage management platform
- Hardware: Boston Servers, Switches and Storage

# Hardware Stack

This section incorporates details about the proposed hardware stack for hosting XenDesktop 7 Hosted Shared Desktop solution on Commodity hardware. It defines the type and amount of physical resources required to support the solution.



## Servers

Boston Fenway 2U AMD Quad Socket Server Solution – VDI Cluster BOS-CIWL4P-01

Enterprise grade 2U servers used for hosting XenDesktop infrastructure components, related Microsoft components and virtual desktop workloads.

### Boston Fenway 2U AMD Quad Socket Server Solution – VDI Cluster



#### Key Features (Can Support)

- Four AMD Opteron™ 6000 series (6300 ready) processors (Socket G34) 16/12/8/4-Core ready; HT3.0 Link support
- Up to 1TB DDR3 1600MHz ECC Registered DIMM; 32x DIMM sockets
- 2x PCI-e Gen 2.0 x16 slot
- 1x PCI-e Gen 2.0 x8 slot
- 1x UIO or x8 slot
- Dual-port GbE LAN Controller, 4x USB 2.0 ports, 1x dedicated LAN for system management (IPMI 2.0)
- 6x Host-swap SATA Drive Bays
- 1400W High-efficiency Redundant Power Supplies Gold Certified
- 6x 4-pin PWM fans with optimal fan speed control

## Switches

Mellanox SX1012B-2BFS switch system provides the highest-performing top-of-rack (ToR) solution in a half-width 1U form factor by delivering up to 1.3Tb/s of non-blocking throughput with 10GbE or 40/56GbE form factor. The SX1012 is the ideal top-of-rack (ToR) switch for small pods connecting a small number of servers with 40GbE. Each QSFP port can be used with a passive breakout cable to create four discrete SFP+ interfaces to be used as 10GbE ports, for a total of 48-ports on the smallest form factor 10GbE ToR in the industry.

Entire network communication between servers and storage traverse via these 2 switches.



### Key Features

- 12 40/56GbE ports in 1RU
- Up to 48 10GbE ports
- Lowest Latency: 220nsec for 40GbE; 270nsec for 10GbE
- Lowest Power: Maximum power consumption: <100 Watts

## Storage

Boston's BOS-CiSSJB-01 is storage JBOD which provides up to 45 hot-swap hard drive bays in an efficient 4U form factor designed for most commonly encountered applications. This storage is managed using 2 storage controllers running Windows Server 2012 R2 Storage Services on Boston 1U AMD Server Solution – Storage Head BOS-CISHN-01.

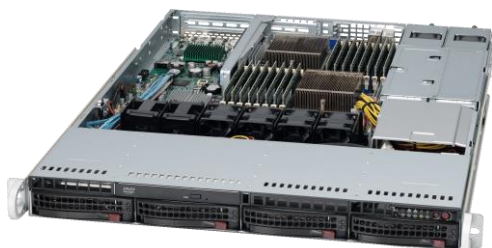
### Boston 4U JBOD Solution



### Key Features

- High Efficiency Power & High Storage Capacity
- Extra High-Density 4U JBOD Storage Chassis
- High-Availability Features: Redundant, Hot-pluggable cooling system, Power Supplies, Hot-swap drives
- Redundant (1+1) 1400W Gold level power supply with PMBus function
- Maximum 3.5" hot-swap drives density 45x (24 front + 21 rear) HDD bays; E26-2x Expanders support SAS2 (6Gb/s)
- 7 x 8cm (middle) hot-swap cooling fans, redundant cooling

### Boston 1U AMD Server Solution – Storage Head



### Key Features

- Dual AMD Opteron™ 6000 series (6300 ready) processors (Socket G34) 16/12/8/4-Core ready; HT3.0 Link support
- Up to 512GB DDR3 1600MHz ECC Registered DIMM; 16x DIMM sockets
- Intel® 82576 controllers, Dual-Port Gigabit Ethernet
- 4x 3.5" hot-swap drive bays
- 2x (x8) PCI-E 2.0 (via riser card)
- Integrated IPMI 2.0 + KVM with dedicated LAN
- 650W redundant power supply

# Scalability & Performance Testing

The focus of testing was on capturing the performance of commodity hardware and its resiliency during the entire process of the virtual desktop lifecycle.

Test metrics are gathered for all components under test such as the hypervisor, virtual desktop, network and storage and from the workload generation system, Login VSI, to determine the overall success of a test run. A repeated test methodology is followed to provide consistency between runs.

## Test Methodology

The following test methodology is used for each test run to ensure consistent results:

- Before each test, all desktop VMs and clients are cleanly started
- All VMs and client launchers are idle before test for consistent results
- Boot phase – All desktop VMs are powered ON and registered
- Logon phase – All user session are launched and active in Login VSI
- Test phase – At least 2 Login VSI loops are executed in each active session
- Logoff phase – All users logged off after VSI completion
- Test run reports and data are gathered
- All desktop VMs and clients are shut down.

## Test Methodology Physical Hardware – Storage & Compute

Function	Citrix Infrastructure Virtualization	Hosted Shared Desktops	Windows Storage Server
Hardware Model	Boston VDI Cluster BOS-CIWL4P-01	Boston VDI Cluster BOS-CIWL4P-01	Boston VDI Cluster BOS-CIWL4P-01
Host Count	1	1	2
Processor	12 core x 4 sockets	12 core x 4 sockets	8 core x 2 socket
Memory	256GB	256GB	64GB
Network	10GbE	10GbE	10GbE
Storage Type	Local SSD	Local SSD	JBOD SSD & SAS Drives
Operating System	Windows Server 2012 R2 Hyper-V	Windows Server 2012 R2 Hyper-V	Windows Storage Server 2012 R2
HA/Resiliency Configuration	No HA	No HA	No HA

## Virtual Machines – XenDesktop Infrastructure and Virtual Desktops

Function	Citrix Desktop Delivery Controllers	Citrix Provisioning Server	Citrix License Server	Citrix StoreFront Server	Citrix Hosted Shared Desktop VM
Hardware Model	Hyper-V VM	Hyper-V VM	Hyper-V VM	Hyper-V VM	Hyper-V VM
VM Count	2	2	1	2	8
Number of Cores	4	6	2	4	6
Memory	4GB	16GB	4GB	4GB	28GB
Hard Drive	40GB	40GB 500GB (SOFS)	40GB	40GB	40GB
Operating System	Windows Server 2012 R2	Windows Server 2012 R2	Windows Server 2012 R2	Windows Server 2012 R2	Windows Server 2012 R2

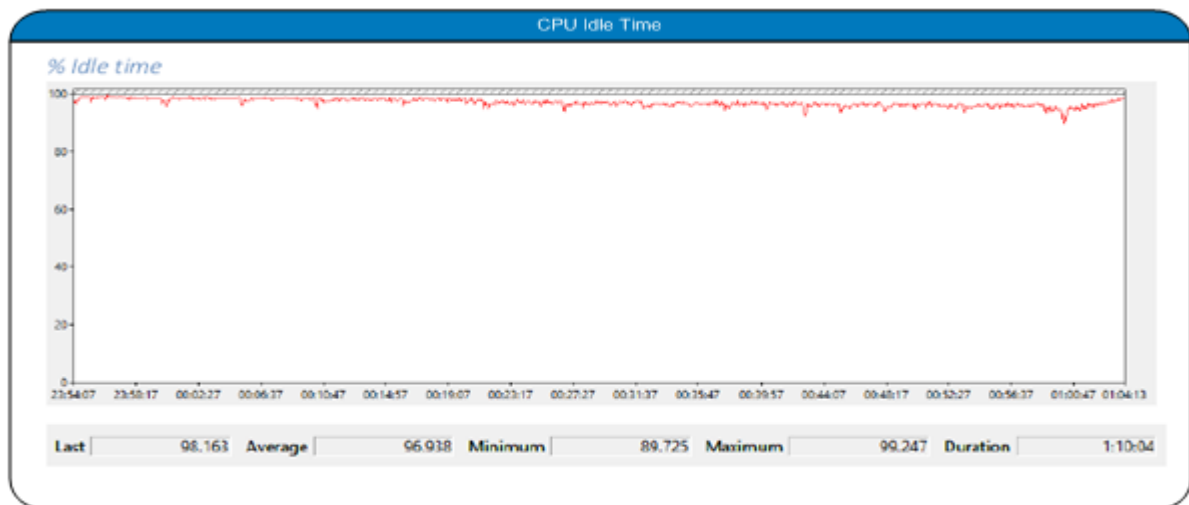
## Other Infrastructure

Function	Domain Controller DNS DHCP	SQL 2012 SP1 Server	Citrix Consoles SCVMM 2012 R2	SCOM & SCEP 2012 R2	LoginVSI Launcher
Hardware Model	Hyper-V VM	Hyper-V VM	Hyper-V VM	Hyper-V VM	Hyper-V VM
VM Count	1	1	1	1	4
Number of Cores	2	4	2	2	2
Memory	4GB	6GB	6GB	4GB	4GB
Hard Drive	40GB	500GB (SOFS)	40GB	40GB	40GB
Operating System	Windows Server 2012 R2	Windows Server 2012 R2	Windows Server 2012 R2	Windows Server 2012 R2	Windows Server 2012 R2

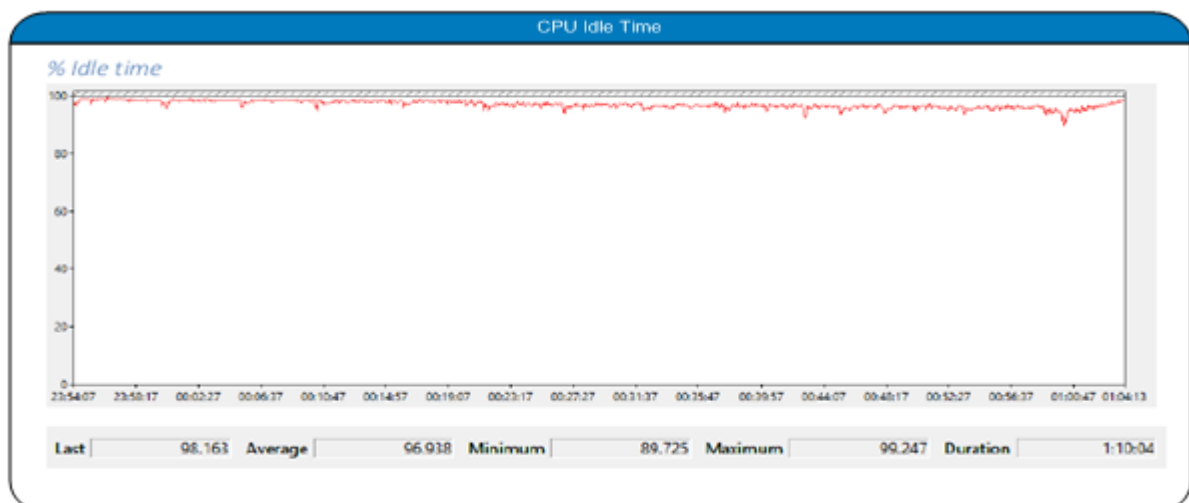
## Storage Performance Results

For the test setup, the Boston JBOD solution is configured with 22 x 10K RPM 140GB SAS drives and 2 x SanDisk dOptimus Eco SSDs. The SSDs are primarily used for storage tiering and write-back cache.

The storage head servers are configured with Windows Storage Spaces and clustering to achieve better performance and resiliency. Storage server is used as file share for storing user profiles; redirected folders; home drives (for storing user data) and as SOFS for storing vDisk and Data store. This data relies on a storage server configured with Storage space 2 way mirror resilience; auto-tier and write cache features.

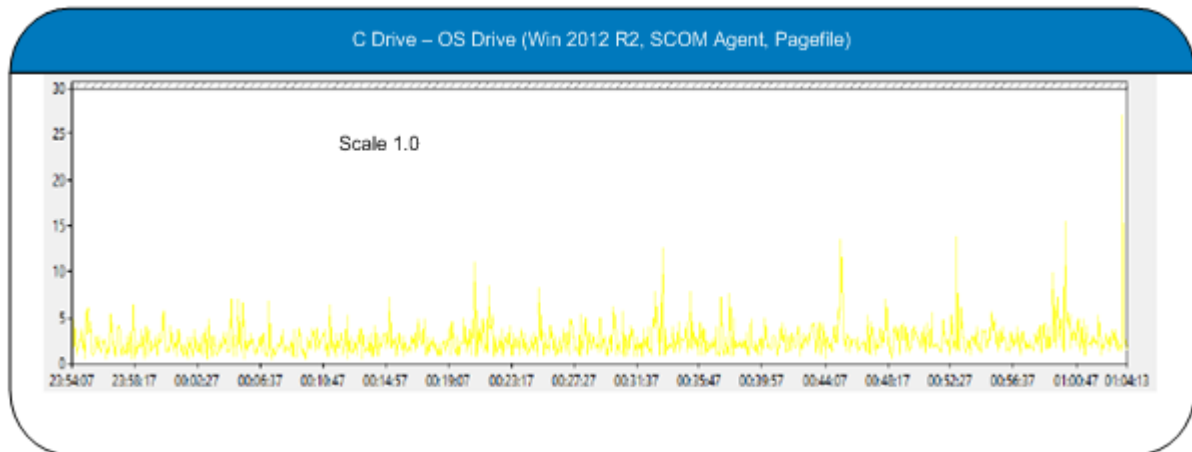


CPU Idle time on storage controllers

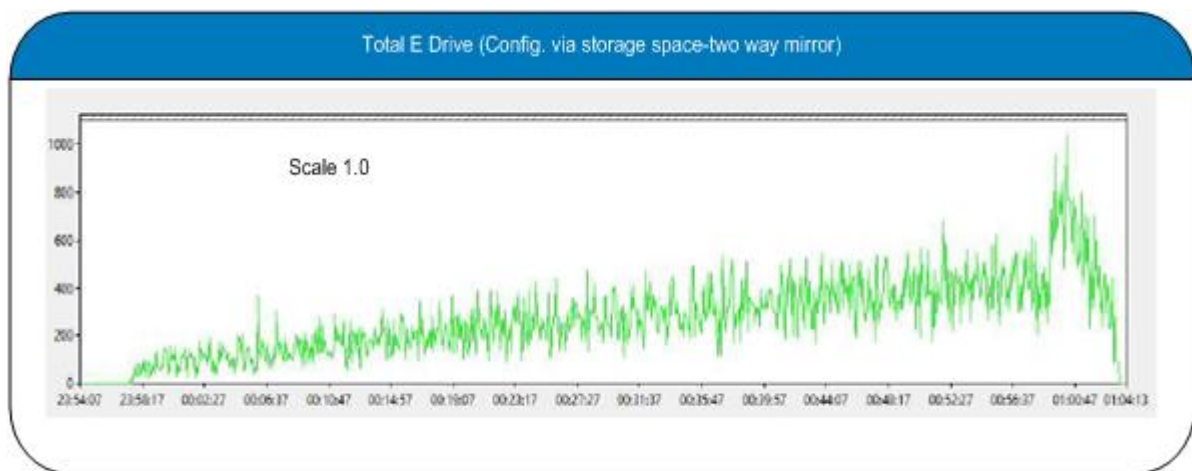


CPU Usage on storage controllers

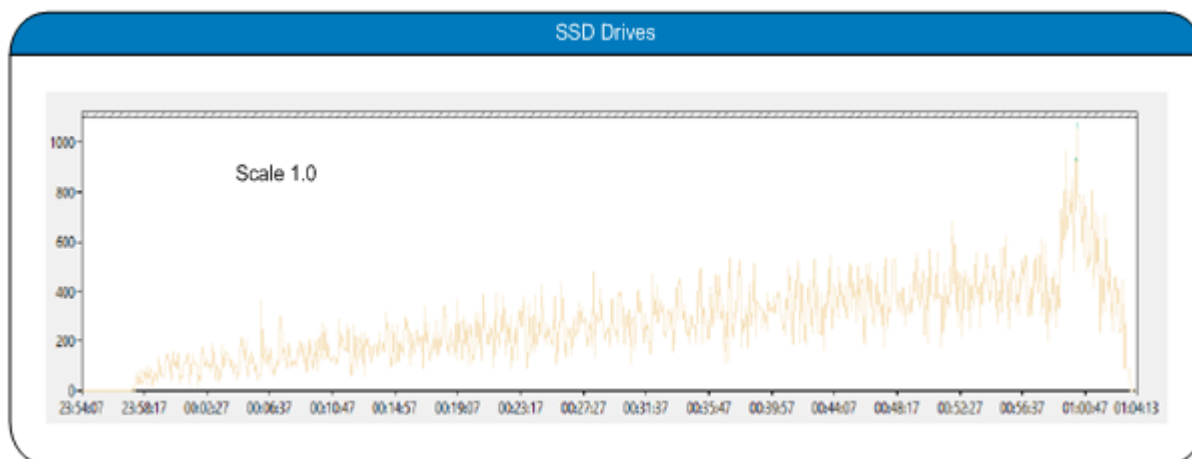
The following graph shows disk transfers/sec (IOPS) on different volumes and drives:



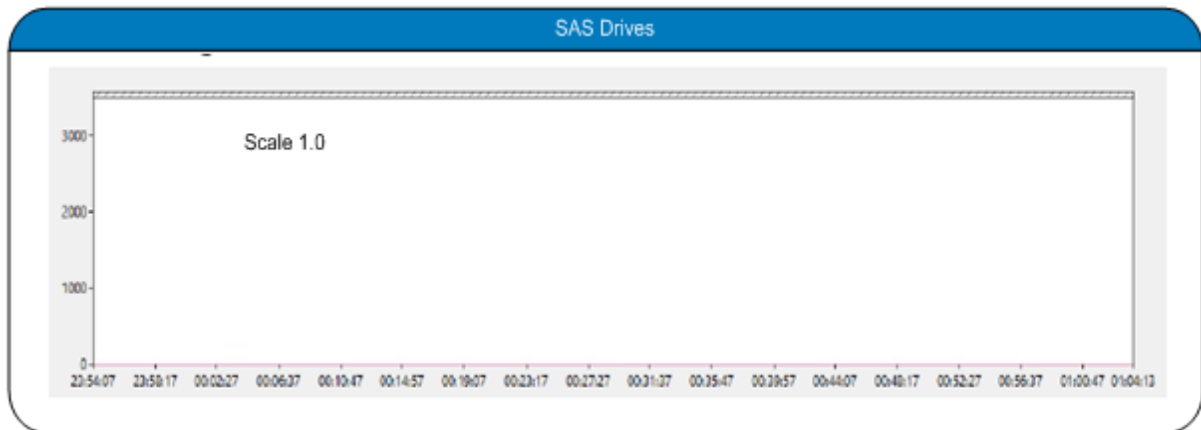
IOPS for PVS vDiskStore on SOFS



IOPS for User Data Share (SSD + SAS Drives)

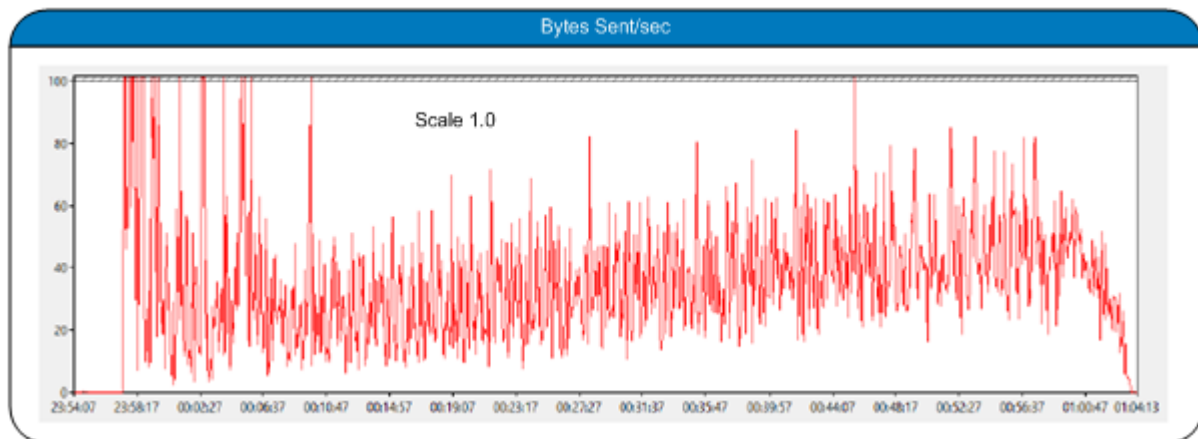


IOPS for User Data Share (2 x SSD drives)

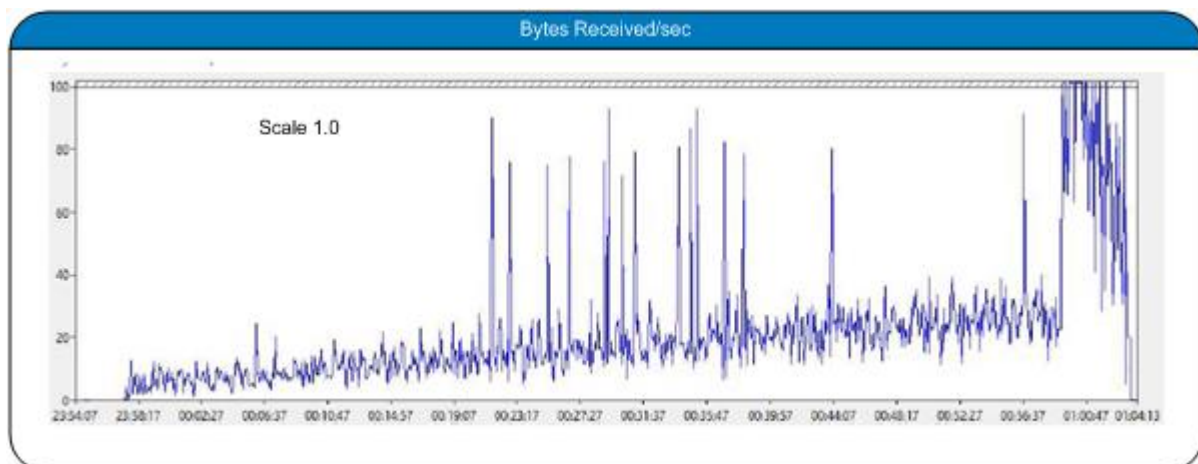


IOPS for User Data Share (22 xSAS drives)

The following graph shows the network utilization:



Bytes Sent/sec from the Storage controllers



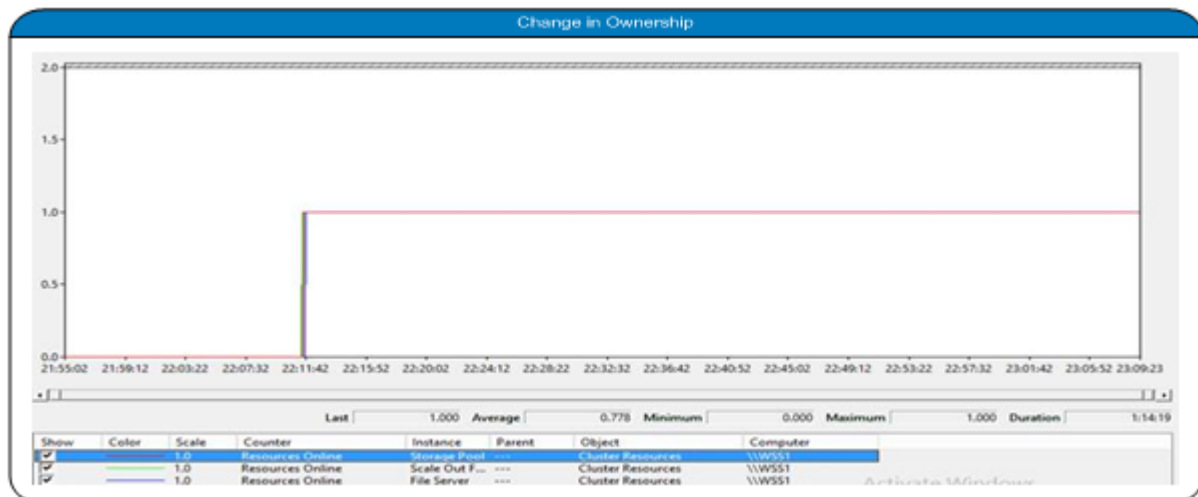
Bytes Received/sec by the Storage controllers

From above graphs it's clear that the storage performance is up to the mark as expected and CPU utilization very minimal. Most of the operations are served by SSD drives which are used for caching. The network utilization is also very minimal.

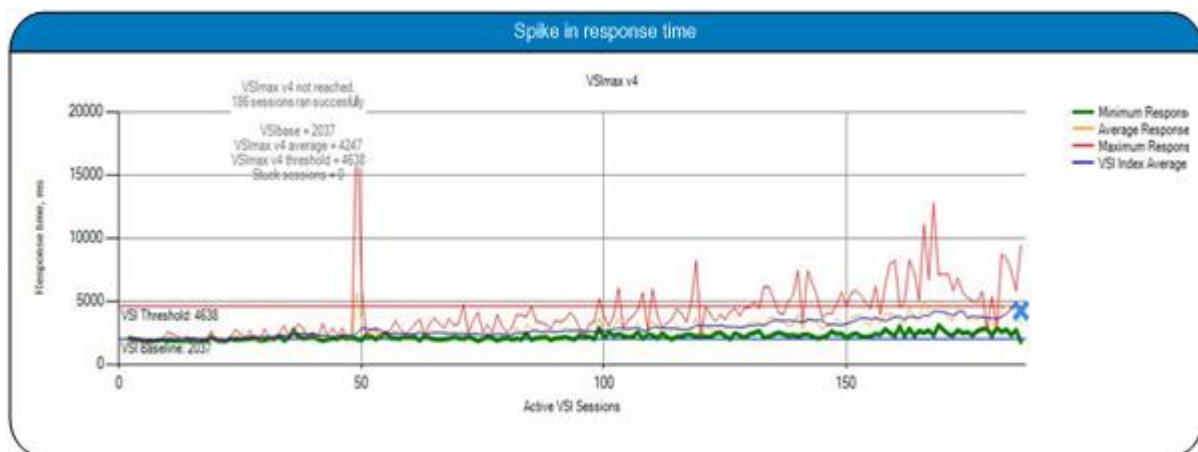
**Note:** Above storage statistics for user data share is in relation to the LoginVSI Medium Workload. The actual usage in production will vary from environment to environment based on end user activity.

In addition we also performed storage cluster failover testing in order to understand the impact on live user sessions. During failover there was no impact on user session as none of the sessions failed. A spike in response time is observed during the fail-over activity.

The following graph shows the change in ownership post failover as well as the spike in response time.



Ownership changes from Storage Head WSS2 to Storage Head WSS1



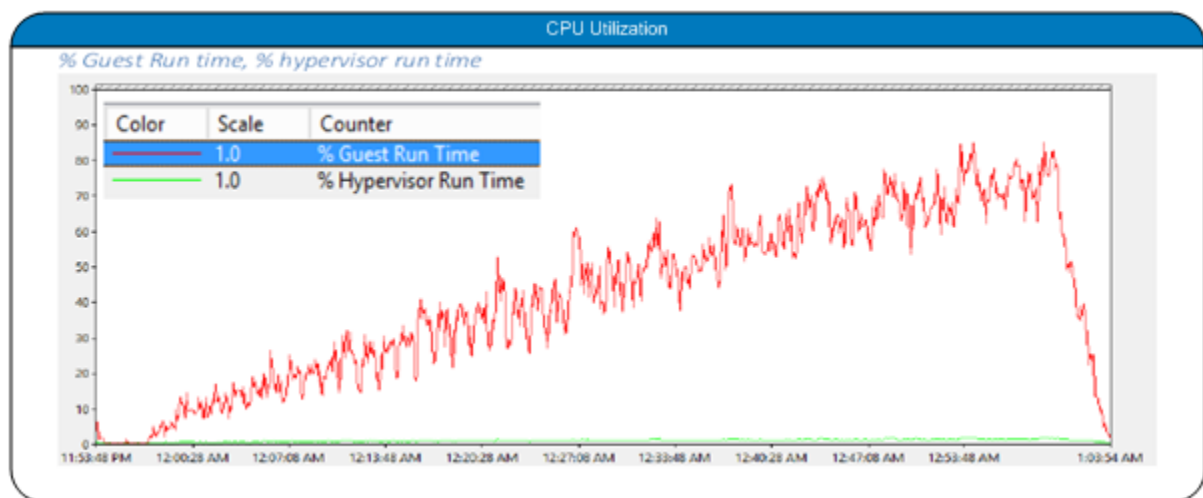
Spike in response time observed during failover

## Host Performance Results

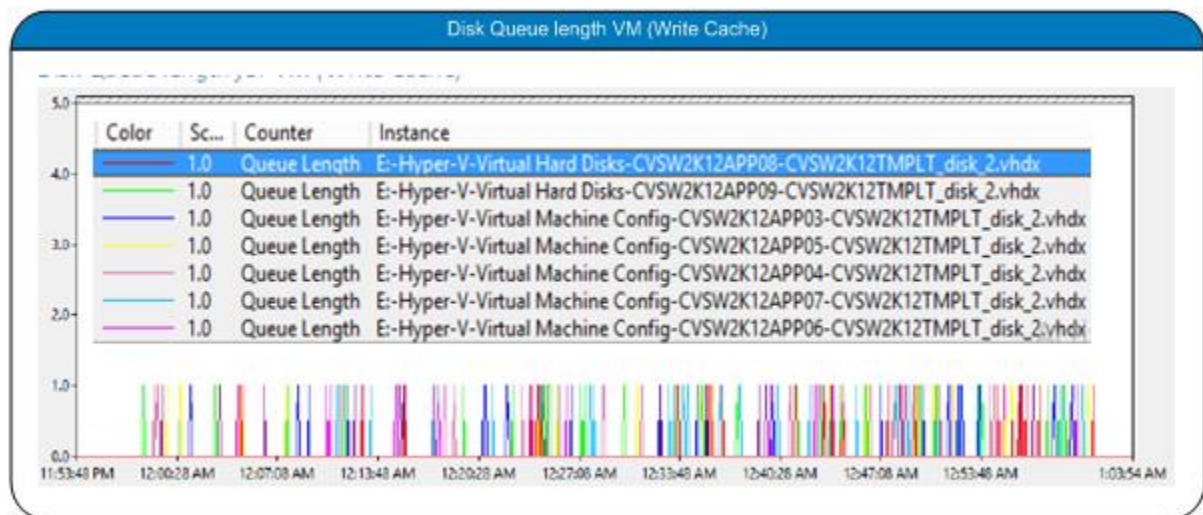
A Boston VDI Cluster BOS-CIWL4P-01 enterprise class server is dedicated to host the Hosted Shared Desktop workloads. One of the three SanDisk CloudSpeed 1000 SSDs is used for host OS installation. The remaining two SSDs are configured as Simple Space using Storage Spaces and store the WriteCache for the Hosted Shared Desktop VMs.

The single server scalability testing using the LoginVSI 4.0 “Medium Workload” revealed that each Boston VDI Cluster BOS-CIWL4P-01 host can sustain ~186 concurrent user sessions.

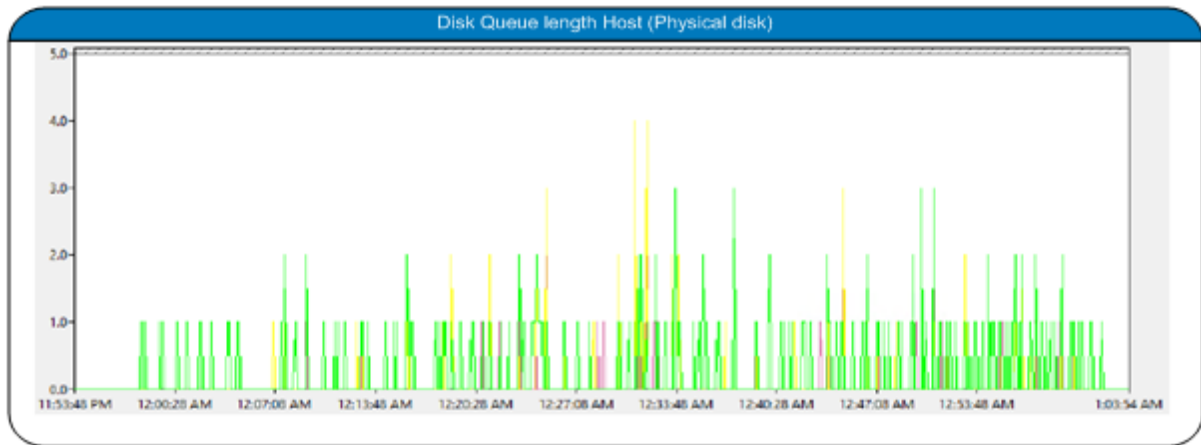
The following graph shows CPU utilization for Host and VMs.



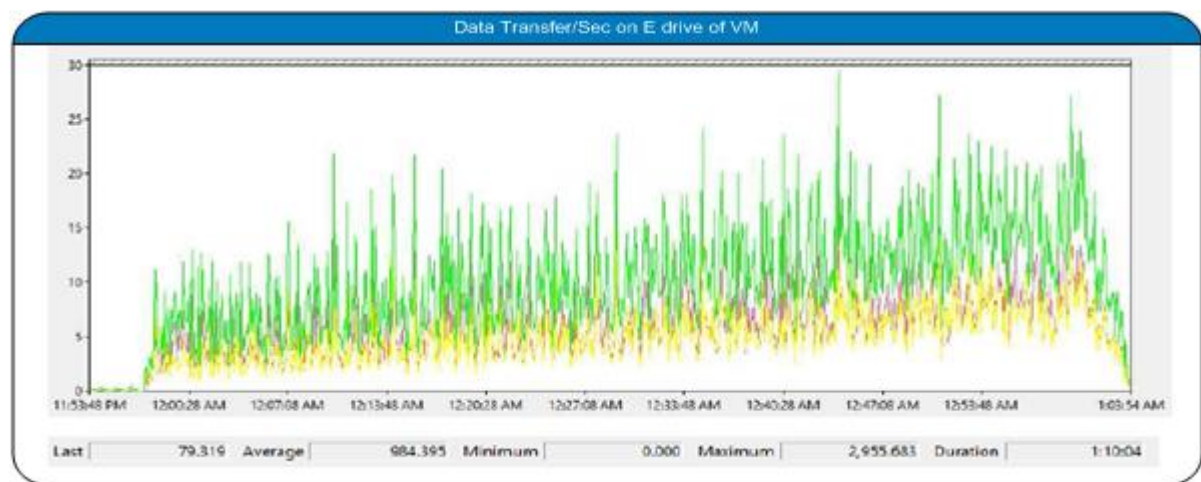
CPU Utilization by Host and Guest VMs



Disk Queue length for VM

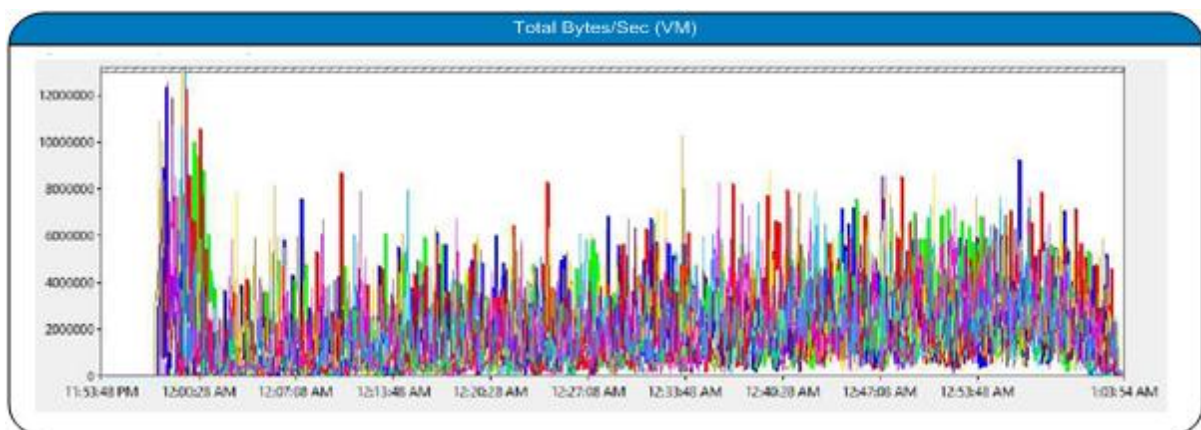


Disk Queue length for Physical server (Write Cache Drive)



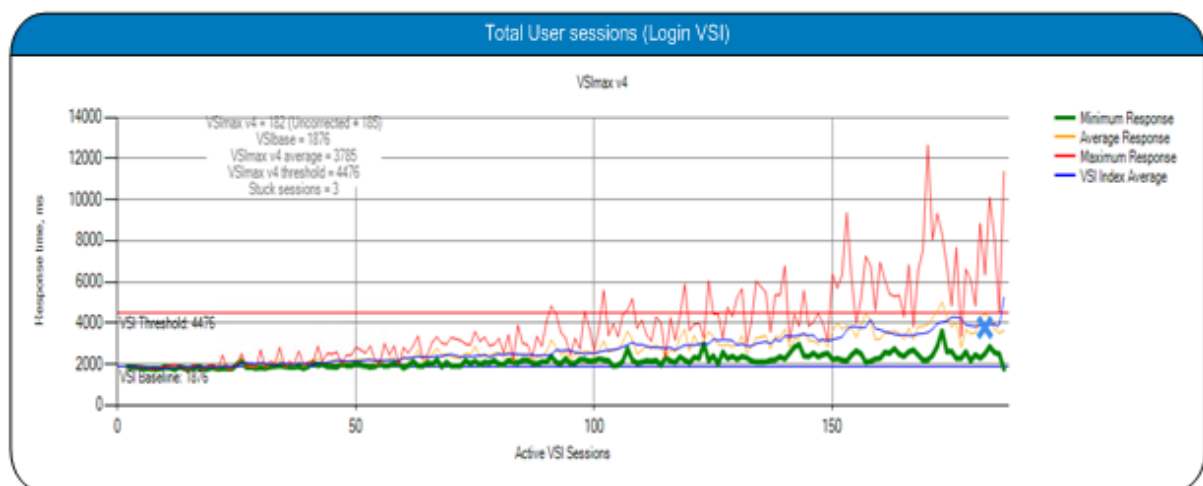
IOPS on WriteCache Drive

The following graph shows the network utilization:



Total Bytes/Sec per VM

The following graph shows the total user sessions run during the testing:



Total User Sessions

## Conclusion

The primary objective of testing was to validate that Citrix XenDesktop 7 supports Commodity Hardware and delivers a high performance virtual desktop at a price point lower or equivalent to that of standard PC. The defined success criteria were:

- **No server CPU utilization average to be over 90% while under load**
- **Storage and network to perform within guidelines**
- **180-200 users connect, complete a test run, and disconnect cleanly**

The testing was executed as planned, the success criteria were met, and it was shown that commodity hardware did meet the initial objective.



# **BOSTON**

**Servers • Storage • Solutions**

## Powered By



### UK Headquarters

Tel: +44 (0) 1727 876 100

E-mail: [sales@boston.co.uk](mailto:sales@boston.co.uk)

[www.boston.co.uk](http://www.boston.co.uk)

### India

Tel: +91 22 6700 0897

E-mail: [sales@bostonindia.in](mailto:sales@bostonindia.in)

[www.bostonindia.in](http://www.bostonindia.in)

### Germany

Tel: +49 (0) 89 9090 199-3

E-mail: [info@bostondeutschland.de](mailto:info@bostondeutschland.de)

[www.bostondeutschland.de](http://www.bostondeutschland.de)