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Horizon View 7 with Instant Clone on Hitachi Unified Compute Platform HC

Reference Architecture Guide

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Revision History

Revision	Changes	Date
AS-590-00	**Initial release**	**March 17, 2017**
AS-590-01	**Included Brocade switch information and updated Solution Overview**	**April 25, 2017**

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Horizon View 7 with Instant Clone on Hitachi Unified Compute Platform HC

Reference Architecture Guide

Use this reference architecture guide to design a hyper-converged solution for VMware Horizon View 7 with Instant Clone on Hitachi Unified Compute Platform HC V240F (UCP HC V240F) for VDI environment.

This describes the performance of Microsoft® Windows® 10 Virtual Desktops and Microsoft RDSH remote sessions on a 4-node UCP HC V240F compute vSAN cluster with a mixture of Power workers, Knowledge workers and Task workers using Instant Cloning features.

This environment uses integrated servers, storage systems, and network with storage software in a unified compute converged solution for VDI environment.

The 4-node UCP HC V240F provides better performance and throughput with low latency. The dedicated UCP HC V240F nodes run ESXi 6.0 U2 with VMware vSAN 6.0 clusters using VMware Horizon View 7.

This VDI environment solution uses Microsoft Windows 10 virtual desktops and Windows Server® 2012 R2 RDSH remote sessions.

Performance Validation for this solution used the following benchmarking tool:

- Login VSI 4.1.15

This document is for the following audiences:

- Corporate Desktop administrators
- Storage administrators
- IT help desk
- IT professionals such as a Pre-sale solution team
- Customer CIO

To use this reference architecture guide, you need familiarity with the following:

- VMware Horizon View 7
- UCP HC V240F
- Hyper-Converged Concept
- VMware vSAN
- All Flash Storage
- Login VSI 4.1.15
- VMware esxtop
- VMware esxi 6.0 U2
- Microsoft Remote Desktop Session

Note — These practices were developed in a lab environment. Many things affect production environments beyond prediction or duplication in a lab environment. Follow recommended practice by conducting proof-of-concept testing for acceptable results before implementing this solution in your production environment. Test the implementation in a non-production, isolated test environment that otherwise matches your production environment.

Solution Overview

This describes the solution overview for Horizon View 7 with Instant Clone on UCP HC V240F.

Many businesses are constrained by legacy IT infrastructure that is not well suited for VDI initiatives. Siloed data centers, composed of independent compute, storage, and networks with distinct administrative interfaces are inherently inefficient, cumbersome and costly.

Each platform requires support, maintenance, licensing, power, and cooling-not to mention a set of dedicated resources capable of administrating and maintaining these elements. Rolling out a new application such as VDI becomes a manually intensive, time-consuming proposition involving a number of different technology platforms, management interfaces, and operations teams.

Expanding system capacity can take days or even weeks, and require complex provisioning and administration. Troubleshooting problems and performing routine data backup, replication, and recovery tasks can be just as inefficient.

While grappling with this complexity, organizations also need to address challenges that are unique to VDI, including the following:

1. Difficulty sizing VDI workloads upfront, due to the randomness and unpredictability of user behavior
2. Periodic spikes in demand, such as "login storms" and "boot storms", that may significantly degrade performance if not properly handled
3. High cost of downtime in the event of an outage

UCP HC addresses each of these challenges by providing a scalable, building block style approach to deploying infrastructure for VDI, offering the enterprise predictable cost, and delivering a high-performing desktop experience to end users.

The workloads used for this solution are based on LoginVSI and extended the functionality of the LoginVSI base of the Task, Knowledge and Power workload tests.

TABLE 1. WORKLOAD APPLICATION DEFINITION

Workload Type	Task, Knowledge, and Power
Applications Exercised	■ Adobe Acrobat ■ Adobe Flash ■ FreeMind ■ Microsoft Excel® ■ Microsoft Internet Explorer® ■ Microsoft Outlook® ■ Microsoft PowerPoint® ■ Microsoft Word ■ Photo Viewer ■ 7-Zip ■ 360p Video Playback ■ 720p Video Playback

TABLE 2. WORKLOAD PROFILE FOR WINDOWS® 10 VDI USERS

Workload Profile	VM OS	vCPU	VM Memory
Task Worker	Windows 10	1	2 GB
Knowledge Worker	Windows 10	2	3 GB
Power Worker	Windows 10	2	4 GB

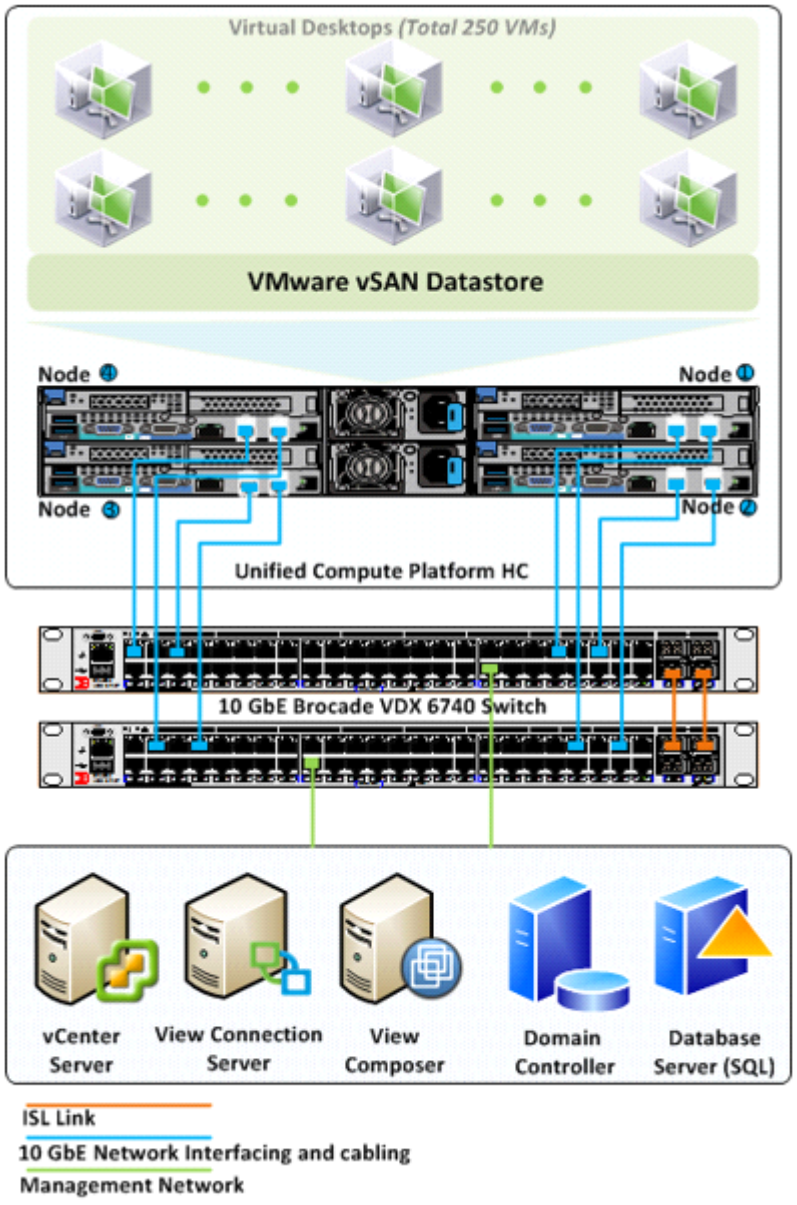
TABLE 3. WORKLOAD PROFILE FOR WINDOWS SERVER® 2012 R2 RDSH USERS

Workload Profile	VM OS	vCPU	VM Memory
Task Worker	Windows Server 2012 R2	1	2 GB
Knowledge Worker	Windows Server 2012 R2	2	3 GB
Power Worker	Windows Server 2012 R2	2	4 GB

Logical Design

Figure 1 shows the high-level infrastructure for this solution.

Figure 1



Key Solution Components

The key solution components for this solution are listed in Table 4, Table 5, and Table 6.

Hardware Components

TABLE 4. HARDWARE COMPONENTS

Hardware	Detailed Description	Version	Quantity
Hitachi Unified Compute Platform HC all-flash appliance V240F	■ 4-node chassis ■ Intel ® Xeon ® CPU E5-2680 v3 @2.50Ghz (per host) ■ 2 × 10GbE NIC ports: ■ NIC options: ■ RJ-45 connections: Dual port 10GigE Base-T Intel X540 OCP Mezzanine card ■ SFP+ connections: Dual port 10GigE Intel 82599ES SFP+ OCP Mezzanine Card ■ 1 × 10/100 Base-T RJ45 port for remote (out-of-band) management 1 × 800GB SSD for Cache Tier ■ 2 fully redundant power supplies ■ LSI SAS 3008 RAID controller mezzanine card ■ Fault-tolerant Virtual SAN datastore	BIOS Firmware: S2S_3A18 BMC: 3.36.00	1
Brocade Top-of-Rack 10 GbE switch	■ 10 GbE ports (at least 16 ports) VDX6740	■ nos 7.0.0.a	2

Software Components

TABLE 5. SOFTWARE COMPONENTS

Software	Version	Function
VMware vCenter server	6.0. U2, Build 3634788	Management console
VMware ESXi	6.0. U2, Build 3620759	Operating system
VMware vSphere Client	6.0. U2, Build 3634788	Management console
Microsoft® Windows Server® 2012	Datacenter, R2	Operating system
Microsoft SQL Server®	2012 SP1	Database server
Microsoft Windows® 10	Enterprise Edition, SP1	Operating system
VMware Horizon View	VMware Horizon View 7.0.0, Build 3634043	Management console
VMware Horizon Client	3.5.2, Build 3634043	Management console
Login VSI	4.1.15.7	Benchmarking tool

TABLE 6. VMWARE HORIZON VIEW 7 COMPONENTS

Server Name	vCPU	Memory	Disk Size	Disk Type	Operating System
View Connection Server	4	16 GB	40 GB	Eager ZeroedThick	Windows Server 2012 R2
View Composer	4	12 GB	40 GB	Eager ZeroedThick	Windows Server 2012 R2
Domain Controller	2	8 GB	40 GB	Eager ZeroedThick	Windows Server 2012 R2
Database Server	4	16 GB	40 GB (operating system) 60 GB (data)	Eager ZeroedThick	Windows Server 2012 R2 Microsoft SQL Server 2014 SP1

All of these virtual machines were configured with LSI Logic SAS Controller. The domain controller was deployed to support user authentication and domain services for the VMware Horizon infrastructure.

The compute nodes were configured as follows:

- **UCP HC V240F Cluster:** All four VMware ESXi 6.0 U2 nodes for task, knowledge, and power user desktops.
- VMware Horizon management and administration components were placed on a separate infrastructure cluster

Unified Compute Platform HC

Unified Compute Platform HC

Unified Compute Platform HC is integrated compute, storage, virtualization and high availability in a simple, scalable, easy-to-manage hyper-converged infrastructure powered by VMware vSphere and Virtual SAN (VSAN)

VMware Horizon

VMware Horizon transforms static desktops into secure, virtual workspaces that can be delivered on demand. Provision virtual or remote desktops and applications through a single VDI platform to streamline management and easily entitle end users.

Dynamically allocate resources with virtual storage, virtual compute and virtual networking to simplify management and drive down costs. With Horizon, reduce day-to-day operations costs with a single platform that allows you to extend virtualization from the data center to your devices.

LoginVSI

Login VSI successfully predicts, validates and manages the performance of virtualized desktop environments

Login VSI makes it easy to load test, benchmark, and plan capacity to improve end user experience and productivity for even the most complex virtualized desktop environments. Login VSI tests performance using virtual users, so your real users benefit from consistently great performance.

With Login VSI, you can gain performance insights that enable you to:

- Predict the performance impact of necessary updates and upgrades
- Know the maximum user capacity of your current infrastructure
- Understand the end users' perspective on performance

With agentless installation and minimal infrastructure requirements, Login VSI works in any Windows-based virtualized desktop environment including VMware Horizon View, Citrix XenDesktop and XenApp, and Microsoft Remote Desktop Services (Terminal Services).

VMware Virtual SAN 6.0 (vSAN)

vSAN is the industry-leading software that powers hyper-converged Infrastructure solutions.

VMware hyper-converged software combines compute, networking, storage and management resources into a hyper-converged infrastructure appliance to create a simple, easy to deploy, all-in-one solutions.

Brocade

Brocade VDX switches are designed to help organizations stay ahead of application-driven network changes by enabling agile growth through a scale-out architecture. This approach offers three key benefits. First, it enables network expansion as a business grows over time. Spine switches can horizontally scale as the number of leaf switches increase. Second, scale-out architecture also enables the creation of resilient network fabrics, eliminating a single point of failure and potential downtime. Third, and most important, a scale-out network architecture delivers a compelling economic benefit. High density switches reduce power, cooling, and data center space providing a lower Total Cost of Ownership (TCO).

Solution Design

The infrastructure servers for VMware Horizon 7 and UCP HC V240F used for this solution are placed on separate infrastructure clusters with dedicated resources.

Storage Infrastructure

SAN Architecture for this reference architecture is not a requirement as UCP HC V240F is used with VMware vSAN, which is local drive clustering.

Deploy the Solution

To deploy this solution requires doing the following procedures.

Deploy VMware Horizon View VMs

VMware Horizon View is the virtual desktop host platform for VMware vSphere that offers advantages for both end users and IT staff. End users are no longer locked into a particular machine and can access their system and files from anywhere at any time. Horizon View transforms IT by simplifying and automating desktop and application management.

Install and configure the following core Horizon View components:

1. **View Connection Server**: The most important VMware View component is the View Connection Server. The View Connection Server is a connection broker, and is responsible for authenticating clients and connecting them to the appropriate virtual desktop.

2. **View Administrator:** The View Administrator or management console is a web component for deploying and managing virtual desktops.

3. **View Client:** Establishes a connection from physical devices to a View Connection Server. View Client is installed on the user's devices (such as thin clients, zero clients, mobile devices, laptops, desktops, or any other devices supported by View Client).

4. **View agent:** The application installed on virtual desktops that allows VMware View to manage access from clients.

5. **View Composer:** This is an optional application, but is necessary to manage all of the operations associated with linked clones (such as pool creation, refresh, recompose, and rebalance). During this test, View Composer was installed as a standalone independent server.

Deploy LoginVSI for Load Generation

The launchers and Login VSI environment are configured and managed by a centralized management console. Three test profiles were used:

- **Task Worker Workload** – includes segments with Microsoft Outlook®, Excel®, and Internet Explorer®, Adobe Acrobat, and PDF Writer. The TaskWorker 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.
- **Power Worker Workload** – includes segments with Microsoft Outlook, Word, PowerPoint, and Excel; Adobe Acrobat, FreeMind, PhotoViewer, Doro PDF Writer; and includes viewing several 720p movies and many file copy and delete operations. The Power Worker workload places an even more severe demand on the environment and the storage than the Knowledge Worker workload, with more intense operations within Excel.

Deploy Master Image for Windows 10 Virtual Desktop

- Create a Master image for Windows 10
- Create a Virtual Machine
- Install the Windows 10 Operating System
- Configure the Operating System
- Run VMware Windows 10 Optimizer
- Install VMware Tools
- Install View Agent
- Shutdown VM
- Snapshot VM

Deploy Windows 10 Instant Clones - Automated Desktop Pool

Provision the Windows 10 instant clones for Power, Knowledge and Task users:

1. Go to **View Administrator**, click select and add **View Connection Server**, and **Add vCenter to View Administrator**.

2. Create a new **Desktop pool** using the **Automated Desktop pool** option for Instant clone.

3. Proceed with naming pattern for your Desktop pool (for example **Power-Pool**).

4. Select Windows 10 Snapshot for **Power, Knowledge** and **Task** users to create three different pools.

5. Select storage option as UCP HC V240F **vSAN Datastaore** to deploy instant clones.

Prepare the Windows Server 2012 R2 RDS Host

- Create a Virtual Machine
- Install the Windows 2012 R2Operating System
- Configure the Operating System
- Enable the High Performance Power option
- Run VM Optimizer for Server 2012 R2
- Install DOTNET 4 software
- Disable "event tracker shutdown" in gpedit.msc>Template>System
- Disable the Server Manager option
- Install VMware Tool
- Install KMS office 2013
- Add LoginVSI group users to remote desktop option to access RDS host remotely
- Install View Agent for Automated Farm
- Shutdown the VM
- Snapshot the VM

Deploy RDS Farm - Automated Linked Clones

In this solution, we are using View Composer. Therefore, SysPrep requires a Customization Specification in vCenter because QuickPrep is not supported with RDS farms.

Pre-requisite

From the vCenter, Home page, click Customization Specification Manager and prepare Windows SysPrep.

To create an Automated farm of linked clones, do the following:

1. Make sure your RDS View Agents have the VMware Horizon View Composer Agent feature installed.
2. In View Administrator, on the left, expand **Resources** and click **Farms**.
3. On the right, click **Add**.
4. In the Type page, select Automated Farm and click Next.
5. In the vCenter Server page, select the vCenter Server and View Composer and click Next.
6. In the Identification and Settings page, enter a name for the Farm. A folder with the same name will be created in vCenter
7. **Allow users to choose protocol** should be set to **No**
8. Set Empty session timeout to 1 minute. Set When timeout occurs to Log off. You usually want the session to end when users close all of their applications
9. For Log off disconnected sessions, specify a disconnect timer. This is in addition to the idle timer configured in View Configuration > Global Settings
10. Check the box next to Allow HTML Access and click Next
11. In the Provisioning Settings page, enter a naming pattern. Make sure that the name includes {n:fixed=3} . In this solution we have prepared three RDS hosts for Power, Knowledge, and Task Users
12. Enter the number of machines to create and click Next
13. In the Storage Optimization page, click Next
14. In the vCenter Settings page, click Browse next to each option and make a selection
15. Select datastore UCP HC vSAN
16. Select a customization specification and click Next
17. In the Ready to Complete page, click Finish.
18. Prepare Automated Desktop Pools by using RDS Hosts created in the previous steps and name these pools Power, Knowledge, and Task.

Engineering Validation

This explains how the environment was validated.

Solution Execution

Execution of this solution consists of the following procedures.

LoginVSI Test Run for Windows 10 VDI and RDS Pool

Launch and configure the Management Console with following workload profiles.

1. Run Task workload profile for VDI pool name 'Task Pool' with 62 sessions.
2. Run Knowledge workload profile for VDI pool name 'Knowledge pool' with 63 sessions.
3. Run Power workload profile for VDI pool name 'Power pool' with 125 sessions.

Execute test runs for all three workload profiles with the following configuration:

- Start the tests with 10 Launchers on the target desktop pool with the desired number of sessions for each test.
- Allow the tests to run for 2880 seconds (48 minutes) and 2 minutes for logging off all sessions for each of the tests.
- Collect and check the LoginVSI logs for each of the tests.

Test Methodology

Test Objectives

The series of tests that were run for this reference architecture are designed to capture the performance and data reduction capabilities of Unified Compute Platform HC V240F for Windows 10 VDI users and Windows Server 2012 RDS users.

There are two scenarios taken into consideration to capture the performance results separately. First, a Windows 10 VDI pool of 250 VMs was deployed and the results were captured. Later this pool was erased and the UCP HC V240F vSAN cluster was recreated to deploy a new RDS pool of 250 VMs to capture performance results separately.

Test Case 1: Deduplication and Compression Testing

The deduplication and compression testing highlights the data footprint reduction available with real-world data.

Test Case 2: Boot Storm Testing

Boot storms occur when all virtual desktops are powered on simultaneously. The boot storm puts a heavy load on the storage system because all of the virtual desktops are competing for the shared storage resources.

During boot storm testing, all 250 virtual desktops were powered on directly from vCenter to show overall response of the system simulating a worst-case power on scenario after a datacenter power outage.

- Configuration 1 — 250 Windows 10 Virtual Desktops were powered on.
- Configuration 2 — 250 Windows Server 2012 R2 RDS machines were powered on.

Test Case 3: Login Storm, Steady State, and Logoff Testing

Login storms occur when users log in to the virtual desktops at the same time. Unlike boot storms, login storms cannot be avoided in an environment where end users start work at the same time.

Steady state occurs when users interact with the desktop. The IOPS for steady state varies because user activities differ. Login VSI medium workload was used to measure the IOPS during steady state.

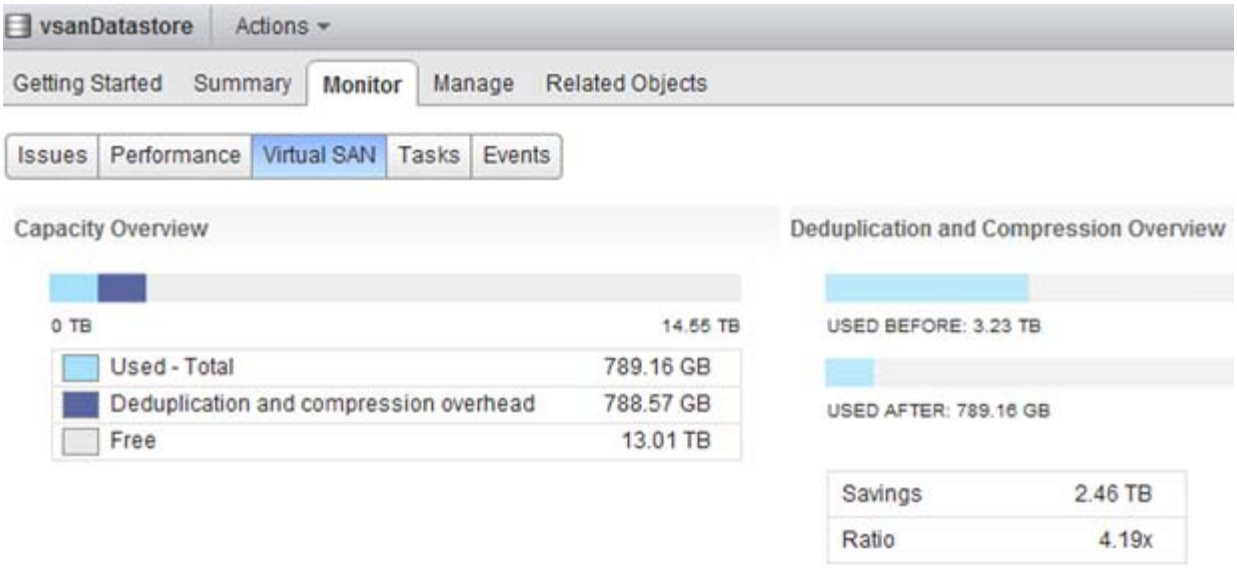
LoginVSI enabled testing of login storms, and generated the workload for the steady state lab validation testing.

- Configuration 1 — 250 Windows 10 Virtual Desktops were under three workload profiles; Task, Knowledge, and Power for 2880 minutes with each profile using LoginVSI.
- Configuration 2 — 250 Windows Server 2012 R2 RDS machines were under three workload profiles; Task, Knowledge, and Power for 2880 minutes with each profile using LoginVSI.

Test Results - Deduplication and Compression

Figure 2 and Figure 3 show the test results before and after deduplication and compression for 250 Virtual Desktops.

Figure 2



Deduplication and Compression Overview

- In Figure 3 Deduplication and compression is enabled for vSAN clusters before deployment of the VDI and RDS pools.
- Deduplication and compression overview is shows the following:
- Before compression and deduplication, the storage size was 3.23 TB, and after the deduplication and compression the size was reduced to 789.16 GB.
- Here the savings is 2.46 TB, that is, the ratio is 4.19 times.

Figure 3

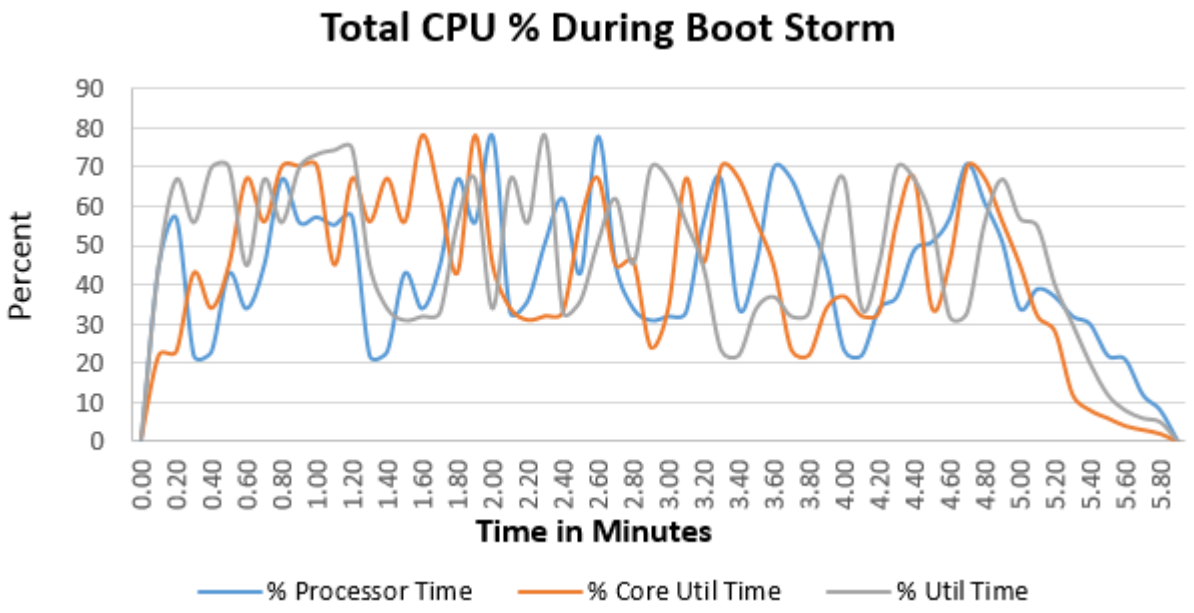
The previous chart is used to calculate the capacity breakdown before it was deduplicated and compressed. Similar test results have been observed for 250 RDS VMs.

Test Results - Boot Storm

These are the test results for the environment operating during a boot storm. The 250 users boot storm took five minutes eighty seconds to complete. This time was measured from when the Windows 10 desktops were flagged available in Horizon View Administrator.

Multiple performance metrics were collected using the `esxtop` command. Figure 4, Figure 5, and Figure 6 show the performance data for the 250 user boot storm.

Figure 4



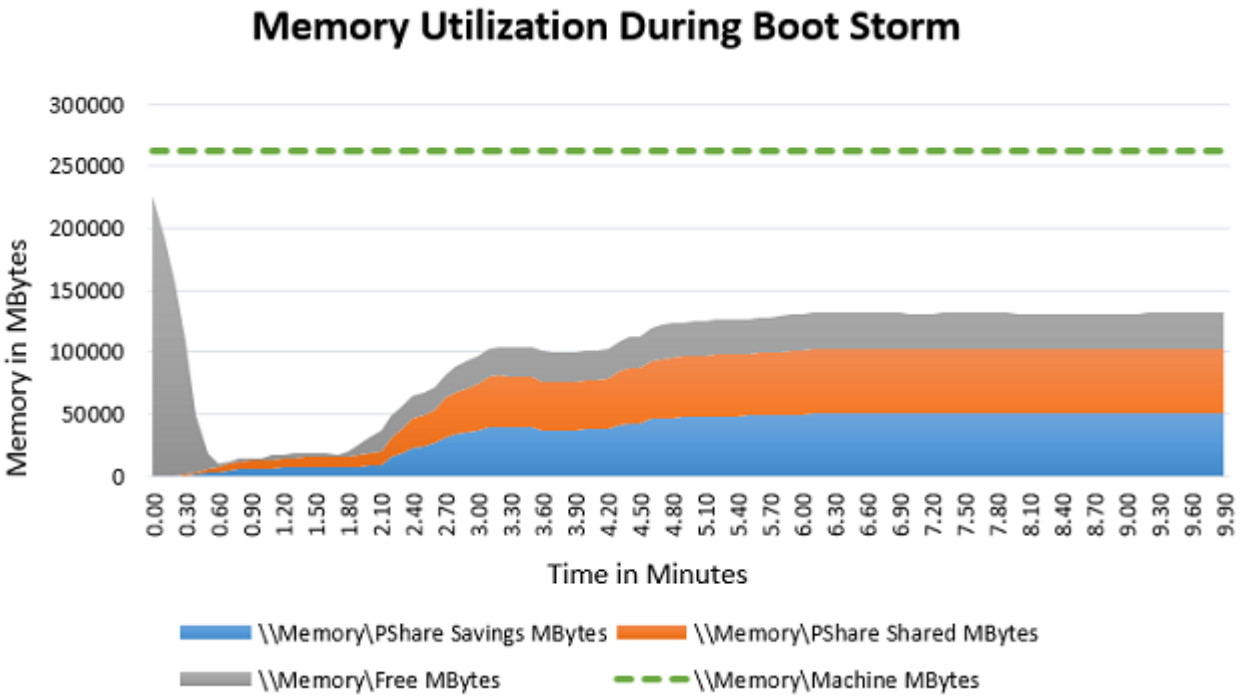
- The performance metrics show the following:
  - Percent utilization peaks at approximately 78% during boot storm.

Hypervisor Memory Performance

Four vSAN cluster nodes were tested, each containing 262 GB of RAM. A 250 Windows 10 user desktop pool was split between 4 nodes, allowing commitment of 2048 MB, 3072 GB, and 4096 MB RAM to Task, Knowledge, and Power Users respectively.

62 Task VVMs with 2048 MB, 63 Knowledge VMs with 3072 MB, and 125 Power VMs with 4096 MB (126976 MB, 193536 MB, and 512000 MB respectively) total approximately 832512 MB (832 GB).

Figure 5



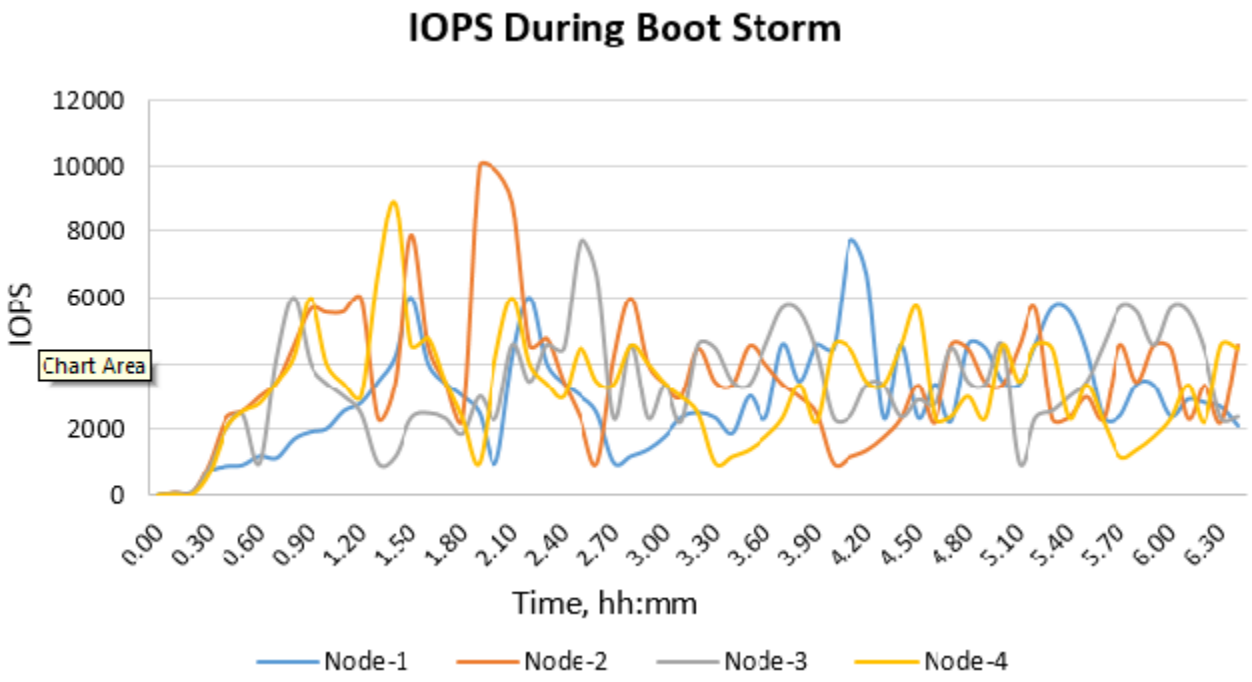
The performance metrics show the following:

- During a boot storm, shared virtual machine memory reached approximately100000 MB. This shows memory utilization during a boot storm can vary.
- PSshare saving memory reached 50000 MB peaks during a boot storm.

Boot Storm IOPS

To simulate a boot storm, the 250 virtual desktops were powered on simultaneously from vCenter. Figure 6 shows the UCP HC V240F storage (vSAN) characteristics during the boot storm – the all flash UCP HC V240F delivered 10,000 IOPS under peak load during this test at an average of 6,000 IOPS per VM.

Figure 6

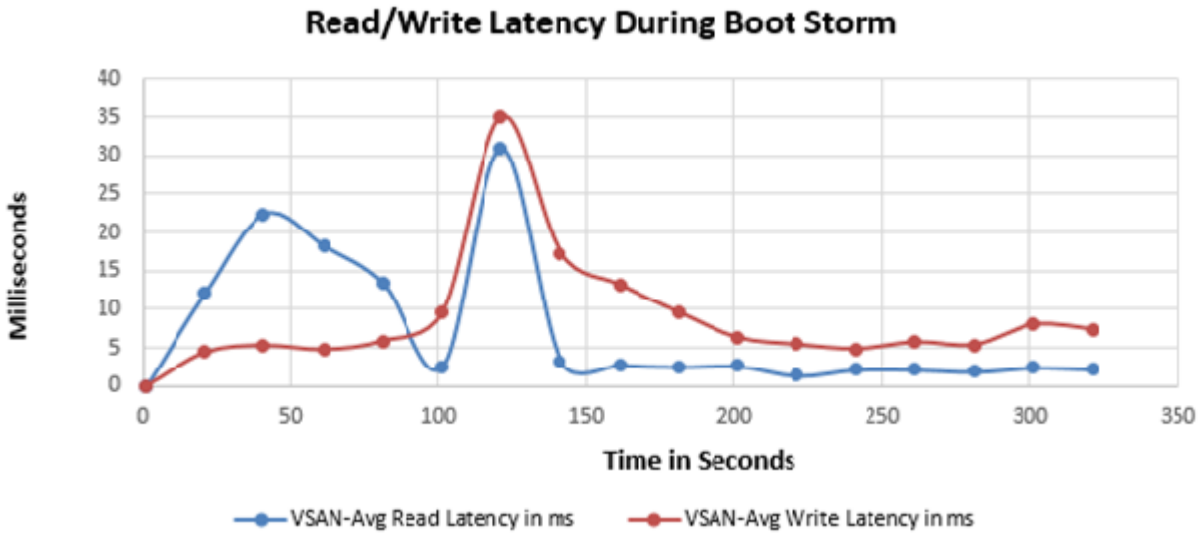


vSAN Storage Performance

Figure 7 shows the storage latency statistics. The performance metrics show the following:

- During boot storm, average read latency increases to 35ms
- During boot storm, average write latency increases to 30ms

Figure 7



Test Results - Login and Steady State

These are the test results for the environment operating during login storm and steady state operations.

Compute Infrastructure

Multiple performance metrics were collected from the ESXi hypervisors during the test operations. Figure 8 through Figure 12 show the performance data for the 250 user test operations.

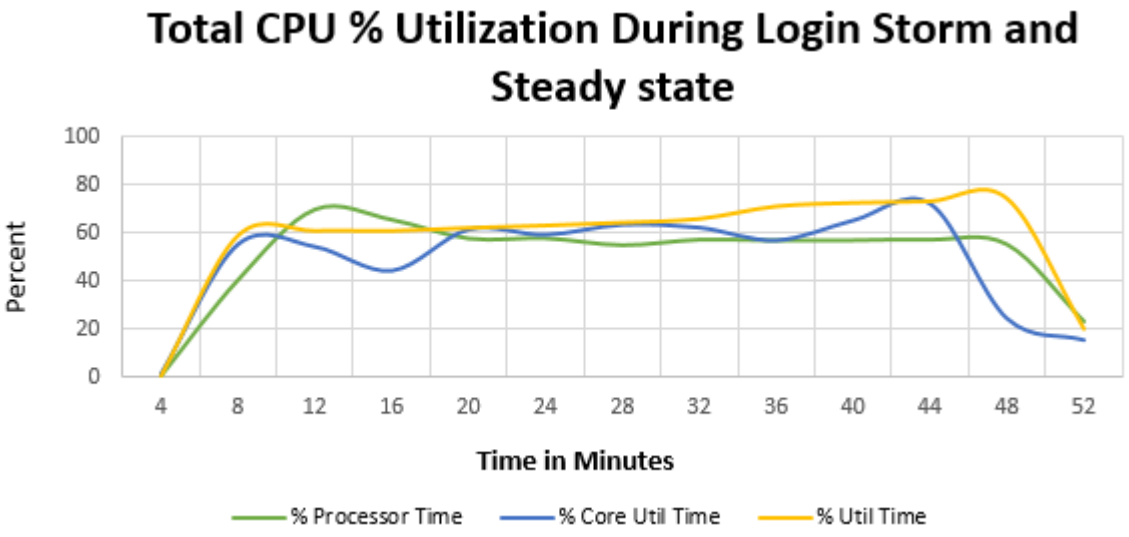
Hypervisor CPU Performance

Figure 8 shows the physical CPU metrics collected on the ESXi hypervisors while running test operations for 250 RDS users.

- There are two operations that occur during this test executed by LoginVSI:
  - Login storm (minutes 1-48)
  - Steady state (minutes 48-50)
- The performance metrics show the following:
  - Percent utilization peaks at approximately 72% during login storm.
  - Percent utilization peaks at approximately 63% during steady state.

This shows that there is still headroom on the UCP HC V240F vSAN to support bursts in workloads while still maintaining acceptable end user performance.

Figure 8



Hypervisor Memory Performance

During Login storm and steady state, memory utilization is captured with esxtop for all 250 Windows 10 Virtual Desktops:

- 62 Task VMs with 2048 MB per virtual machine,
- 63 Knowledge VMs with 3072 MB each
- 125 Power VMs with 4096 MB each

This corresponds to 126976 MB, 193536 MB, and 512000 MB respectively, and totals 832512 MB (approximately 832 GB).

Figure 9

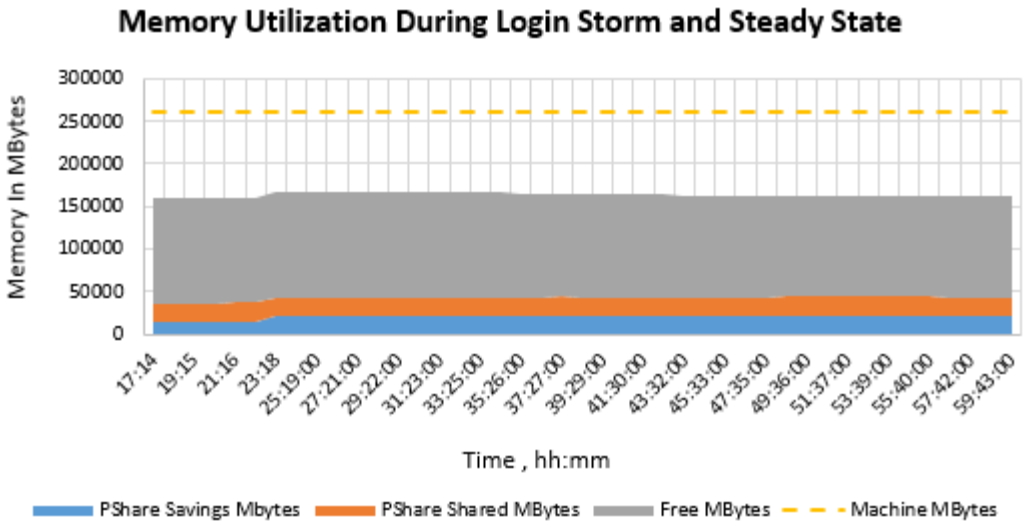
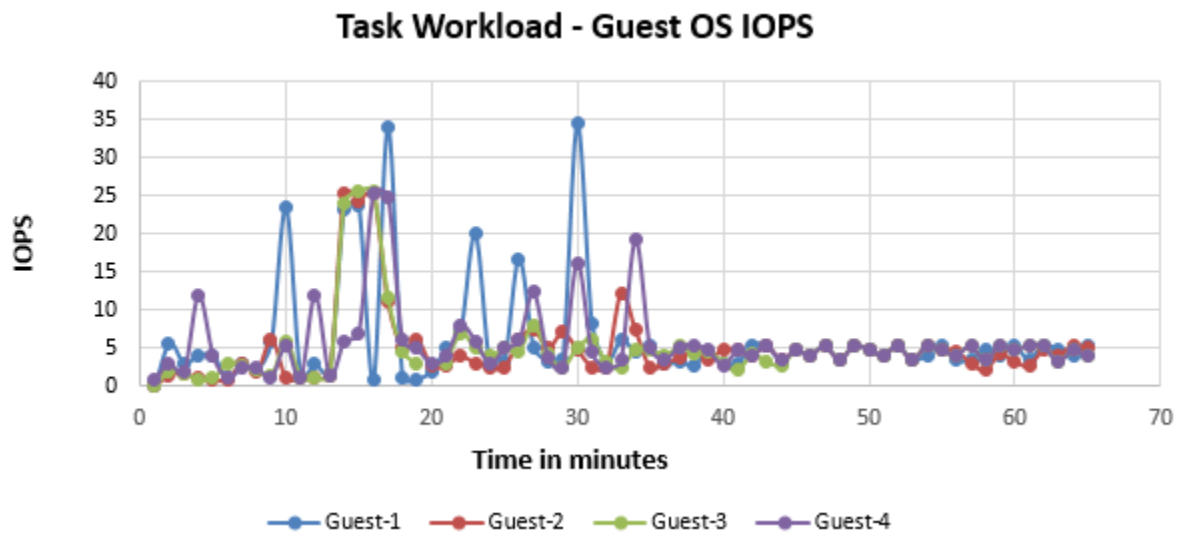


Figure 9 shows the memory utilization within the environment during the test operations. The performance metrics show the following:

- During Login storm, shared virtual machine memory reached 150000 MB and became stable.
- During steady state the PShare Saving and Shared memory was stable throughout.
- Guest OS IOPS for Task, Knowledge, and Power workload are shown in Figure 10 and Figure 11.

Figure 10



- Figure 10 shows Guest IOPS for four Task Windows 10 virtual desktops (Guest-1, Guest-2, Guest-3, and Guest-4).
- Guest-1 IOPS reached to a peak value of 34 during login storm
- Average IOPS for task workload during login storm was 7
- During steady state the average guest OS IOPS was 5

Figure 11

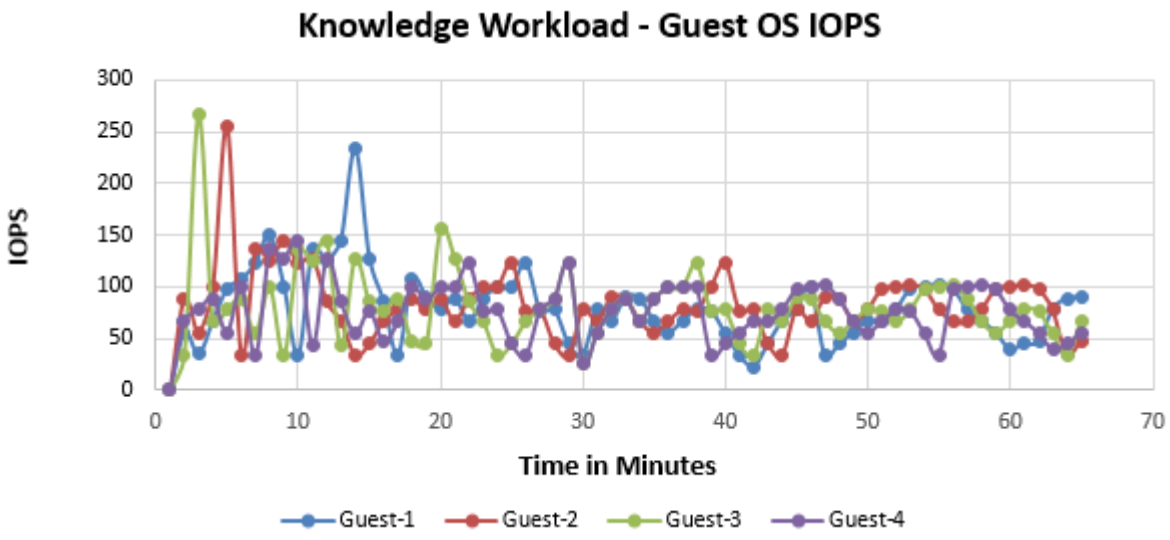


Figure 11 shows Guest IOPS for four Knowledge Windows 10 virtual desktops (Guest-1, Guest-2, Guest-3, and Guest-4).

- Guest-3 IOPS reached to a peak value of 267 during login storm
- Average IOPS for task workload during login storm was 89
- During steady state the average guest OS IOPS was 78

Figure 12

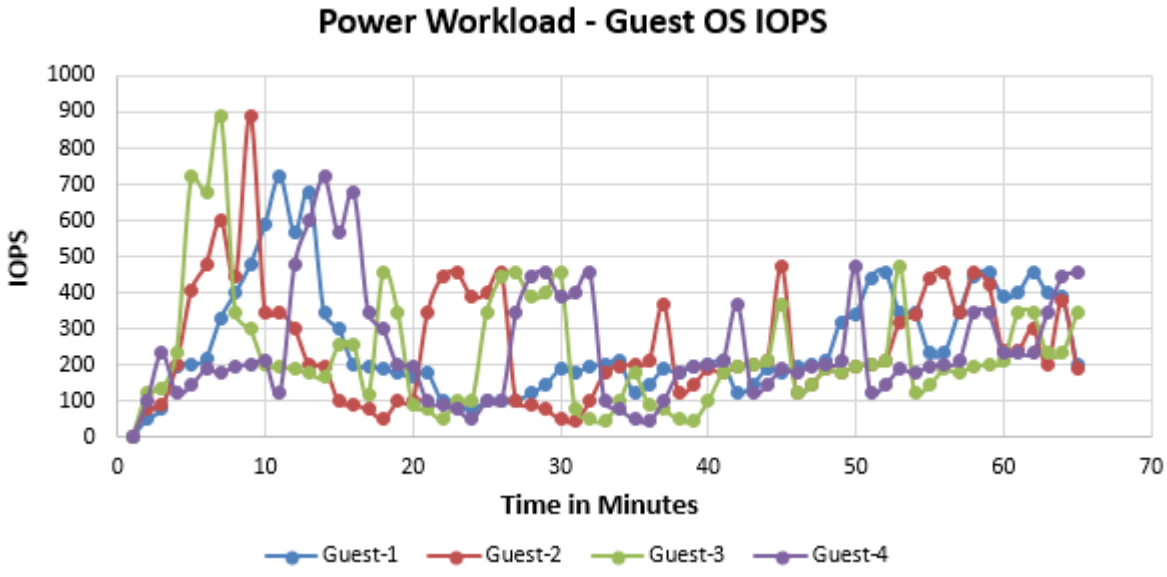


Figure 12 shows Guest IOPS for 4 Power Windows 10 virtual desktops (Guest-1, Guest-2, Guest-3, and Guest-4).

- Guest-3 IOPS reached a peak value of 888 during login storm
- Average IOPS for task workload during login storm was 456
- During steady state the average guest OS IOPS was 444

Login VSI - Test Results

LoginVSI tests were executed on 250 instant-clone desktop VMs hosted on four node vSAN cluster configured on UCP HC V240F. Task, Knowledge, and Power users performance is represented by the Login VSI Analyzer score and latency values are shown in the following LoginVSI graph.

LoginVSI Response - Task Worker Workload

Figure 13

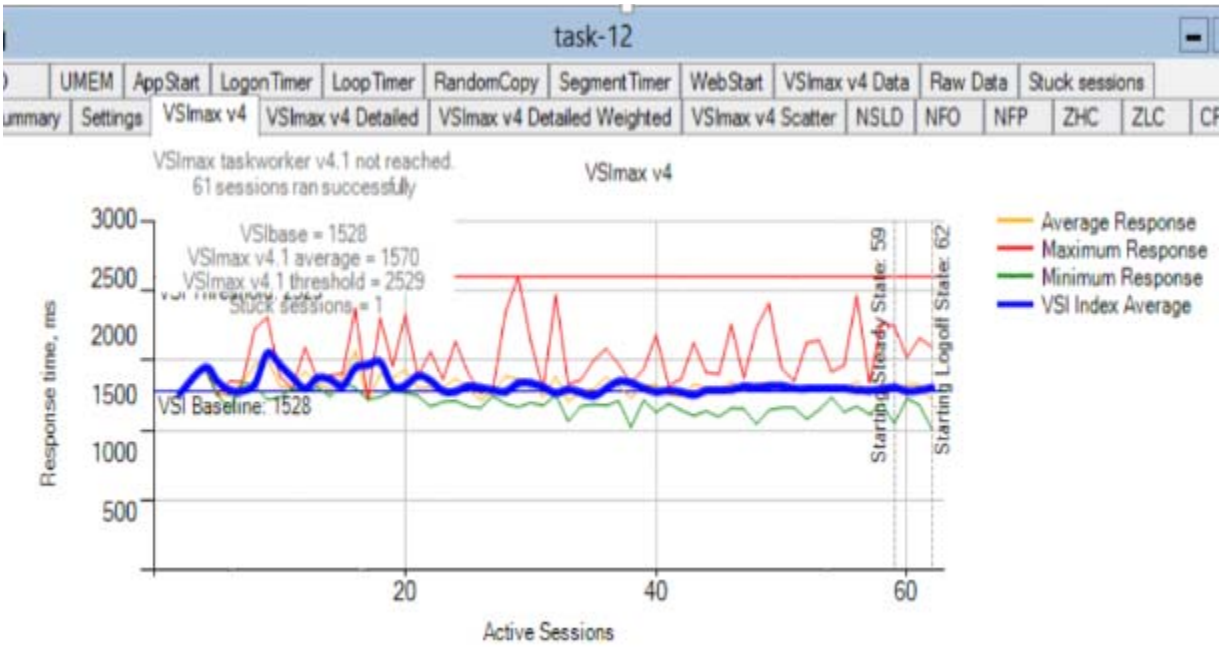


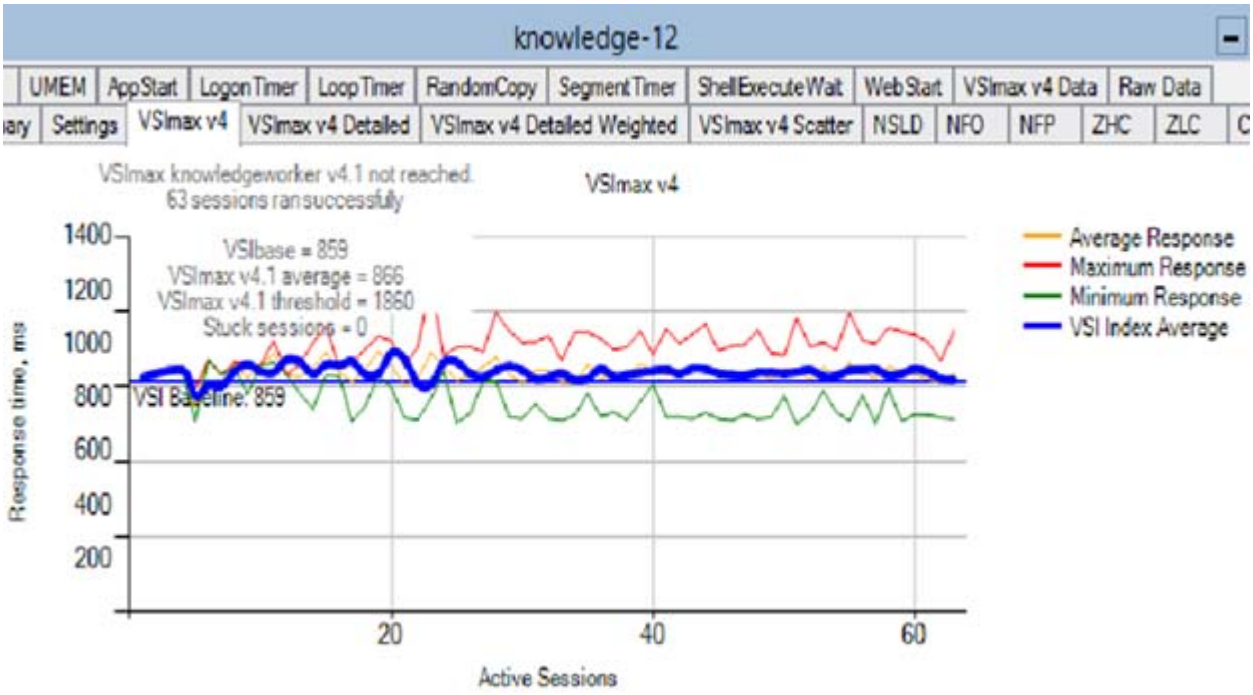
Figure 13 shows the Task Workload Login VSI test results:

- VSI baseline performance was 1528
- The Login VSI index average score is 645 lower than the threshold. It is possible to launch more sessions in this configuration
- 61 sessions ran successfully out of 62, and VSImax was not reached

LoginVSI Response -Knowledge worker Workload

Figure 14 shows the Knowledge worker workload LoginVSI test results.

Figure 14



- VSI baseline performance was 859
- The Login VSI index average score was 866 lower than the threshold. It is possible to launch more sessions in this configuration.
- 63 out of 63 sessions ran successfully and VSImax was not reached.

LoginVSI Response - Power Worker Workload

Figure 15

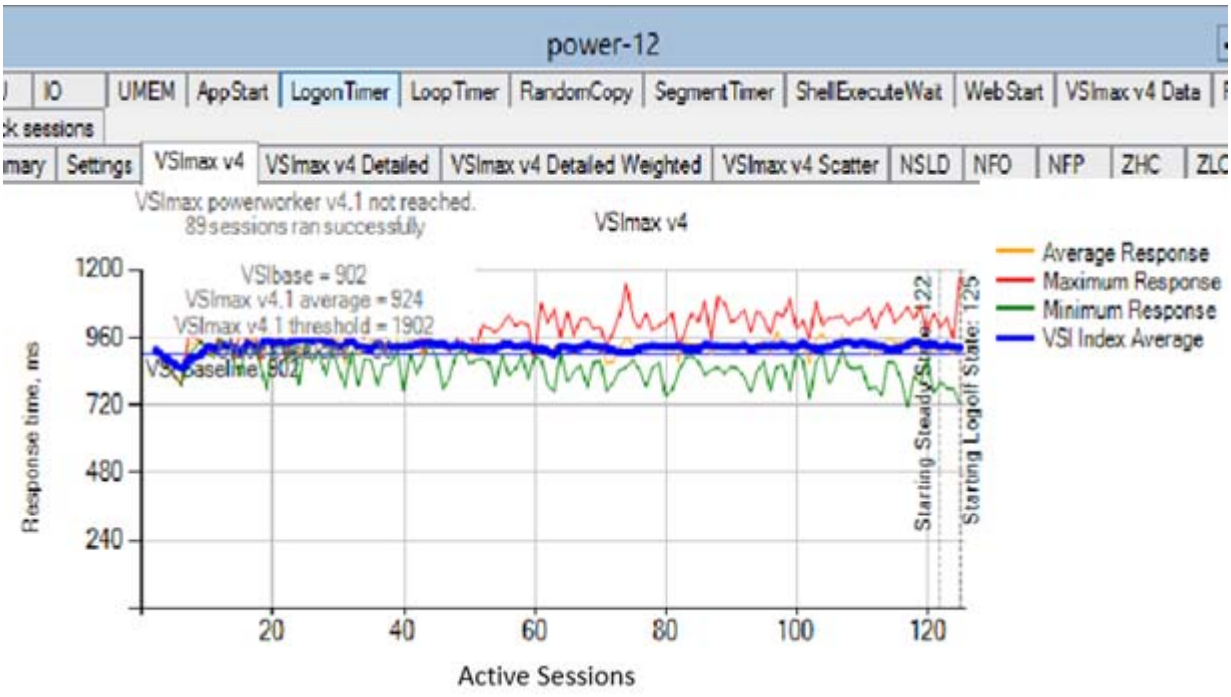


Figure 15 shows Power Workload Login VSI test results:

- VSI baseline performance was 902.
- Login VSI index average score was 924 lower than the threshold. It is possible to launch more sessions in this configuration.
- 89 sessions ran successfully out of 125 and VSImax is not reached.
- Note: All 125 user sessions launched successfully and few sessions failed due to application failure.

RDS-Pool Test Results - Boot Storm

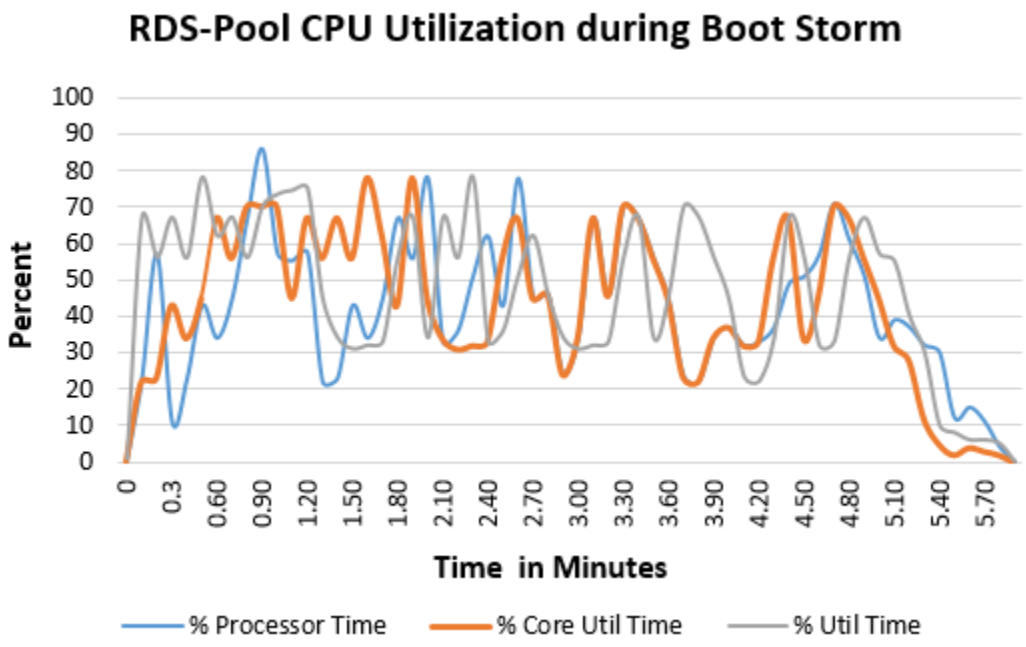
These are the test results for the environment operating during boot storm. The 250 users boot storm took six minutes to complete. This time was measured from when the RDS Server VMs were flagged as available in Horizon View Administrator.

Multiple performance metrics were collected using the `esxtop` command. Figure 16 through Figure 19 show the performance data for the 250 user boot storm.

Hypervisor CPU Performance during Boot Storm

Figure 16 shows the physical CPU metrics collected on the ESXi hypervisors while powering on 250 users.

Figure 16



- The performance metrics show the following:
  - Percent utilization peaks at approximately 86% during boot storm.

Hypervisor Memory Performance

The four VSAN cluster nodes were tested, each containing 262 GB of RAM. 250 Windows Server 2012 R2 was deployed on the four nodes, allowing a commitment of 2048 MB, 3072 GB, and 4096 MB RAM to Task, Knowledge, and Power Users respectively. This results in the following:

- 62 Task virtual machines with 2048 MB per VM
- 63 Knowledge VMs with 3072 MB each
- 125 Power VMs with 4096 MB each

This is 126976 MB, 193536 MB, and 512000 MB respectively, and equals 832512 MB (approximately 832 GB).

Figure 17

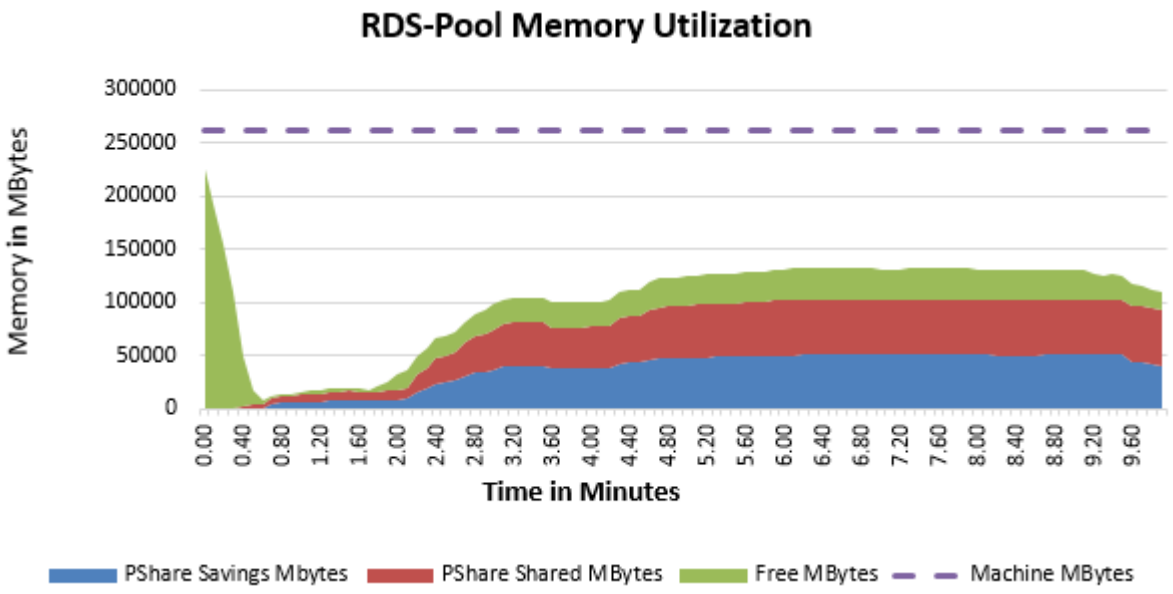


Figure 17 shows the memory utilization within the environment during the test operations. The performance metrics show the following:

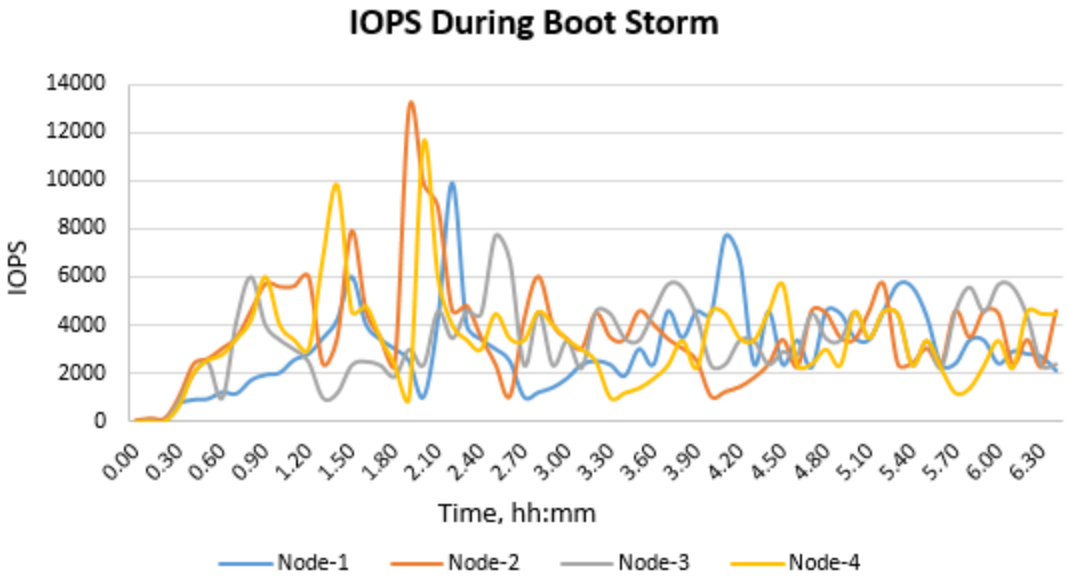
- During boot storm, shared virtual machine memory reached approximately 140000 MB and slightly reduced until it was flagged as available in Horizon View Administrator. This shows the true randomness of the boot storm.
- PSshare saving memory peaked at 40000 MB during boot storm and reduced slightly at the end of the boot storm.

Boot Storm IOPS

To simulate a boot storm, the 250 virtual desktops were powered on simultaneously from vCenter. Figure 18 shows the UCP HC storage (vSAN) characteristics during the boot storm – the all flash UCP HC delivered 13,000 IOPS under peak load during this test at an average of 5678 IOPS per VM.

Figure 18 shows IOPS during a boot storm.

Figure 18



vSAN Storage Performance

Figure 19

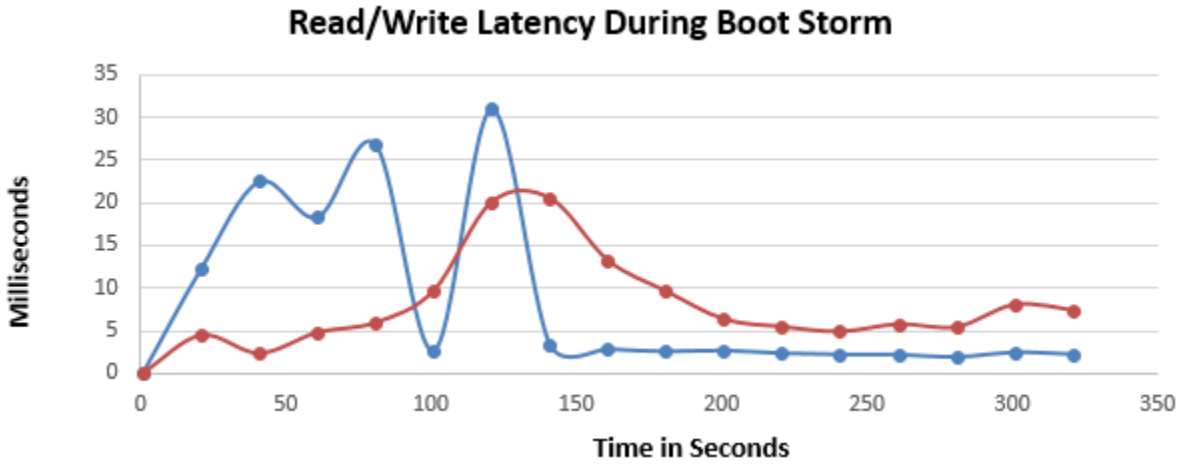


Figure 19 shows the storage latency statistics. The performance metrics show the following:

- During a boot storm, the average read latency rises 35ms
- During a boot storm, the average write latency rises 30ms

RDS-Pool Test Results - Login and Steady State

These are the test results for the environment operating during login storm, steady state operations.

Compute Infrastructure

Multiple performance metrics were collected from the ESXi hypervisors during the test operations. Figure 20 and Figure 21 show the performance data for the 250 user test operations.

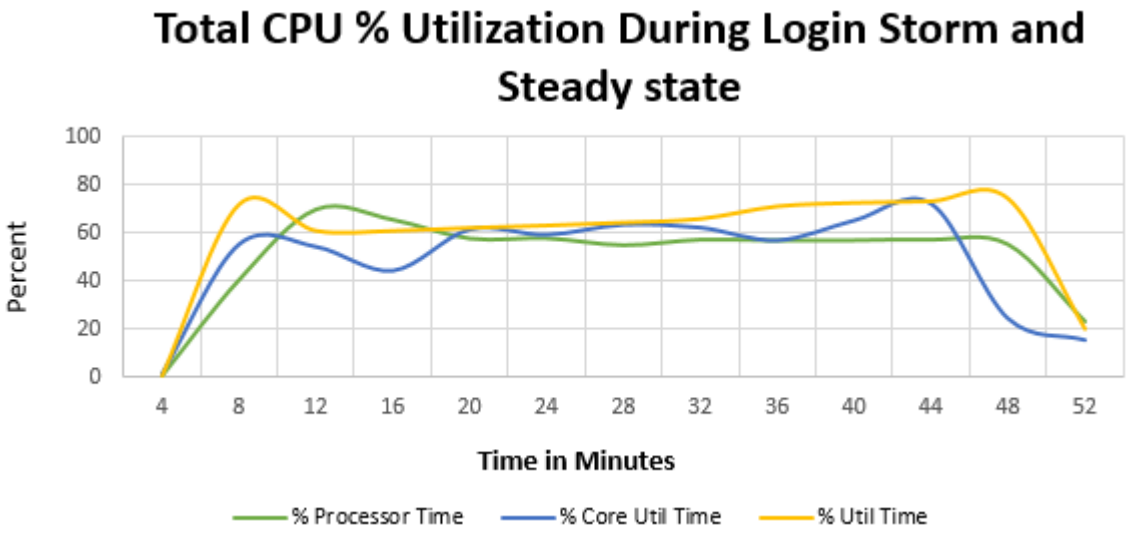
Hypervisor CPU Performance

Figure 20 shows the physical CPU metrics collected on the ESXi hypervisors while running the 250 RDS users test operations.

- The following operations occur during this test that is executed by LoginVSI:
  - Login storm (minutes 1-48)
  - Steady state (minutes 48-50)
- The performance metrics show the following:
  - Percent utilization peaks at approximately 66% during login storm.
  - Percent utilization peaks at approximately 73% during steady state.

This shows that there is still headroom on the UCP HC vSAN to support bursts in workloads while still maintaining acceptable end user performance.

Figure 20



Hypervisor Memory Performance

Memory utilization during a login storm is almost stable. Free memory during a login storm is 100 GB for each of the hosts.

Figure 21 shows Memory utilization during a boot storm of 250 Virtual desktops.

Figure 21

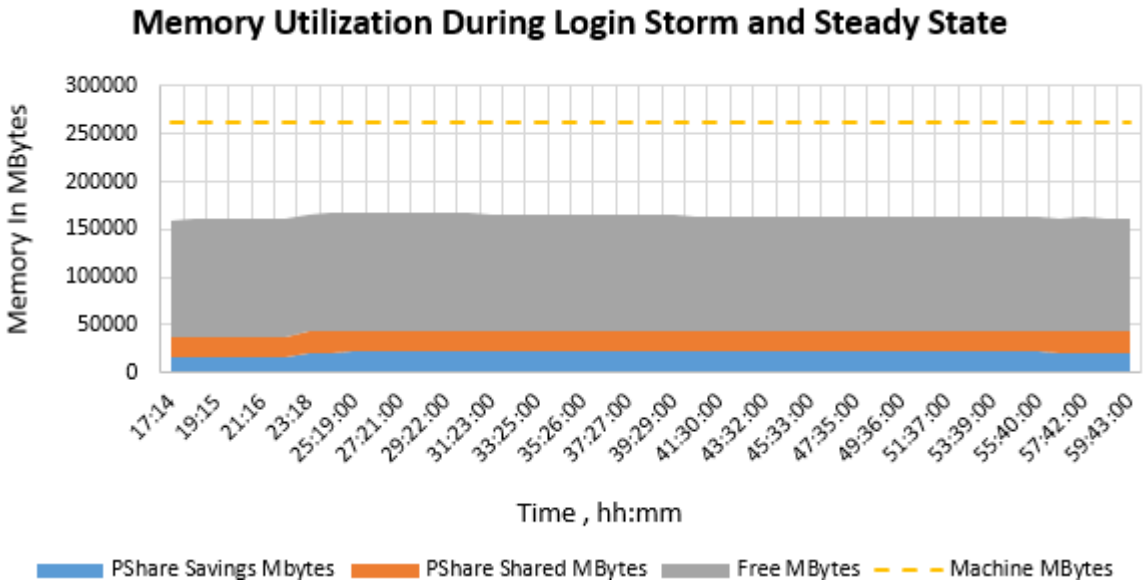


Figure 22

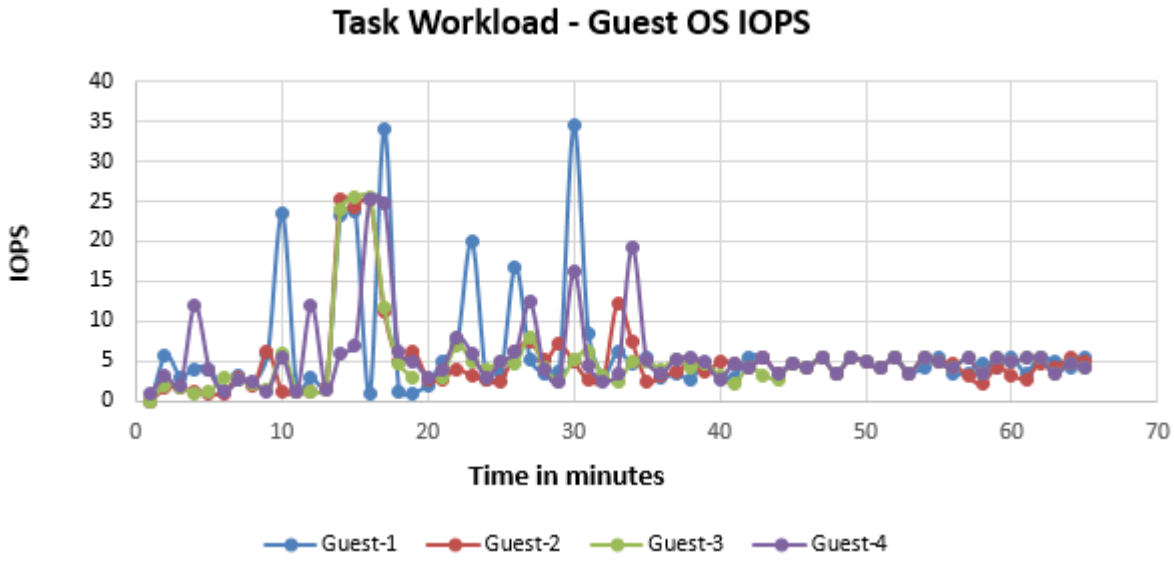


Figure 22 shows Guest IOPS for four Windows 10 Task virtual desktops (Guest-1, Guest-2, Guest-3, and Guest-4).

- Guest-1 IOPS reached a peak value of 34 during login storm
- Average IOPS for task workload during login storm was 7

During steady state the average guest, OS IOPS was 5.

Figure 23

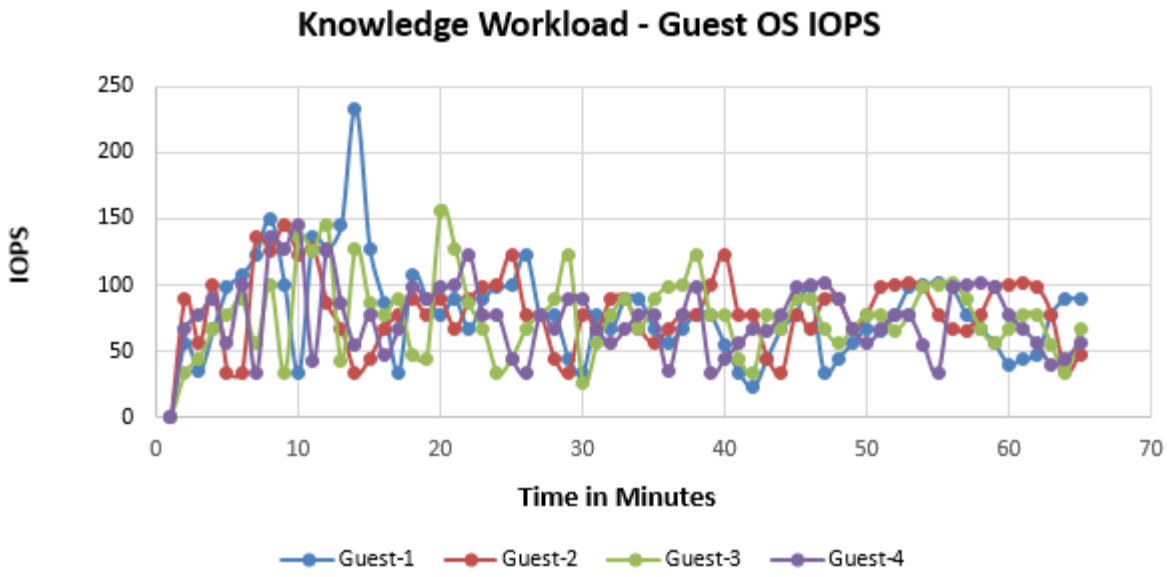


Figure 23 shows Guest IOPS for four Knowledge Windows RDS Servers

- Guest-1 IOPS reached a peak value of 233 during login storm
- Average IOPS for Knowledge workload during login storm was 100
- Steady state showed a stable IOPS count of 65

Figure 24

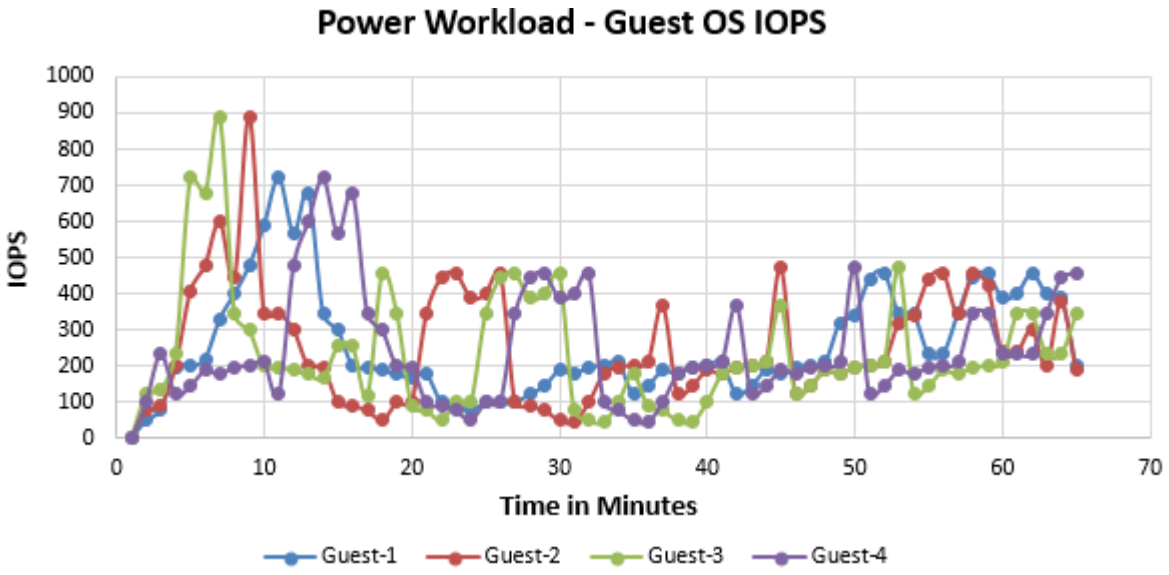


Figure 24 shows Guest IOPS for 4 Knowledge Windows RDS Servers

- Guest-1 IOPS reached a peak value of 233 during Login storm
- Average IOPS for Knowledge workload during login storm was 100
- Steady state showed a stable IOPS count of 65

RDS-LoginVSI Test Results

RDS-LoginVSI Response -Task Worker Workload

Figure 25

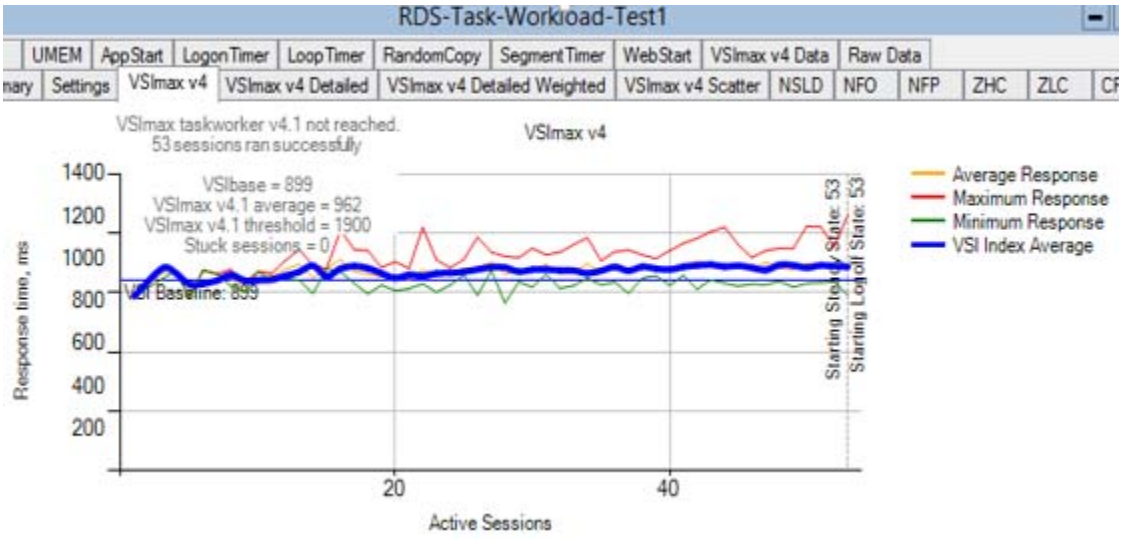


Figure 25 shows Task Workload Login VSI test results:

- VSI baseline performance was 899.
- Login VSI index average score is 962 lower than the threshold. It is possible to launch more sessions in this configuration.
- 53 sessions ran successfully out of 62 and the VSImax was not reached

Note that all 62 user sessions launched successfully and few sessions failed due to application failure.

RDS-LoginVSI Response - Knowledge Worker Workload

Figure 26

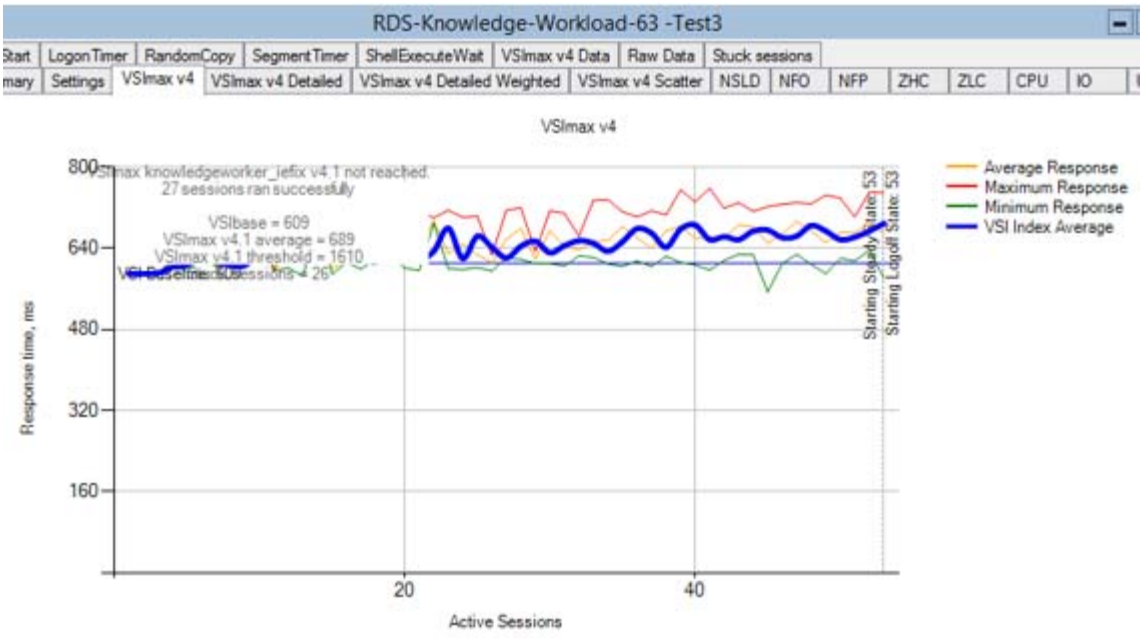


Figure 26 shows Knowledge Workload Login VSI test results:

- VSI baseline performance was 609.
- The Login VSI index average score was 689 lower than the threshold. It is possible to launch more sessions in this configuration.
- 27 sessions ran successfully out of 63 and the VSImax was not reached.
- Note that all 63 user sessions launched successfully and few sessions failed due to application failure.

RDS-LoginVSI Response - Power Worker Workload

Figure 27

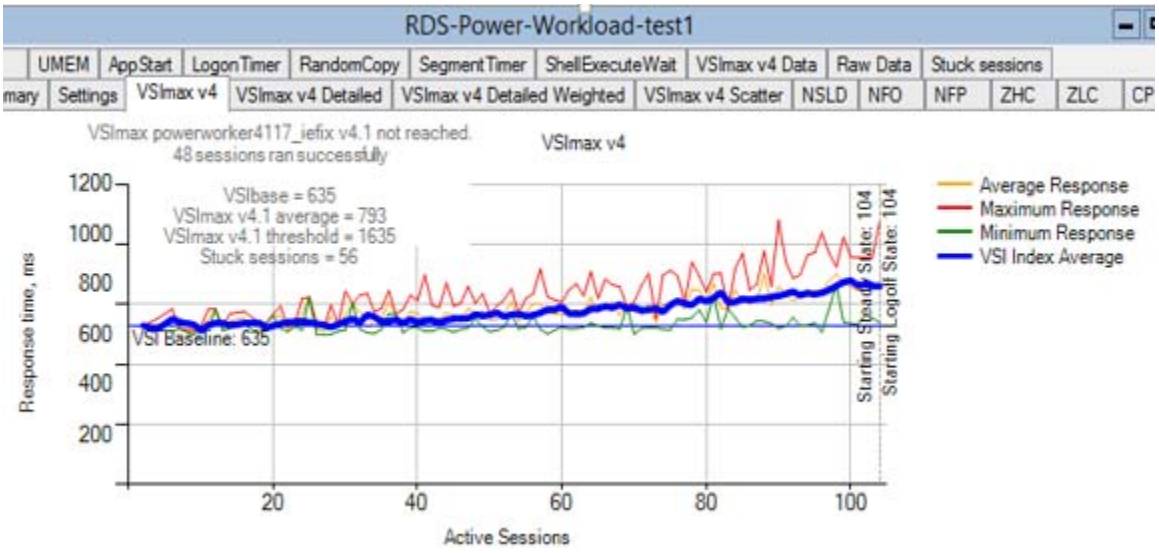


Figure 27 shows the Power Workload Login VSI test results:

- VSI baseline performance was 635.
- The Login VSI index average score was 793 lower than the threshold. It is possible to launch more sessions in this configuration.
- 48 sessions ran successfully out of 125 and the VSImax was not reached.

Note that all 125 user sessions launched successfully and few sessions failed due to application failure.

Conclusion

This architecture provides guidance to organizations implementing VMware Horizon 7 on a Unified Compute Platform HC infrastructure, and describes tests performed by Hitachi Data Systems to validate and measure the operation and performance of the recommended solution, including third-party validated performance testing from Login VSI, the industry standard benchmarking tool for virtualized workloads.

Organizations are looking to VDI solutions like VMware Horizon to reduce software licensing, distribution, and administration expenses, and to improve security and compliance. Hitachi's market-leading hyperconverged infrastructure platform helps to deliver the promised benefits of VDI, while overcoming many common challenges.

UCP HC for VDI provides:

- Simplified deployment with hyperconverged Infrastructure.
- Ability to start small and scale out in affordable increments-from pilot to production.
- Highest density of desktops per node in the hyperconverged infrastructure category.
- Independently validated, unmatched VDI performance for a superb end user experience.
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- Enterprise-class data protection and resiliency

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