Lab Validation Report

By  Tim Darnell

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Feedback

Hitachi Data Systems welcomes your feedback. Please share your thoughts by sending an email message to SolutionLab@hds.com. To assist the routing of this message, use the paper number in the subject and the title of this white paper in the text.
Persistent desktops are becoming more prevalent in Virtual Desktop Infrastructure (VDI) environments within the corporate datacenter. Persistence provides the following benefits:

- Allows users to install custom applications
- Keeps user data locally on the desktop
- Guarantees that the end user receives the same desktop upon login every time
- Allows corporations to utilize traditional desktop management solutions

This lab validation report shows how Hitachi Data Systems tested a Heavy Power User workload using Login VSI as a test harness to:

- Validate end user performance
- Ensure the underlying hardware was sized correctly for the given workload

This paper is intended for vSphere and VDI engineers implementing VMware Horizon View on Hitachi Unified Compute Platform Pro for VMware vSphere.

**Note** — Testing of this configuration was in a lab environment. Many things affect production environments beyond prediction or duplication in a lab environment. Follow the recommended practice of conducting proof-of-concept testing for acceptable results in a non-production, isolated test environment that otherwise matches your production environment before your production implementation of this solution.
Product Features

The following information describes the hardware and software features used in testing.

Hitachi Unified Compute Platform Pro for VMware vSphere

Hitachi Unified Compute Platform Pro for VMware vSphere offers the following:

- Full parity across the RESTful API
- Command line interface
- Graphical user interface

Director software on the Unified Compute Platform Pro integrates directly into VMware vSphere. It provides unified end-to-end infrastructure orchestration within a single interface.

Unified Compute Platform (UCP) Pro for VMware vSphere leverages your existing storage in one of two ways:

- Connect to your existing Hitachi Virtual Storage Platform or Hitachi Unified Storage VM
- Virtualize other storage arrays that you have from other vendors using Virtual Storage Platform or Unified Storage VM

UCP Pro for VMware vSphere provides the following benefits:

- Centralization and automation of compute, storage, and networking components
- Significant reduction of time to value and operational costs across data centers
- Faster deployment of converged infrastructure with more efficient resource allocation
- Provides a foundation for the journey to the software defined datacenter using full support of the RESTful API

Hitachi Unified Storage VM

Hitachi Unified Storage VM is an entry-level enterprise storage platform. It combines storage virtualization services with unified block, file, and object data management. This versatile, scalable platform offers a storage virtualization system to provide central storage services to existing storage assets.
Unified management delivers end-to-end central storage management of all virtualized internal and external storage on Unified Storage VM. A unique, hardware-accelerated, object-based file system supports intelligent file tiering and migration, as well as virtual NAS functionality, without compromising performance or scalability.

The benefits of Unified Storage VM are the following:

- Enables the move to a new storage platform with less effort and cost when compared to the industry average
- Increases performance and lowers operating cost with automated data placement
- Supports scalable management for growing and complex storage environments while using fewer resources
- Achieves better power efficiency and with more storage capacity for more sustainable data centers
- Lowers operational risk and data loss exposure with data resilience solutions
- Consolidates management with end-to-end virtualization to prevent virtual server sprawl

Hitachi Dynamic Provisioning

On Hitachi storage systems, Hitachi Dynamic Provisioning provides wide striping and thin provisioning functionalities.

Using Dynamic Provisioning is like using a host-based logical volume manager (LVM), but without incurring host processing overhead. It provides one or more wide-striping pools across many RAID groups. Each pool has one or more dynamic provisioning virtual volumes (DP-VOLs) of a logical size you specify of up to 60 TB created against it without allocating any physical space initially.

Deploying Dynamic Provisioning avoids the routine issue of hot spots that occur on logical devices (LDEVs). These occur within individual RAID groups when the host workload exceeds the IOPS or throughput capacity of that RAID group. Dynamic provisioning distributes the host workload across many RAID groups, which provides a smoothing effect that dramatically reduces hot spots.

When used with Hitachi Unified Storage VM, Hitachi Dynamic Provisioning has the benefit of thin provisioning. Physical space assignment from the pool to the dynamic provisioning volume happens as needed using 42 MB pages, up to the logical size specified for each dynamic provisioning volume. There can be a dynamic expansion or reduction of pool capacity without disruption or downtime. You can rebalance an expanded pool across the current and newly added RAID groups for an even striping of the data and the workload.
Hitachi Compute Blade 500

Hitachi Compute Blade 500 combines the high-end features with the high compute density and adaptable architecture you need to lower costs and protect investment. Safely mix a wide variety of application workloads on a highly reliable, scalable, and flexible platform. Add server management and system monitoring at no cost with Hitachi Compute Systems Manager, which can seamlessly integrate with Hitachi Command Suite in IT environments using Hitachi storage.

The Hitachi Compute Blade 500 chassis contains internal Fibre Channel and network switches for the high availability requirements of Hitachi Unified Compute Platform Select for VMware vSphere.

Brocade Storage Area Network and Ethernet Switches

Brocade and Hitachi Data Systems have collaborated to deliver storage networking and data center solutions. These solutions reduce complexity and cost, as well as enable virtualization and cloud computing to increase business agility.

This lab validation report uses the following Brocade products:

- Brocade 6510 Switch
- Brocade VDX 6720 Data Center Switch

VMware vSphere 5

VMware vSphere 5 is a virtualization platform that provides a datacenter infrastructure. It features vSphere Distributed Resource Scheduler (DRS), High Availability, and Fault Tolerance.

VMware vSphere 5 has the following components:

- ESXi 5 — This is a hypervisor that loads directly on a physical server. It partitions one physical machine into many virtual machines that share hardware resources.

- vCenter Server — This allows management of the vSphere environment through a single user interface. With vCenter, there are features available such as vMotion, Storage vMotion, Storage Distributed Resource Scheduler, High Availability, and Fault Tolerance.

VMware Horizon View 5.2

VMware Horizon View 5.2 provides virtual desktops as a managed service. Using Horizon View, you can create clones of approved desktops and deploy them automatically, as needed. Desktop users access their personalized desktop, including data, applications, and settings from anywhere with network connectivity to the server. PCoIP, a high performance display protocol, provides enhanced end-user experience compared to traditional remote display protocols.
Test Environment Configuration

Testing of the persistent desktops took place in the Hitachi Data Systems laboratory using the Hitachi Compute Blade 500, Hitachi Unified Storage VM, and Hitachi Unified Compute Platform Director.

Hardware Components

Table 1 describes the details of the hardware components used.

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi Unified Storage VM</td>
<td>▪ Dual controllers</td>
<td>73-01-02-00/00</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>▪ 16 × 8 Gb/sec Fibre Channel ports</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 64 GB cache memory</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 96 × 600 GB 10k RPM SAS disks, 2.5 inch SFF</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hitachi Compute Blade 500 Chassis</td>
<td>▪ 8-blade chassis</td>
<td>SVP: A0150-E-7559</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>▪ 2 Brocade 5460 Fibre Channel switch modules, each with 6 × 8 Gb/sec uplink ports</td>
<td>5460: FOS 7.0.2c</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 2 Brocade VDX 6746 Ethernet switch modules, each with 8 × 10 Gb/sec uplink ports</td>
<td>VDX6746: NOS 3.0.0_dcb</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 2 management modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 6 cooling fan modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 4 power supply modules</td>
<td></td>
<td></td>
</tr>
<tr>
<td>520AH1 Server Blade</td>
<td>▪ Half blade</td>
<td>BMC/EFI: 01-63</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>▪ 2 × 8-core Intel Xeon E5-2680 processors, 2.70 GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 256 GB RAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 16 × 16 GB DIMMs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR 210H Rack Server</td>
<td>▪ 2 × 6-core Intel Xeon E5-2620 processors, 2.00 GHz</td>
<td>BMC/EFI: 01-05</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>▪ 96 GB RAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 6 × 16 GB DIMMs</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1. Infrastructure Hardware Components (Continued)

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brocade 6510</td>
<td>SAN switch with 48 \times 8 Gb Fibre Channel ports</td>
<td>FOS 7.1.1</td>
<td>2</td>
</tr>
<tr>
<td>Brocade VDX 6720</td>
<td>Ethernet switch with 24 \times 10 Gb/sec ports</td>
<td>NOS 3.0.1aa</td>
<td>2</td>
</tr>
<tr>
<td>Brocade FCX648</td>
<td>Ethernet switch with 48 \times 1 Gb/sec ports</td>
<td>07.4.00cT7f3</td>
<td>2</td>
</tr>
</tbody>
</table>

Software Components

Table 2 describes the details of the software components used in this testing.

Table 2. Software Components

<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi Storage Navigator Modular 2</td>
<td>Microcode Dependent</td>
</tr>
<tr>
<td>Hitachi Dynamic Provisioning</td>
<td>Microcode Dependent</td>
</tr>
<tr>
<td>Hitachi UCP Director</td>
<td>3.0.1</td>
</tr>
<tr>
<td>VMware vCenter server</td>
<td>5.1.0, Build 1123961</td>
</tr>
<tr>
<td>VMware Virtual Infrastructure Client</td>
<td>5.1.0, Build 786111</td>
</tr>
<tr>
<td>VMware ESXi</td>
<td>5.1.0, Build 1065491</td>
</tr>
<tr>
<td>Microsoft® Windows Server® 2008</td>
<td>Enterprise edition, R2</td>
</tr>
<tr>
<td>VMware Horizon View</td>
<td>5.2.0, Build 987719</td>
</tr>
<tr>
<td>Login VSI</td>
<td>4.0.2.1902</td>
</tr>
</tbody>
</table>

Network Infrastructure

The network infrastructure for Hitachi UCP Pro for VMware vSphere is configured for management and automation through Hitachi UCP Director. For more information, please visit the Hitachi UCP Pro for VMware vSphere product homepage.

Storage Infrastructure

The storage infrastructure for Hitachi UCP Pro for VMware vSphere is configured for management and automation through Hitachi UCP Director. For more information, please visit the Hitachi UCP Pro for VMware vSphere product homepage.
Solution Infrastructure

The VMware Horizon View connection server used for this solution was placed on the Hitachi Unified Compute Platform management cluster. Table 3 describes the details of the connection server virtual machine configuration used during this testing.

Table 3. VMware Horizon View Connection Server Virtual Machine Details

<table>
<thead>
<tr>
<th>Configuration Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>Microsoft Windows 2008 R2 Server, Enterprise Edition</td>
</tr>
<tr>
<td>Virtual CPUs</td>
<td>4</td>
</tr>
<tr>
<td>Memory</td>
<td>16 GB</td>
</tr>
<tr>
<td>Disk Size</td>
<td>40 GB</td>
</tr>
<tr>
<td>Disk Type</td>
<td>Eager Zeroed Thick</td>
</tr>
</tbody>
</table>

A Microsoft Windows 2008 R2 Active Directory domain controller was deployed onto the Hitachi Unified Compute Platform management cluster to support user authentication and domain services for the VMware Horizon View solution infrastructure. Table 4 describes the details of the Active Directory virtual machine configuration used during this testing.

Table 4. Microsoft Windows 2008 R2 Active Directory Domain Controller Virtual Machine Details

<table>
<thead>
<tr>
<th>Configuration Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>Microsoft Windows 2008 R2 Server, Enterprise Edition</td>
</tr>
<tr>
<td>Virtual CPUs</td>
<td>2</td>
</tr>
<tr>
<td>Memory</td>
<td>4 GB</td>
</tr>
<tr>
<td>Disk Size</td>
<td>40 GB</td>
</tr>
<tr>
<td>Disk Type</td>
<td>Eager Zeroed Thick</td>
</tr>
</tbody>
</table>
Hitachi Unified Compute Platform contains a dedicated management cluster, and a minimum of one compute cluster. For this testing, VMware Horizon View management/administration components were placed on the management cluster, and the virtual desktops were placed on the compute cluster. Figure 1 gives a high-level overview of the infrastructure and component placement.

Figure 1
Test Methodology

This section describes the solution configuration and testing methodology used. The purpose of the tests is to show acceptable levels of performance on the underlying hardware and to show that acceptable end user experience exists. All testing was completed in a high density configuration.

VMware Horizon View Configuration

A dedicated user assignment, full clone desktop pool of 440 desktops was configured in VMware Horizon View Administrator for use in all test cases. The virtual machine template used for the full clones was configured for a Heavy Power User workload type as defined in the VMware whitepaper "Storage Considerations for VMware Horizon View 5.2". The virtual machine template was prepared for VDI use by following the guidelines in the VMware optimization guide "VMware Horizon View Optimization Guide for Windows 7 and Windows 8". The virtual machine template was also configured for use with Login VSI by following the guidelines established in the Login VSI 4.0 Documentation. Table 5 lists the configuration details of the virtual machine template used for the full clone desktops.

<table>
<thead>
<tr>
<th>Description</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating System</td>
<td>Microsoft Windows 7, 64-bit</td>
</tr>
<tr>
<td>vCPU Allocation</td>
<td>2</td>
</tr>
<tr>
<td>Memory Allocation</td>
<td>4 GB</td>
</tr>
<tr>
<td>Desktop Disk/Type</td>
<td>34 GB/Thin Provisioned</td>
</tr>
<tr>
<td>Average Steady State IOPS</td>
<td>25-30</td>
</tr>
<tr>
<td>High-Density vCPU per Core</td>
<td>6.9</td>
</tr>
</tbody>
</table>
The desktop pool was configured to use four datastores, which were presented to all eight hosts in the Hitachi UCP Pro for VMware vSphere compute cluster. Each datastore was presented to the cluster as a Hitachi Dynamic Provisioning (HDP) pool virtual volume, with the HDP pool containing 24 RAID-10 (2D+2D) parity groups. After creating the desktop pool and allowing Horizon View to provision the desktops, each datastore contained 110 desktops (+/- 2 desktops). Figure 2 illustrates the storage configuration used for the VMware Horizon View desktops.

Figure 2

Each ESXi hypervisor was configured to host exactly 55 desktops in order to obtain accurate end user experience metrics during the testing.

Login VSI Test Harness Configuration

Login VSI was used to generate a heavy workload on the persistent desktops. Login VSI launchers were each configured to initiate up to 15 PCoIP sessions to the VMware Horizon View Connection Server to simulate end-to-end execution of the entire VMware Horizon View infrastructure stack. The test harness infrastructure was hosted on hardware separate from the Hitachi UCP Pro for VMware vSphere management and compute clusters in order to accurately measure desktop performance.
The standard "Heavy" Login VSI workload was modified to include running Vdbench in the background during all test phases in order to generate additional IOPS necessary to meet the 25-30 IOPS target for a Heavy Power User. In order to ensure the I/O profile used in Vdbench was applicable to desktop application usage, individual application I/O profiles were captured from previous testing and used as Vdbench workload definitions. Table 6 lists the applications and associated I/O profiles used to define the Vdbench workload definitions.

Table 6. Vdbench Application I/O Profiles Used in Workload Definitions

<table>
<thead>
<tr>
<th>Application</th>
<th>% Read</th>
<th>% Write</th>
<th>% Random</th>
<th>% Sequential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft PowerPoint®</td>
<td>19</td>
<td>81</td>
<td>75</td>
<td>25</td>
</tr>
<tr>
<td>Adobe Acrobat Reader</td>
<td>22</td>
<td>78</td>
<td>71</td>
<td>29</td>
</tr>
<tr>
<td>Microsoft Outlook®</td>
<td>17</td>
<td>83</td>
<td>81</td>
<td>19</td>
</tr>
<tr>
<td>Microsoft Excel®</td>
<td>18</td>
<td>82</td>
<td>74</td>
<td>26</td>
</tr>
<tr>
<td>Mozilla Firefox</td>
<td>36</td>
<td>64</td>
<td>55</td>
<td>45</td>
</tr>
<tr>
<td>Microsoft Internet Explorer®</td>
<td>17</td>
<td>83</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>Microsoft Web Album</td>
<td>27</td>
<td>73</td>
<td>68</td>
<td>32</td>
</tr>
<tr>
<td>Microsoft Media Player</td>
<td>23</td>
<td>77</td>
<td>61</td>
<td>39</td>
</tr>
<tr>
<td>Microsoft Word</td>
<td>26</td>
<td>74</td>
<td>62</td>
<td>38</td>
</tr>
</tbody>
</table>

Login VSI was configured to stagger logins of all 440 users with a single login occurring every 5.45 seconds. This ensured all 440 users logged into the desktops and began the steady state workload within a 40 minute period in order to ensure simulation of a moderate login storm.

Test Case 1: Boot Storm

To simulate a power outage or other catastrophic failure of the supporting infrastructure, an immediate power on of all desktops was performed through the VMware Virtual Infrastructure Client.

This test case was performed to ensure storage assigned to the desktop pool performed adequately under stress, and to determine the amount of time necessary for the desktops to be ready for login by the end user.

Test Case 2: Login Storm and Steady State

Login VSI allows for staggering logins of users within a desktop pool and then looping the configured workload for a specified amount of time before logging the session off. For this set of tests, a single login was performed every 5.45 seconds, and the session was configured to log off approximately two hours from the initial login time.

This test case was performed to ensure that all of the 440 desktops ran the full steady state workload to show sustained concurrent performance, as well as show that the infrastructure can support a moderate login storm of all 440 desktops.
Analysis

Test Case 1: Boot Storm

The immediate power on of all 440 desktops took one minute and 55 seconds. This was measured from the time that the desktops were concurrently powered on from vCenter until the time all 440 desktops showed as "Available" within VMware Horizon View Administrator. Six minutes of metrics are graphed to illustrate the periods prior to power-on and after the desktops were marked as available and ready to login.

Storage Infrastructure

Multiple performance metrics from the Hitachi Unified Storage VM were analyzed to ensure that the storage could support the stress of an immediate power on of all of the desktops.

*HDP Pool IOPS*

Figure 3 illustrates the total combined IOPS during the boot storm for the LDEVs used within the HDP pool used for the virtual desktops.

- Write IOPS peak at approximately 7,000
- Read IOPS peak at approximately 34,000

![HDP Pool IOPS](image)
Processor and Cache Write Pending

Figure 4 and Figure 5 illustrate the management processor utilization and cache write pending rate observed during the boot storm.

- MPU utilization does not rise above 17%
- Cache write pending rate does not rise above 18%
Cache Hit Percentage

Figure 6 illustrates the read cache hit percentage observed during the boot storm.

- The read cache hit percentage decreases throughout the boot storm as individual desktops power on.
Physical Disk

Figure 7 illustrates the average physical disk busy rate for the LDEVs used within the HDP pool used for the virtual desktops.

- The disk busy rate does not rise above 96%

![Average Disk Busy Rate](image)

**Figure 7**
Front End Ports

Figure 8 illustrates the throughput observed on the front end Fibre Channel ports of the HUS-VM during the boot storm.

- Throughput on each port peaked at 95 MB/sec during the boot storm, for a total peak of 760 MB/sec

![Storage Port Throughput](image-url)
Latency

Figure 9 illustrates the averaged storage latency observed on the HUS VM during the boot storm.

- Average latency peaked at 13.5 milliseconds during the boot storm.

![Storage Latency Graph]

**Figure 9**

Test Case 2: Login Storm and Steady State

Multiple performance metrics were collected and analyzed from the ESXi hypervisors, Hitachi Unified Storage VM, and Login VSI test harness during the login storm and steady state operations.

**Compute Infrastructure**

Esxtop was used to capture performance metrics on all eight hosts in the desktop cluster during the login storm and steady state operations. The following metrics illustrate the performance of the hypervisor and guest virtual machines.
Hypervisor CPU Performance

Figure 10 illustrates the CPU utilization representative of a host in the desktop cluster during the login storm and steady state operations.

- Percent core utilization does not rise above 96%
- Percent utilization time does not rise above 87%
- Percent processor time does not rise above 59%
Hypervisor System Load

Figure 11 illustrates the CPU load representative of a host in the desktop cluster during the login storm and steady state operations.

- The five minute load average does not rise above 1.82
**Hypervisor Memory Performance**

Figure 12 illustrates the memory performance representative of a host in the desktop cluster during the login storm and steady state operations.

- Shared VM memory declines as the 440 desktops login over the 40 minute login period, then drops to zero which shows the randomness of the workload generated by Login VSI.

![Hypervisor Memory Metrics](image)

**Figure 12**
Hypervisor Network Performance

Figure 13 illustrates the network performance representative of a host in the desktop cluster during the login storm and steady state operations.

- MB/sec transmitted does not rise above 165 MB/sec
- MB/sec received does not rise above 65 MB/sec

**Figure 13**
Guest CPU Performance

Figure 14 and Figure 15 illustrate the in-guest CPU performance metrics obtained from esxtop during the login storm and steady state operations. The graphs show five representative virtual desktops from the 440 that ran the workloads. Percent ready should not average above 10% for every vCPU assigned to the virtual desktop (20% in the case of the tested infrastructure). Percent costop is an important metric to observe when deploying virtual machines with multiple vCPUs. A low costop percentage indicates that the underlying host is not overloaded to the point where the virtual machine is ready to execute a command, but cannot due to availability of multiple pCPUs from the ESXi CPU scheduler.

- Percent ready does not rise above 31%, and averages between 12 and 17%
- Percent costop does not rise above 0.8%

Figure 14

![Guest CPU Ready Times Graph]

---

22
Figure 15

Guest CPU CoStop

Time in Minutes

Percent

Guest 1  Guest 2  Guest 3  Guest 4  Guest 5
Guest IOPS Performance

Figure 16 illustrates the in-guest IOPS performance metrics during the login storm and steady state operations. The graphs show five representative virtual desktops from the 440 that ran the workloads.

- IOPS peak at 157 during the login storm
- IOPS peak at 41 and average 29 during steady state
Storage Infrastructure
Performance metrics were captured from the HUS VM during the login storm and steady state operations. The following metrics illustrate the performance of the storage array.

**HDP Pool IOPS**
Figure 17 illustrates the total combined IOPS during the login storm and steady state operations for the LDEVs used within the HDP pool used for the virtual desktops.

- Write IOPS peak at approximately 12,800
- Read IOPS peak at approximately 4,600

![HDP Pool IOPS Graph](image-url)
Processor and Cache Write Pending

Figure 18 and Figure 19 illustrate the management processor utilization and cache write pending rate observed during the login storm and steady state operations.

- MPU utilization does not rise above 18%
- Cache write pending rate does not rise above 28%

Figure 18
Figure 19

Cache Write Pending

Percent

Time in Minutes

Cache Write Pending
Cache Hit Percentage

Figure 20 illustrates the read cache hit percentage observed during the login storm and steady state operations.

- The read cache hit percentage decreases throughout the login storm as individual desktops begin their workload.

![Read Cache Hit](image)

**Figure 20**
**Physical Disk**

Figure 21 illustrates the average physical disk busy rate for the LDEVs used within the HDP pool used for the virtual desktops during the login storm and steady state operations.

- The disk busy rate does not rise above 86%
Front End Ports

Figure 22 illustrates the throughput observed on the front end Fibre Channel ports of the HUS VM during the login storm and steady state operations.

- Throughput on each port peaked at 20 MB/sec, for a total peak of 160 MB/sec.
Latency

Figure 23 illustrates the averaged storage latency observed on the HUS VM during the login storm and steady state operations.

- Average latency peaked at 4.9 milliseconds during the login storm
- Average latency peaked at 1.7 milliseconds during steady state

Application Experience

Login VSI was used to measure end user application response times and to determine the maximum number of desktops that can be supported on the tested infrastructure running the specified workload.

Application Response Times

Login VSI reported the time required for various operations to complete within the desktop during the test.

- All operations completed in less than 1.3 seconds.

These performance metrics are extremely close to physical desktop performance. This proves that the tested infrastructure provides adequate user experience for 440 Heavy Power Users.
Table 7 lists the operation abbreviations used in Login VSI and a description of the action taken during the operation.

<table>
<thead>
<tr>
<th>Login VSI Operation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>FCDL</td>
<td>File Copy Document Local</td>
</tr>
<tr>
<td>FCDS</td>
<td>File Copy Document Share</td>
</tr>
<tr>
<td>FCTL</td>
<td>File Copy Text Local</td>
</tr>
<tr>
<td>FCTS</td>
<td>File Copy Text Share</td>
</tr>
<tr>
<td>NFP</td>
<td>Notepad File Print</td>
</tr>
<tr>
<td>NSLD</td>
<td>Notepad Start/Load File</td>
</tr>
<tr>
<td>WFO</td>
<td>Windows File Open</td>
</tr>
<tr>
<td>WSLD</td>
<td>Word Start/Load File</td>
</tr>
<tr>
<td>ZHC</td>
<td>Zip High Compression</td>
</tr>
<tr>
<td>ZNC</td>
<td>Zip No Compression</td>
</tr>
</tbody>
</table>
Figure 24 shows the application experience metrics as reported by Login VSI.

**VSI Max Metric**

VSI Max is a metric that indicates the number of desktop sessions the tested infrastructure can support running a specified workload.

- VSI Max was measured by Login VSI at 439 — a less than one percent variance from the number of desktops tested.
Conclusion

All metrics analyzed supported that the underlying hardware contained within the Hitachi UCP Pro for VMware vSphere converged stack supported:

- An immediate power on of 440 persistent desktops
- Adequate end user experience for 440 Heavy Power Users running at 25-30 IOPS per desktop
For More Information

Hitachi Data Systems Global Services offers experienced storage consultants, proven methodologies and a comprehensive services portfolio to assist you in implementing Hitachi products and solutions in your environment. For more information, see the Hitachi Data Systems Global Services website.

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