Deploy Hitachi Unified Compute Platform Select for VMware Horizon View with Heavy Power User Workloads using Hitachi NAS Platform with Hitachi Unified Storage VM

Reference Architecture Guide

By Tim Darnell

August 19, 2013
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.
## Table of Contents

**Solution Overview** ................................................................. 3
  - Determine User Workload ............................................... 4
  - Logical Design ............................................................... 6

**Key Solution Components** .................................................. 7
  - Hardware Components .................................................. 7
  - Software Components ................................................... 10

**Solution Design** ................................................................ 12
  - Required Solution Cells ................................................. 15
  - Optional Solution Cells .................................................. 42
  - Scale Out Using Hitachi Converged Infrastructure Cells ....... 50

**Engineering Validation** ...................................................... 53
  - Test Methodology .......................................................... 55
  - Test Results - Provisioning Storm ...................................... 56
  - Test Results - Boot Storm ................................................ 65
  - Test Results - Login/Steady State/Logoff/Refresh ................. 74

**Conclusion** ........................................................................... 93
Deploy Hitachi Unified Compute Platform Select for VMware Horizon View with Heavy Power User Workloads using Hitachi NAS Platform with Hitachi Unified Storage VM

Reference Architecture Guide

Hitachi Unified Compute Platform Select for VMware Horizon View with heavy power user workloads using Hitachi NAS Platform with Hitachi Unified Storage VM provides an Enterprise Network File System (NFS)-based storage solution. You can integrate this environment with appropriate HDS SAN environments.

Use Hitachi converged infrastructure cells to scale from hundreds to thousands of VMware Horizon View desktops as organizational needs grow. This reference architecture guide contains advice on deploying a virtual desktop infrastructure, which uses Hitachi NAS Platform for:

- Primary storage of VMware Horizon View linked clone and replica virtual machines
- VMware Horizon View Persona Management data

This guide provides information to plan and deploy linked clone desktops with VMware Horizon View Persona Management enabled in a VMware Horizon View 5.2 environment using the following:

- Hitachi NAS Platform
- Hitachi Unified Storage VM
- Hitachi Compute Blade 500
- VMware vSphere 5.1 Update 1
- VMware Horizon View 5.2

Hitachi Unified Compute Platform Select is a family of completely integrated and flexible solutions. Each solution is configured for immediate deployment to run top-tier infrastructure applications without over-purchasing or provisioning unnecessary equipment. Each custom-built solution has its entire solution stack-certified. There are no compatibility issues.
Prior to production deployment in your environment, run a VMware Horizon View pilot program to gather sizing and IOPS information for production environment planning purposes.

This reference architecture guide is for virtualization or desktop engineers that need to implement a linked clone desktop environment. You need a working familiarity with techniques and practices used for the products listed in this guide.

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.
Solution Overview

This reference architecture uses the following:

- Hitachi NAS Platform
- Hitachi Unified Storage VM
- Hitachi Compute Blade 500
- VMware vSphere 5.1 Update 1
- VMware Horizon View 5.2
- Brocade VDX-6720 Ethernet switches
- Brocade 6510 enterprise fabric switches
Determine User Workload

An important factor when sizing a VMware Horizon View environment for acceptable end-user performance is to define the typical workload profile for the end-user that will be using the environment. The workloads used for sizing this solution are based on LoginVSI and were supplemented by installing Vdbench within the gold image and extending the functionality of the LoginVSI base "heavy" workload test. Table 1 lists the applications that LoginVSI exercises during workload testing.

This reference architecture uses a Microsoft Windows 7 64-bit desktop running a heavy workload for defining sizing requirements. The virtual machine configuration represents a “Heavy Power User” as defined in VMware whitepaper “Storage Considerations for VMware Horizon View 5.2”. Table 2 lists the recommendations for desktop sizing, based on high-density or highly-available configurations.

Table 1. Workload Application Definition

<table>
<thead>
<tr>
<th>Workload Type</th>
<th>Heavy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applications Exercised</td>
<td></td>
</tr>
<tr>
<td>- Adobe Acrobat</td>
<td></td>
</tr>
<tr>
<td>- Adobe Flash</td>
<td></td>
</tr>
<tr>
<td>- FreeMind</td>
<td></td>
</tr>
<tr>
<td>- Microsoft Excel®</td>
<td></td>
</tr>
<tr>
<td>- Microsoft Internet Explorer</td>
<td></td>
</tr>
<tr>
<td>- Microsoft Outlook</td>
<td></td>
</tr>
<tr>
<td>- Microsoft PowerPoint</td>
<td></td>
</tr>
<tr>
<td>- Microsoft Word</td>
<td></td>
</tr>
<tr>
<td>- Photo Viewer</td>
<td></td>
</tr>
<tr>
<td>- Vdbench</td>
<td></td>
</tr>
<tr>
<td>- 7-Zip</td>
<td></td>
</tr>
<tr>
<td>- 720p Video Playback</td>
<td></td>
</tr>
<tr>
<td>- 1080p Video Playback</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Virtual Desktop Sizing

<table>
<thead>
<tr>
<th>Workload Type</th>
<th>Heavy</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>24GB/Thin Provisioned</td>
</tr>
</tbody>
</table>
For the purposes of this reference architecture guide, all sizing and testing was done:

- Logging on users at a rate of one login every 5.45 seconds
- Using a heavy workload averaging thirty to thirty-five IOPS per desktop during steady state

---

Note — Hitachi Data Systems recommends that you perform in-depth testing to determine the correct resource requirements of each type of end user in a production VDI environment.

Table 2. Virtual Desktop Sizing

<table>
<thead>
<tr>
<th>User Data</th>
<th>Up to 35GB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Login Storm IOPS</td>
<td>140 to 160</td>
</tr>
<tr>
<td>Average Steady State IOPS</td>
<td>30 to 35</td>
</tr>
<tr>
<td>High-Density vCPU per Core</td>
<td>6.9</td>
</tr>
<tr>
<td>Highly Available vCPU per Core</td>
<td>3.4</td>
</tr>
</tbody>
</table>
Logical Design

Figure 1 illustrates the high-level logical design of this reference architecture using Hitachi NAS Platform (HNAS), Hitachi Unified Storage VM (HUS VM), and Hitachi Compute Blade 500 (CB 500).

Figure 1

The solution in this reference architecture guide supports up to 440 Microsoft Windows 7, 64-bit, dual vCPU linked clone desktops with 4 GB of RAM running a heavy workload. Scale out this architecture to support thousands of desktops using the Hitachi converged infrastructure cell design.
Key Solution Components

These are descriptions of the key hardware and software components used to deploy this solution.

Hardware Components

Table 3 lists information about the hardware components used in this solution.

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi NAS Platform 4080</td>
<td>2 × 10 Gb/sec Cluster ports, 4 10 Gb/sec Ethernet ports, 4 × 8 Gb/sec Fibre Channel ports</td>
<td>11.1</td>
<td>2</td>
</tr>
<tr>
<td>Hitachi Unified Storage VM</td>
<td>Dual controllers, 16 × 8 Gb/sec Fibre Channel ports, 64 GB cache memory, 104 × 600 GB 10k RPM SAS disks, 2.5 inch SFF, 8 x 3 TB 7.2k RPM SAS disks</td>
<td>73-02-00-00/01</td>
<td>1</td>
</tr>
<tr>
<td>Hitachi Compute Blade 500 chassis</td>
<td>8-blade chassis, 2 x Brocade 5460 Fibre Channel switch modules, each with 6 × 8 Gb/sec uplink ports, 2 x Brocade VDX 6746 Ethernet switch modules, each with 8 × 10 Gb/sec uplink ports, 2 x management modules, 6 x cooling fan modules, 4 x power supply modules</td>
<td>SVP: A0145-H-7304 5460: FOS 6.3.2d1 VDX6746: NOS 2.0.1_kat4</td>
<td>1</td>
</tr>
</tbody>
</table>
Hitachi NAS Platform

Hitachi NAS Platform is an advanced and integrated network attached storage (NAS) solution. It provides a powerful tool for file sharing, file server consolidation, data protection, and business-critical NAS workloads.

- Powerful hardware-accelerated file system with multiprotocol file services, dynamic provisioning, intelligent tiering, virtualization, and cloud infrastructure
- Seamless integration with Hitachi SAN storage, Hitachi Command Suite, and Hitachi Data Discovery Suite for advanced search and index
- Integration with Hitachi Content Platform for active archiving, regulatory compliance, and large object storage for cloud infrastructure

Table 3. Hardware Components

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>520AH1 server blade</td>
<td>Half blade</td>
<td>BMC/EFI: 01-59</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>2 × 8-core Intel Xeon E5-2680 processor, 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 DIMMs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hitachi Compute Rack 210H</td>
<td>Rack mount server</td>
<td>01-05-03</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2 × 6-core Intel Xeon E5-2620L processor, 2.0 GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>96 GB RAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 × 2 port 10Gb/sec Emulex PCIe Ethernet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 × 2 port 1Gb/sec onboard Ethernet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brocade 6510 switch</td>
<td>SAN switch with 48 × 8 Gb Fibre Channel ports</td>
<td>FOS 7.0.1a</td>
<td>2</td>
</tr>
<tr>
<td>Brocade VDX 6720 switch</td>
<td>Ethernet switch with 24 × 10 Gb/sec ports</td>
<td>NOS 2.0.1b</td>
<td>2</td>
</tr>
</tbody>
</table>
Take advantage of the following features for better management and tighter integration of your Hitachi NAS environment with your VMware infrastructure.

- **Hitachi NAS Virtual Infrastructure Integrator** — A management console plug-in for VMware vCenter that simplifies virtual machine backup, restore, cloning, and NFS datastore management
- Hitachi Storage Provider for VMware vCenter — An adapter that enables the ESXi host to offload specific storage operations to the storage array
- Hitachi Storage Adapter for VMware API for Array Integration NAS — An adapter to show storage capabilities
- Hitachi NAS Deduplication — Technology to reclaim up to 90% of unstructured data storage capacity, extending the life of existing storage assets

**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 environment 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 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 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 reference architecture uses the following Brocade products:

- **Brocade 6510 Switch**
- **Brocade VDX 6720 Data Center Switch**

Software Components

Table 4 provides information about the software components used in this reference architecture.

<table>
<thead>
<tr>
<th>Software</th>
<th>Version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi Storage Navigator</td>
<td>Microcode Dependent</td>
</tr>
<tr>
<td>VMware vCenter Server</td>
<td>5.1 Update 1, Build 1123961</td>
</tr>
<tr>
<td>VMware ESXi</td>
<td>5.1 Update 1, Build 1065491</td>
</tr>
<tr>
<td>Microsoft SQL Server 2008</td>
<td>Standard Edition, R2</td>
</tr>
<tr>
<td>VMware Horizon View</td>
<td>5.2.0, Build 987719</td>
</tr>
</tbody>
</table>

VMware vSphere 5

VMware vSphere 5 is a virtualization platform that provides a data center 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 5** — 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.
Solution Design

This Hitachi Unified Compute Platform Select for VMware Horizon View with heavy power user workloads using Hitachi NAS Platform with Hitachi Unified Storage VM reference architecture uses the Hitachi converged infrastructure cell architecture that provides packaged components necessary to build a solution. The Hitachi converged infrastructure cell architecture defines the compute, network, and storage resources necessary to support a defined workload.

Use the Hitachi Unified Compute Platform Select design to implement a solution that scales in a cost-effective manner to meet your changing business needs quickly. Depending on density or availability requirements, scale from 55 to 2,640 desktops using a single Hitachi Unified Storage VM storage subsystem, multiple Hitachi NAS Platform storage heads, and multiple Hitachi Compute Blade 500 chassis.
Figure 2 illustrates a 50% density cell footprint, which supports 1,320 heavy power users.

The architecture consists of preconfigured cells designed to support a defined user workload. All cell sizing targets are for high density environments.
The minimum cell configuration required for Hitachi Unified Compute Platform Select for VMware Horizon View with heavy power user workloads using Hitachi NAS Platform consists of:

- **Infrastructure cell for compute resources** — Foundation for compute components
- **Infrastructure cell for storage resources** — Foundation for storage components
- **Infrastructure cell for Hitachi NAS Platform resources** — Foundation for NAS Platform components
- **Application cell for VMware Horizon View linked clones for heavy power users** — Resources for hosting VMware Horizon View Linked Clone desktops running a heavy power user workload
- **Resource cell for VMware Horizon View replicas** — Resources for hosting VMware Horizon View Linked Clone replica disks
- **Resource cell for VMware Horizon View user data** — Resources for hosting VMware Horizon View user data such as VMware Horizon View Persona Management data

Figure 3 illustrates the minimum cell configuration required as shown on the 1,320 user footprint.
Optional cells for additional functionality or performance within the solution include the following:

- **Application cell for Unified Compute Platform Select management** — Resource to manage this environment
  - This cell is required only if an existing configuration for managing a VMware vSphere environment does not exist.

- **Expansion cell for compute resources** — Resources for scaling out application cells.

- **Expansion cell for storage resources** — Additional expansion tray for disk-based resource cells.

The required and optional cells make up this Hitachi Unified Compute Platform Select for VMware Horizon View with heavy power user workloads using Hitachi NAS Platform solution to provide the needed compute, storage, and network hardware.

**Required Solution Cells**

This solution requires the following cells.
Infrastructure Cell for Compute Resources

The infrastructure cell for compute resources provides the foundation for the compute components needed to start building a scalable VMware Horizon View solution. Figure 4 illustrates the individual components within the infrastructure cell for compute resources with its location in the 1,320 user footprint.

Figure 4
Use the infrastructure cell for compute resources in conjunction with the following cells:

- Infrastructure cell for storage resources
- Infrastructure cell for Hitachi NAS Platform resources
- Application cell for VMware Horizon View linked clones for heavy power users
- Resource cell for VMware Horizon View replicas
- Resource cell for VMware Horizon View user data
- Application cell for Hitachi Unified Compute Platform Select management
- Expansion cell for compute resources

The infrastructure cell for compute resources supports up to two expansion cells for Hitachi Compute Blade 500 (three chassis total) before requiring a new infrastructure cell for compute resources.
Table 5 lists the individual components of the infrastructure cell for compute resources used in this reference architecture.

**Table 5. Infrastructure Cell for Compute Resources Components**

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Detail Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
</table>
| Hitachi Compute Blade 500 Chassis | ■ 2 × Brocade VDX6746 DCB switch modules  
                              ■ 2 × Brocade 5460 6-port 8 Gb/sec Fibre Channel switch modules  
                              ■ 2 × chassis management modules  
                              ■ 6 × cooling fan modules  
                              ■ 4 × power supply modules | SVP: A0145-H-7304  
                              5460: FOS 6.3.2d1  
                              VDX6746: NOS 2.0.1_kat4 | 1        |
| Brocade Ethernet Switch    | ■ Brocade VDX6720-60 10 Gb/sec 60 port Ethernet Switch                             | NOS 2.0.1b         | 2        |
| Brocade Fibre Channel Switch | ■ Brocade 6510-48 8 Gb/sec 48 port Fibre Channel Switch                           | FOS 7.0.1a         | 2        |
| Brocade Ethernet Switch    | ■ Brocade FCX 648.10/100/1000 48 port Ethernet Switch                             | 07.4.00c           | 1        |

The hardware in the infrastructure cell for compute resources makes up the core compute hardware in this Hitachi Unified Compute Platform Select for VMware Horizon View with heavy power user workloads using Hitachi NAS Platform solution.

**Chassis Components**

The Hitachi Compute Blade 500 chassis has redundant management modules to provide high availability access to manage and monitor the chassis, switch modules, and server blades. The chassis contains redundant switch modules for high availability and maximum throughput. Hot swappable power and fan modules allow for non-disruptive maintenance.
Network Infrastructure

The network design used in this solution provides ample bandwidth and redundancy for the following:

- A fully populated infrastructure cell for compute resources
- Up to three infrastructure cells for Hitachi NAS Platform resources
- Up to two expansion cells for compute resources

Figure 5 illustrates the physical network configuration of the infrastructure cell for compute resources.

Figure 5

The Brocade FCX switch provides 1 Gb/sec management connectivity for all hardware components in this solution.
The network design also allows for the utilization of advanced features in the Brocade VDX switch family such as Brocade VCS Fabric technology.

- Non-stop networking
- Simplified, automated networks
- An evolutionary approach that protects existing IT investments

**SAN Infrastructure (Optional)**

For this file services-based reference architecture, direct access from the Hitachi Compute Blade 500 chassis to the SAN infrastructure is not a requirement because the environment presents storage resources through the network. Consider this option when designing a hybrid architecture, when you need access to file storage resources and block storage resources.

The Hitachi Unified Storage VM controller used for this solution has 16 ports for connections to the Brocade 6510 enterprise Fabric switches. Zone the infrastructure cell for compute resources to four ports on the Hitachi Unified Storage VM controller, two ports per cluster. When adding an expansion cell for compute resources to the solution, zone four new open storage ports on the cluster.

Dedicating four ports to each Hitachi Compute Blade 500 chassis ensures sufficient bandwidth between the chassis and Hitachi Unified Storage VM.
Figure 6 illustrates the physical SAN architecture of the infrastructure cell for compute.

**Hitachi Compute Blade 500**

![Diagram showing the physical SAN architecture of the infrastructure cell for compute]

Figure 6
Infrastructure Cell for Storage Resources

The infrastructure cell for storage resources contains all of the base storage hardware required to start building this solution.

Figure 7 illustrates the individual components within the infrastructure cell for storage resources and its location in the 1,320 user footprint.

![Diagram of infrastructure cell for storage resources]

**Figure 7**

Use an infrastructure cell for storage in conjunction with the following cells:

- Infrastructure cell for compute resources
- Infrastructure cell for Hitachi NAS Platform resources
- Application cell for VMware Horizon View linked clones for heavy power users
- Resource cell for VMware Horizon View replicas
- Resource cell for VMware Horizon View user data
- Application cell for Hitachi Unified Compute Platform Select management
- Expansion cell for storage resources
With the infrastructure cell for Hitachi NAS Platform resources, the infrastructure cell for storage resources provides the back-end storage infrastructure for the other cells in the solution. Once an infrastructure cell for storage resources is fully populated, add additional infrastructure cells for storage resources to scale out the solution.

Table 6 shows the components of the infrastructure cell for storage resources.

**Table 6. Infrastructure Cell for Storage Resources Components**

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Detail Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
</table>
| Hitachi Unified Storage VM                    | ■ Dual controllers and Fibre Channel modules  
|                                               | ■ 16 × 8 Gb/sec Fibre Channel ports        | 73-02-00-00/01 | 1        |
|                                               | ■ 64 GB cache                             |               |          |
| Small Form Factor (SFF) disk expansion tray for Hitachi Unified Storage VM | ■ Contains disks for other cells           |               | 1        |
| Large Form Factor (LFF) disk expansion tray for Hitachi Unified Storage VM | ■ Contains disks for LFF-based cells        |               | 1        |

Each infrastructure cell for storage can support up to twenty-four application cells for VMware Horizon View linked clones for heavy power users.

The infrastructure cell for storage houses the following for this solution:

- Application or resource cells
- Hot spare drives

**Infrastructure Cell for Hitachi NAS Platform Resources**

The infrastructure cell for Hitachi NAS resources contains the file module components for building out a network attached storage infrastructure with high availability.
Figure 8 illustrates the individual components within the infrastructure cell for Hitachi NAS Platform resources and its location in the 1,320 user footprint.

**Figure 8**

Use an infrastructure cell for Hitachi NAS Platform resources in conjunction with the following cells:

- Infrastructure cell for compute resources
- Infrastructure cell for storage resources
- Application cell for Hitachi Unified Compute Platform Select management
- Application cell for VMware Horizon View linked clones for heavy power users
- Resource cell for VMware Horizon View replicas
- Resource cell for VMware Horizon View user data
The infrastructure cell for Hitachi NAS Platform resources provides multiprotocol file services for the other cells. The infrastructure cell for storage resources provides the backend physical disk resources for the Hitachi NAS Platform. One infrastructure cell for Hitachi NAS Platform resources supports up to:

- Four application cells for VMware Horizon View linked clones for heavy power users
- Two resource cells for VMware Horizon View replicas
- One resource cell for VMware Horizon View user data

The system management unit (SMU) provides server administration and monitoring tools. In addition, it manages data migration, replication, and supports clustering operations.

There are two Hitachi NAS Platform 4080 heads connected directly to each other to form a cluster. This cluster provides high performance and highly available NFS storage to the ESXi hypervisors. When clustering with three or more nodes, connect the cluster interconnect ports to a dedicated 10 Gb/sec switch.

A LUN presented from Hitachi Unified Storage VM to Hitachi NAS Platform 4080 is called a system drive. A storage pool is the logical container for one or more system drives. The storage pool can be expanded by adding storage drives to the pool.

Create one or more file systems from a storage pool. The file system is the primary storage component in Hitachi NAS Platform. All other features directly or indirectly support file systems.

For this solution, the VMware vSphere infrastructure uses NFS exports from a file system to connect to the storage resources provided by Hitachi NAS Platform 4080. VMware Horizon View Persona Management is configured to use an Active Directory integrated CIFS share from a file system to connect to the storage resources provided by Hitachi NAS Platform 4080.
Table 7 shows the components of the infrastructure cell for Hitachi NAS Platform resources.

Table 7. Infrastructure Cell for Hitachi NAS Platform Resources

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi NAS Platform 4080</td>
<td>2 × 10 Gb/sec cluster ports</td>
<td>11.1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4 × 10 Gb/sec Ethernet ports</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4 × 8 Gb/sec Fibre Channel ports</td>
<td></td>
<td></td>
</tr>
<tr>
<td>System management unit</td>
<td>2 × 10/100/1000 Mb/sec Ethernet ports</td>
<td>11.1</td>
<td>1</td>
</tr>
</tbody>
</table>

Network Infrastructure

The network design for network attached storage in this solution uses the following:

- **Link aggregation (LACP)**
  - Combine three 10 Gb/sec Ethernet ports into a single logical link to provide increased bandwidth, load balancing, and higher link availability for NFS exports.
  - Use a single 10 Gb/sec Ethernet port to dedicate to the virtual machine network for access to the CIFS server by the linked clone desktops.
  - The three 10 Gb/sec Ethernet ports on each node used for NFS connect to two Brocade VDX6720 switches in a Brocade VCS Fabric using link aggregation to provide high bandwidth and high availability in case of a switch failure.
  - The single 10 Gb/sec Ethernet ports on each node used for CIFS are connected to different Brocade VDX6720 switches to provide high availability of the CIFS server in case of a switch failure.

- **Jumbo frames**
  - Configure the link aggregate interface MTU size to 9000 to support jumbo frames.
  - Configure the VDX6720 switch ports MTU size to 9100 to support jumbo frames.

- **VLANs**
  - Separate NFS traffic from VMware vSphere management, VMware vMotion, and virtual machine network traffic.
Figure 9 shows the physical network configuration of the infrastructure cell for Hitachi NAS Platform resources.

**SAN Infrastructure**

While the four 8 Gb/sec Fibre Channel ports on each Hitachi NAS Platform 4080 controller can connect directly to the Hitachi Unified Storage VM Fibre Channel ports, this reference architecture leverages two Brocade 6510 Fibre Channel switches to provide the following:

- Port flexibility when designing an optional hybrid architecture for access to file storage resources and block storage resources
- Scalability when adding additional Hitachi NAS Platform nodes and Hitachi Unified Storage VM controllers to the infrastructure
Figure 10 shows the SAN configuration of the infrastructure cell for Hitachi NAS Platform resources.

Zone each Hitachi NAS Platform 4080 Fibre Channel port to the Hitachi Unified Storage VM through the Brocade 6510 Fibre Channel switch using single initiator to multi target zoning. Following best practice, configure the SAN environment in a dual fabric topology for redundancy and high availability. This results in four paths available to each ESXi host, providing the following:

- Resiliency to failure
- Redundant paths to the storage subsystem
Table 8 shows the zoning configuration used for the infrastructure cell for Hitachi NAS Platform resources.

Table 8. HNAS Zoning Configuration

<table>
<thead>
<tr>
<th>Host</th>
<th>Port</th>
<th>Director Zone Name</th>
<th>Storage Port</th>
<th>Fabric</th>
</tr>
</thead>
<tbody>
<tr>
<td>HNAS1</td>
<td>1</td>
<td>HNAS1_P1_HUS_VM_3A_5B_4A_6B</td>
<td>3A,5B,4A,6B</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>HNAS1_P2_HUS_VM_3A_5B_4A_6B</td>
<td>3A,5B,4A,6B</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>HNAS1_P3_HUS_VM_5A_3B_6A_4B</td>
<td>5A,3B,6A,4B</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>HNAS1_P4_HUS_VM_5A_3B_6A_4B</td>
<td>5A,3B,6A,4B</td>
<td>2</td>
</tr>
<tr>
<td>HNAS2</td>
<td>1</td>
<td>HNAS2_P1_HUS_VM_3A_5B_4A_6B</td>
<td>3A,5B,4A,6B</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>HNAS2_P2_HUS_VM_3A_5B_4A_6B</td>
<td>3A,5B,4A,6B</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>HNAS2_P3_HUS_VM_5A_3B_6A_4B</td>
<td>5A,3B,6A,4B</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>HNAS2_P4_HUS_VM_5A_3B_6A_4B</td>
<td>5A,3B,6A,4B</td>
<td>2</td>
</tr>
</tbody>
</table>

Configure Hitachi NAS Platform 4080 with the following best practice recommendations:

- Disable the read ahead cache on the Hitachi NAS Platform 4080 cluster
- Use a 4 KB file system block size with VMware environments
- Install and use VMware VAAI for NAS adapter for Hitachi NAS Platform
- When creating a storage pool, dedicate a minimum of four system drives to the storage pool

**Application Cell for VMware Horizon View Linked Clones for Heavy Power Users**

The application cell for VMware Horizon View linked clones for heavy power users contains all compute and storage components necessary to support up to 110 linked clone desktops for heavy power users.
Figure 11 illustrates the individual components within the application cell for VMware Horizon View linked clones for heavy power users and its location in the 1,320 user footprint.

**Figure 11**

Use an application cell for VMware Horizon View linked clones for heavy power users in conjunction with the following cells:

- Infrastructure cell for compute resources
- Infrastructure cell for storage resources
- Infrastructure cell for Hitachi NAS Platform
- Resource cell for VMware Horizon View replicas
- Resource cell for VMware Horizon View user data
- Expansion cell for compute resources
- Expansion cell for storage resources
Add the compute components of the application cell for VMware Horizon View linked clones for heavy power users to the infrastructure cell for compute resources, and the storage components to the infrastructure cell for storage resources and infrastructure cell for Hitachi NAS Platform to start building a scalable environment. Each application cell for VMware Horizon View linked clones for heavy power users supports up to 110 heavy power users.

To scale out the solution, add additional application cells for VMware Horizon View linked clones for heavy power users to your infrastructure cell for compute resources or expansion cell for Hitachi Compute Blade 500 to increase capacity. Up to 12 application cells for VMware Horizon View linked clones for heavy workloads can be supported by a single infrastructure cell for compute resources.

**Compute Infrastructure**

The application cell for VMware Horizon View linked clones for heavy power users supports a maximum density of 110 heavy power user desktops per cell. However, in a high density configuration, a cell cannot support the failover of desktops in the case of a server blade failure.

Enable VMware Horizon View Accelerator feature for desktop pools to reduce the read I/O seen on the Hitachi NAS Platform and the Hitachi Unified Storage VM. The maximum amount of memory on the ESXi hosts that can be dedicated to VMware Horizon View Accelerator is 2 GB. The 520HA1 server blades included in the application cell for VMware Horizon View linked clones for heavy power users contain enough memory to dedicate the maximum memory to the VMware Horizon View Accelerator feature.

To design for high availability, create a dedicated High Availability and Distributed Resource Scheduler cluster and place the hosts from each application cell into the cluster. This ensures the separation of resources from management and other workloads for optimal hypervisor efficiency and desktop performance.

To ensure that a minimum of one host is available for High Availability resources, reduce the number of desktops in the cluster by 55. If you require additional High Availability host capacity, continue to reduce desktops in sets of 55 for each host required for a High Availability resource allocation.

Based on VMware configuration maximums, each High Availability and Distributed Resource Scheduler cluster can support up to 16 application cells for VMware Horizon View linked clones for heavy power users (32 hosts).
Table 9 lists the components of the application cell for VMware Horizon View linked clones for heavy power users.

Table 9. Application Cell for VMware Horizon View Linked Clones for Heavy Power Users Components

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Detail Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>520HA1 server blade</td>
<td></td>
<td>BMC/EFI: 01-59</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>▪ 2 × 8-Core Intel Xeon E5-2680 processors, 2.7 GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 256 GB RAM per server blade</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 1 Emulex 4-port 10 Gb/sec CNA card</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 1 Hitachi FIVE-EX 2-port 8 Gb Fibre Channel mezzanine card</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFF disk drives</td>
<td>RAID-10 (2D+2D)</td>
<td></td>
<td>24</td>
</tr>
<tr>
<td></td>
<td>▪ Hot spare</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>▪ Installed in infrastructure cell for storage resources disk tray</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFF disk expansion tray</td>
<td>Added to the infrastructure cell for storage resources</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

Network Infrastructure

Configure each 520HA1 server blade with an Emulex 4-port 10 Gb/sec CNA card for network traffic. The CNA card contains two controllers each managing two physical ports. Each card can be split into four logical NICs per physical port.
The solution design dedicates the following ports:

- Two ports on Controller 0 for hypervisor and virtual machine traffic
  - Split each port on Controller 0 into four logical NICs per channel, for a total of eight NICs per server blade.
  - For the purpose of this design, use only three NICs per channel. This allows maximum bandwidth for the virtual machine network.
- Two ports on Controller 1 for NFS storage traffic
  - Leave the two ports on Controller 1 as individual NICs.

Add each pair of vmnics as an active physical adapter in its respective vSwitch. This allows for redundancy in the network fabric in case of failure of the server blade chassis, switch module, or upstream switch.

Set bandwidth allocation for each NIC as follows:

- **Controller 0 — Channel 0 and 1 NIC 0 (vmnic0 and vmnic1)**
  - Virtual machine management network
  - VMkernel management network vSwitch
  - 1 Gb/sec per NIC, for a total of 2 Gb/sec

- **Controller 0 — Channel 0 and 1 NIC 1 (vmnic2 and vmnic3)**
  - vMotion network
  - VMkernel vMotion network vSwitch
  - 2 Gb/sec per NIC, for a total of 4 Gb/sec

- **Controller 0 — Channel 0 and 1 NIC 2 (vmnic4 and vmnic5)**
  - Virtual machine network
  - Virtual machine network vSwitch
  - 7 Gb/sec per NIC, for a total of 14 Gb/sec

- **Controller 1 — Channel 0 and 1 NIC 3 (vmnic8 and vmnic9)**
  - NFS storage network
  - VMkernel NFS network vSwitch
  - 10 Gb/sec per NIC, for a total of 20 Gb/sec
This solution uses the following VLANs to separate network traffic in the application cell for VMware Horizon View linked clones for heavy power users:

- **Management-VLAN** — Chassis management connections and primary management of the ESXi hypervisors
- **vMotion-VLAN** — Configured for VMware vMotion
- **VM-VLAN** — Configured for the virtual machine network
- **NFS-VLAN** — Configured for NFS traffic

Following best practice, separate the management, vMotion, virtual machine, and NFS traffic to achieve greater security or better performance.

- Team the logical NICs to allow network path redundancy.
- Configure the VMkernel NFS vSwitch MTU size to 9000 to support jumbo frames.
- Use link aggregation by creating port channels across the two internal Brocade VDX6746 switch module ports in a Brocade VCS fabric for the two 10 Gb/sec ports (vmnic8 and vmnic9) dedicated to NFS traffic on each server blade. This provides high bandwidth using an active-active connection and high availability in case of a switch module failure.
- Configure the load balancing policy for the NFS vSwitch for “route based on IP hash.”
- Perform maintenance upgrades with zero downtime of the Brocade VDX6746 switch modules while you keep the server blades online.

With enhancements to VMware vSphere 5, VMkernel load balances vMotion traffic over all VMkernel ports configured for vMotion. This improves performance and reduces migration times.

**Hitachi NAS Platform Infrastructure**

The Hitachi NAS Platform infrastructure of the application cell for VMware Horizon View linked clones for heavy power users consists of twenty-four 600 GB 10k RPM SAS drives presented from Hitachi Unified Storage VM to each Hitachi NAS Platform 4080 head with the following configuration:

- 24 drives (1 tray) consisting of 6 parity groups in a RAID-10 (2D+2D) configuration presented as 6 LDEVs, each of which correspond to a Hitachi NAS Platform system drive

Alternate pool, file system, and EVS assignment across the Hitachi NAS Platform for each application cell for VMware Horizon View linked clones deployed. This ensures linear performance scalability for workloads and allows even utilization across the Hitachi NAS Platform 4080 heads.
Each node can concurrently access system drives. Therefore, present all system drives to all nodes in a Hitachi NAS Platform cluster, so any head can access the storage during a failover event.

Figure 12 shows the back-end storage and file system mapping for the application cell for VMware Horizon View linked clones for heavy power users.

**Storage for Horizon View Linked Clones**

- 24 Drives Configured in 6 RAID-10 (2D+2D) Parity Groups

**HUS VM System Objects**

- Each RAID-10 (2D+2P) Parity Group Configured in an HUS VM LDEV

**HNAS System Objects**

- Each LDEV is a System Disk on HNAS 4080

- 6 System Drives create 1 Storage Pool

- 1 HNAS 4080 File System is created from the Storage Pool

- 1 Storage Pool Exported as 5 HNAS NFS Targets

*Figure 12*
Figure 12

**Storage Infrastructure**
Hitachi Unified Storage VM LDEVs are presented to the Hitachi NAS Platform nodes as system drives. These LDEVs are mapped evenly to the four MPUs on Hitachi Unified Storage VM automatically. This spreads the workload across the four storage processors.

**Resource Cell for VMware Horizon View Replicas**
The resource cell for VMware Horizon View replicas contains the storage components necessary to host the replica disks for linked clone desktop deployments.

Figure 13 illustrates the individual components within the resource cell for VMware Horizon View replicas and their location within the 1,320 user footprint.
Use a resource cell for VMware Horizon View replicas in conjunction with the following cells:

- Infrastructure cell for compute resources
- Infrastructure cell for storage resources
- Infrastructure cell for Hitachi NAS Platform resources
- Application cell for VMware Horizon View linked clones for heavy power users

The resource cell for VMware Horizon View replicas hosts the cloned replica of the desktop gold image for deployment in a VMware Horizon View linked clone pool.

Pair this cell with a maximum of two application cells for VMware Horizon View linked clones for heavy power users. You can install this cell in either of the following:

- Infrastructure cell for storage resources
- Expansion cell for storage resources

Table 10 shows the components of the resource cell for VMware Horizon View replicas.

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Detail Description</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>SFF disk drives</td>
<td>600 GB 10k RPM SAS drives</td>
<td></td>
</tr>
<tr>
<td></td>
<td>RAID-10 (2D+2D)</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Installed in infrastructure cell for storage resources SFF disk tray</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hot spare</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Installed in infrastructure cell for storage resources SFF disk tray</td>
<td></td>
</tr>
</tbody>
</table>

**Hitachi NAS Platform Infrastructure**

The Hitachi NAS Platform infrastructure of the resource cell for VMware Horizon View replicas consists of four 600 GB 10k RPM SAS drives presented from Hitachi Unified Storage VM to each Hitachi NAS Platform 4080 head with the following configuration:

- 4 drives consisting of 1 parity group in a RAID-10 (2D+2D) configuration presented as 4 LDEVs, each of which correspond to a Hitachi NAS Platform system drive
Alternate pool, file system, and EVS assignment across the Hitachi NAS Platform for each resource cell for VMware Horizon View replicas deployed. This ensures linear performance scalability for workloads and allows even utilization across the Hitachi NAS Platform 4080 heads.

Each node can concurrently access system drives. Therefore, present all system drives to all nodes in a Hitachi NAS Platform cluster, so any head can access the storage during a failover event.

Figure 14 shows the back-end storage and file system mapping for the resource cell for VMware Horizon View replicas.
Storage Infrastructure

Hitachi Unified Storage VM LDEVs are presented to the Hitachi NAS Platform nodes as system drives. These LDEVs are mapped evenly to the four MPUs on Hitachi Unified Storage VM automatically. This spreads the workload across the four storage processors.

As resource cells for VMware Horizon View replicas are added to the infrastructure, ensure that they are evenly distributed across MPUs on Hitachi Unified Storage VM.

Resource Cell for VMware Horizon View User Data

The resource cell for VMware Horizon View user data contains the storage components necessary to host user data for linked clone desktop deployments.

Figure 15 illustrates the individual components within the resource cell for VMware Horizon View user data and their location within the 1,320 user footprint.

![Resource Cell for VMware Horizon View User Data](image)

Figure 15
Use a resource cell for VMware Horizon View user data in conjunction with the following cells:

- Infrastructure cell for compute resources
- Infrastructure cell for storage resources
- Infrastructure cell for Hitachi NAS Platform resources
- Application cell for VMware Horizon View linked clones for heavy power users

The resource cell for VMware Horizon View user data hosts the storage necessary to provide up to 35 GB per user of CIFS-based storage for VMware Horizon View Persona Management or Microsoft Windows roaming profile data.

Pair this cell with a maximum of four application cells for VMware Horizon View linked clones for heavy power users. Add resource cells for VMware Horizon View user data if more than 35 GB of capacity per user is required.

Table 11 shows the components of the resource cell for VMware Horizon View user data.

### Table 11. Resource Cell for VMware Horizon View User Data

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Detail Description</th>
<th>Quantity</th>
</tr>
</thead>
</table>
| LFF disk drives 3TB 7.2k RPM NL-SAS drives | ▪ RAID-6 (6D+2P)  
▪ Installed in infrastructure cell for storage resources LFF disk tray | 8        |
|                               | ▪ Hot spare  
▪ Installed in infrastructure cell for storage resources LFF disk tray | 1        |

### Hitachi NAS Platform Infrastructure

The Hitachi NAS Platform infrastructure of the resource cell for VMware Horizon View user data consists of eight 3 TB 7.2k RPM NL-SAS drives presented from Hitachi Unified Storage VM to each Hitachi NAS Platform 4080 head with the following configuration:

- 8 drives consisting of 1 parity group in a RAID-6 (6D+2P) configuration presented as 5 LDEVs, each of which correspond to a Hitachi NAS Platform system drive
Alternate pool, file system, and EVS assignment across the Hitachi NAS Platform for each resource cell for VMware Horizon View user data deployed. This ensures linear performance scalability for workloads and allows even utilization across the Hitachi NAS Platform 4080 heads.

Each node can concurrently access system drives. Therefore, present all system drives to all nodes in a Hitachi NAS Platform cluster, so any head can access the storage during a failover event.
Figure 16 shows the back-end storage and file system mapping for the resource cell for VMware Horizon View user data.

**Storage for Horizon View User Data**

8 Drives Configured in 1 RAID-6 (6D+2P) Parity Group

RAID Group
RAID 6 (6D+2P)

HUS VM LDEV

RAID-6 (6D+2P) Parity Group Configured as 5 HUS VM LDEVs

**HUS VM System Objects**

**HNAS System Objects**

LDEV is a System Disk on HNAS 4080

5 System Drives create 1 Storage Pool

1 HNAS 4080 File System is created from the Storage Pool

1 Storage Pool Exported as HNAS CIFS Target

**Figure 16**

*Storage Infrastructure*

Hitachi Unified Storage VM LDEVs are presented to the Hitachi NAS Platform nodes as system drives. These LDEVs are mapped evenly to the four MPUs on Hitachi Unified Storage VM automatically. This spreads the workload across the four storage processors.
As resource cells for VMware Horizon View user data are added to the infrastructure, ensure that they are evenly distributed across MPUs on Hitachi Unified Storage VM.

Optional Solution Cells
Using these cells is optional in your implementation of this reference architecture.

Application Cell for Hitachi Unified Compute Platform Select Management
The application cell for Hitachi Unified Compute Platform Select management contains the compute and storage components for hosting the VMware vSphere and VMware Horizon View infrastructure management services.

Figure 17 illustrates the individual components within the application cell for Hitachi Unified Compute Platform Select management and their location within the 1,320 user footprint.
Use an application cell for Hitachi Unified Compute Platform Select management in conjunction with the following cells:

- Infrastructure cell for compute resources
- Infrastructure cell for storage resources
- Infrastructure cell for Hitachi NAS Platform resources
- Application cell for VMware Horizon View linked clones for heavy power users
- Resource cell for VMware Horizon View replicas
- Resource cell for VMware Horizon View user data

Use an application cell for Hitachi Unified Compute Platform Select management when a VMware vSphere environment does not already exist.

**Compute Infrastructure**

The application cell for Hitachi Unified Compute Platform Select management provides enough capacity to support an emergency high availability event if a single server fails.

Use VMware High Availability and VMware Distributed Resource Scheduler to configure a cluster dedicated to the application cell for Hitachi Unified Compute Platform Select management to ensure virtual machine failover in the event of a hardware failure.
Table 12 shows the details of the hardware configuration in the application cell for Unified Compute Platform Select management.

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Detail Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi Compute Rack 210H</td>
<td>Rack mount server</td>
<td>BMC/EFI: 01-05-03</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>2 × 6-core Intel Xeon E5-2620L processor, 2.0 GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>96 GB RAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Emulex OCE11102-NX 2 port 10 Gb/sec PCIe Ethernet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 Broadcom 2 port 1Gb/sec onboard Ethernet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFF disk drives 600 GB 10k RPM SAS drives</td>
<td>RAID-6 (6D+2P)</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Installed in the infrastructure cell for storage resources disk tray or expansion cell for storage resources</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hot spare</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Installed in the infrastructure cell for storage resources disk tray or expansion cell for storage resources</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The compute infrastructure of the application cell for Hitachi Unified Compute Platform Select management supports all associated Microsoft® SQL Server®, Microsoft Active Directory®, VMware vCenter, and VMware Horizon View requirements.

Manage your environment using the above resources or by connecting to a pre-existing VMware vSphere management environment.

**Network Infrastructure**

Configure each Hitachi Compute Rack 210H server with a single Emulex OCE11102-NX 2 port 10 Gb/sec PCIe Ethernet card for network traffic.
This solution uses the following VLANs to separate network traffic in the application cell for VMware vSphere:

- **Management-VLAN** — Chassis management connections and primary management of the ESXi hypervisors
- **vMotion-VLAN** — Configured for VMware vMotion
- **VM-VLAN** — Configured for the virtual machine network
- **NFS-VLAN** — Configured for management applications that access infrastructure on the NFS VLAN

Following best practice, separate the management, vMotion, virtual machine, and NFS traffic to achieve greater security or better performance.

- Team the two physical NICs to allow network path redundancy
- Set the load balancing policy to “route based on IP hash”

With enhancements to VMware vSphere 5, the VMkernel load balances vMotion traffic over all VMkernel ports configured for vMotion. This improves performance and reduces migration times.

**Storage Infrastructure**

The storage infrastructure of the application cell for Hitachi Unified Compute Platform Select management consists of eight 600 GB 10k RPM SAS drives housed in the disk expansion tray contained in the infrastructure cell for storage resources.

Configure the storage into a single RAID-6 (6D+2P) LDEV. Present the storage as a system drive to the Hitachi NAS Platform 4100 node. Create a storage pool and file system dedicated to management servers. The pool provides an overall capacity of 3 TB.
Table 13 lists the virtual machine configurations used for each component of the management infrastructure used in this reference architecture.

**Table 13. Virtual Machine Sizing Recommendations**

<table>
<thead>
<tr>
<th>Virtual Machine</th>
<th>Configuration</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microsoft Active Directory, DNS, DHCP</td>
<td>vCPU — 1</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>vMemory — 4 GB</td>
<td></td>
</tr>
<tr>
<td>VMware vCenter</td>
<td>vCPU — 4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>vMemory — 16 GB</td>
<td></td>
</tr>
<tr>
<td>Microsoft SQL Server 2008 database for the following:</td>
<td>vCPU — 2</td>
<td>1</td>
</tr>
<tr>
<td>- VMware vCenter</td>
<td>vMemory — 8 GB</td>
<td></td>
</tr>
<tr>
<td>- VMware Horizon View Composer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- VMware Horizon View Event DB</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VMware Horizon View Connection Server</td>
<td>vCPU — 4</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>vMemory — 16 GB</td>
<td></td>
</tr>
</tbody>
</table>

**Expansion Cell for Compute Resources**

Use the expansion cell for compute resources to scale out the Hitachi Unified Compute Platform Select for VMware Horizon View with heavy power user workloads using Hitachi NAS Platform with Hitachi Unified Storage VM solution beyond the Hitachi Compute Blade 500 chassis included in the infrastructure cell for compute resources.
Figure 18 illustrates the individual components within the expansion cell for compute resources and their location on the 1,320 user footprint.

**Figure 18**

Use an expansion cell for compute resources in conjunction with the following cells:

- Infrastructure cell for compute resources
- Application cell for VMware Horizon View linked clones for power user workloads

Use the expansion cell for compute resources when the Hitachi Compute Blade 500 chassis included with the infrastructure cell for compute resources is fully populated. Connect the expansion cell for compute resources to the existing Brocade VDX 6720 and Brocade 6510 (if desired) switching infrastructures included in the infrastructure cell for compute resources.
You can add up to two expansion cells for compute resources to an infrastructure cell for compute resources before you must add a new infrastructure cell for compute resources due to port density requirements on the switching infrastructures.

**Chassis Components**

The expansion cell for compute resources uses the same chassis components contained in “Infrastructure Cell for Compute Resources.”

**Networking Infrastructure**

The networking for the expansion cell for Hitachi Compute Blade 500 uses the same networking configurations as the chassis found in “Infrastructure Cell for Compute Resources.”

**Expansion Cell for Storage Resources**

Use the expansion cell for storage resources to scale out the Hitachi Unified Compute Platform Select for VMware Horizon View with heavy power user workloads using Hitachi NAS Platform with Hitachi Unified Storage VM solution beyond the Hitachi Unified Storage VM disk trays included in the infrastructure cell for storage resources and the application cells for VMware Horizon View linked clones for heavy power users.
Figure 19 illustrates the individual components within the expansion cell for storage resources and their location on the 1,320 user footprint.

**Figure 19**

Use an expansion cell for storage resources in conjunction with the following cells:

- Infrastructure cell for storage resources
- Resource cell for VMware Horizon View replicas
- Resource cell for VMware Horizon View user data

Use the expansion cell for storage resources when the disk expansion trays included with the infrastructure cell for storage resources is fully populated with hot spare disks, resource cell for VMware Horizon View replicas disks, and resource cell for VMware Horizon View user data disks.
Scale Out Using Hitachi Converged Infrastructure Cells

To scale out using Hitachi converged infrastructure cells, add the necessary pre-validated cells to the solution. The following examples show scalability up to 2,640 heavy power users in a maximum density environment.

Based on VMware recommendations deploy a dedicated VMware Horizon View Connection Server for every 2,000 linked clone desktops when using VMware Horizon View 5.2. Prior to scaling out to 2,640 linked clone desktops, deploy appropriate VMware Horizon View Connection Server instances within the management infrastructure, and add them to the VMware Horizon View infrastructure through Horizon View Administrator.

Scale Out to 440 Heavy Power Users

Table 14 lists the cells and quantities necessary to deploy the 440 user maximum density architecture.

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure cell for compute resources</td>
<td>1</td>
</tr>
<tr>
<td>Infrastructure cell for storage resources</td>
<td>1</td>
</tr>
<tr>
<td>Infrastructure cell for Hitachi NAS Platform resources</td>
<td>1</td>
</tr>
<tr>
<td>Application cell for VMware Horizon View linked clones for heavy power users</td>
<td>4</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View replicas</td>
<td>2</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View user data</td>
<td>1</td>
</tr>
</tbody>
</table>

Scale Out to 880 Heavy Power Users

Table 15 lists the cells and quantities necessary to deploy the 880 user maximum density architecture.

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure cell for compute resources</td>
<td>1</td>
</tr>
<tr>
<td>Infrastructure cell for storage resources</td>
<td>1</td>
</tr>
<tr>
<td>Infrastructure cell for Hitachi NAS Platform resources</td>
<td>2</td>
</tr>
<tr>
<td>Application cell for VMware Horizon View linked clones for heavy power users</td>
<td>8</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View replicas</td>
<td>4</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View user data</td>
<td>2</td>
</tr>
<tr>
<td>Expansion cell for compute resources</td>
<td>1</td>
</tr>
<tr>
<td>Expansion cell for storage resources (SFF)</td>
<td>1</td>
</tr>
</tbody>
</table>
### Scale Out to 1,320 Heavy Power Users

Table 16 lists the cells and quantities necessary to deploy the 1,320 user maximum density architecture.

**Table 16. Cells Necessary for 1,320 User Maximum Density Architecture**

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure cell for compute resources</td>
<td>1</td>
</tr>
<tr>
<td>Infrastructure cell for storage resources</td>
<td>1</td>
</tr>
<tr>
<td>Infrastructure cell for Hitachi NAS Platform resources</td>
<td>3</td>
</tr>
<tr>
<td>Application cell for VMware Horizon View linked clones for heavy power users</td>
<td>12</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View replicas</td>
<td>6</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View user data</td>
<td>3</td>
</tr>
<tr>
<td>Expansion cell for compute resources</td>
<td>2</td>
</tr>
<tr>
<td>Expansion cell for storage resources (SFF)</td>
<td>1</td>
</tr>
</tbody>
</table>

### Scale Out to 1,760 Heavy Power Users

Table 17 lists the cells and quantities necessary to deploy the 1,760 user maximum density architecture.

**Table 17. Cells Necessary for 1,760 User Maximum Density Architecture**

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure cell for compute resources</td>
<td>2</td>
</tr>
<tr>
<td>Infrastructure cell for storage resources</td>
<td>1</td>
</tr>
<tr>
<td>Infrastructure cell for Hitachi NAS Platform resources</td>
<td>4</td>
</tr>
<tr>
<td>Application cell for VMware Horizon View linked clones for heavy power users</td>
<td>16</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View replicas</td>
<td>8</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View user data</td>
<td>4</td>
</tr>
<tr>
<td>Expansion cell for compute resources</td>
<td>2</td>
</tr>
<tr>
<td>Expansion cell for storage resources (SFF)</td>
<td>2</td>
</tr>
</tbody>
</table>
Scale Out to 2,200 Heavy Power Users
Table 18 lists the cells and quantities necessary to deploy the 2,200 user maximum density architecture.

Table 18. Cells Necessary for 2,200 User Maximum Density Architecture

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure cell for compute resources</td>
<td>2</td>
</tr>
<tr>
<td>Infrastructure cell for storage resources</td>
<td>1</td>
</tr>
<tr>
<td>Infrastructure cell for Hitachi NAS Platform resources</td>
<td>5</td>
</tr>
<tr>
<td>Application cell for VMware Horizon View linked clones for heavy power users</td>
<td>20</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View replicas</td>
<td>10</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View user data</td>
<td>5</td>
</tr>
<tr>
<td>Expansion cell for compute resources</td>
<td>3</td>
</tr>
<tr>
<td>Expansion cell for storage resources (SFF)</td>
<td>2</td>
</tr>
</tbody>
</table>

Scale Out to 2,640 Heavy Power Users
Table 19 lists the cells and quantities necessary to deploy the 2,640 user maximum density architecture.

Table 19. Cells Necessary for 2,640 User Maximum Density Architecture

<table>
<thead>
<tr>
<th>Cell Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure cell for compute resources</td>
<td>2</td>
</tr>
<tr>
<td>Infrastructure cell for storage resources</td>
<td>1</td>
</tr>
<tr>
<td>Infrastructure cell for Hitachi NAS Platform resources</td>
<td>6</td>
</tr>
<tr>
<td>Application cell for VMware Horizon View linked clones for heavy power users</td>
<td>24</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View replicas</td>
<td>12</td>
</tr>
<tr>
<td>Resource cell for VMware Horizon View user data</td>
<td>6</td>
</tr>
<tr>
<td>Expansion cell for compute resources</td>
<td>4</td>
</tr>
<tr>
<td>Expansion cell for storage resources (SFF)</td>
<td>2</td>
</tr>
</tbody>
</table>
Engineering Validation

This is the test methodology used to validate this reference architecture and the results of the validation testing.

This reference architecture tested the core components of the Hitachi Unified Compute Platform Select for VMware Horizon View with heavy power user workloads using Hitachi NAS Platform with Hitachi Unified Storage VM solution to determine maximum loads per application cell that the solution should support while still maintaining an acceptable end-user experience.

The tested components were validated to support up to 110 linked clone desktops per application cell running a heavy power user workload. The actual number of desktops in a deployed environment will vary, depending on workloads and high availability requirements.
Figure 20 illustrates the Hitachi converged infrastructure cells tested in this 440-user reference architecture.
Test Methodology

Testing used a single Hitachi Compute Blade 500 chassis to test a 440 seat linked clone configuration, including:

- One infrastructure cell for compute resources
- One infrastructure cell for storage resources
- One infrastructure cell for Hitachi NAS Platform resources
- Four application cells for VMware Horizon View linked clones for heavy power users
- Two resource cells for VMware Horizon View replicas
- One resource cell for VMware Horizon View user data

Provisioning Storm Testing

Provisioning storm testing was performed for 440 desktops. Concurrent provisioning operations for VMware Horizon View Composer were increased to 32 in order to show the rapid provisioning capabilities of the Hitachi NAS Platform 4080 heads.

Boot Storm Testing

During boot storm testing, all 440 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.

Login Storm, Steady State, and Logoff/Refresh Testing

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

To boost IOPS per desktop for heavier workload testing, Vdbench was incorporated into the desktop gold image, and configured to run in each segment of the LoginVSI heavy workload. The LoginVSI heavy workload was also modified to open, save, and copy files within the folders enabled for Horizon View Persona Management to exercise the resource cell for VMware Horizon View user data. LoginVSI 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.

Login rates were kept at a constant one login per 5.45 seconds ratio throughout all cell testing. Steady state workload IOPS targets were set to average thirty to thirty-five IOPS per desktop.

The Horizon View floating user assignment desktop pool was configured to immediately refresh the desktop after user logoff, and VMware Horizon View Storage Accelerator was enabled for all testing. View Composer Array Integration (VCAI) is available on Hitachi NAS Platform through use of the Hitachi NAS VAAI plugin, but was not used during lab validation testing due to tech preview status in Horizon View 5.2.
Test Results - Provisioning Storm

These are the test results for the environment operating during a provisioning storm. The 440 user provisioning storm took sixty-three minutes to complete. This time was measured from when the provisioning operation started until the Horizon View desktops were flagged as available in Horizon View Administrator.

Hitachi NAS Platform Infrastructure

Multiple performance metrics were collected from the Hitachi NAS Platform System Management Unit (SMU) during the test. Figure 21 through Figure 25 show the performance data for the 440 user provisioning storm.

- NAS Platform leverages field-programmable gateway arrays (FPGA) to provide hardware acceleration of processing for certain operations. CPU load and FPGA load were captured to provide an indicator of overall performance.

- Individual file system operations are shown to demonstrate the difference in NFS operations between the different disk/data types used in this solution.
Node NFS Operations

Figure 21 shows the number of NFS operations per node during the 440 user provisioning storm.

- Node 1 NFS operations peaked at approximately 22,000 during the provisioning storm.
- Node 2 NFS operations peaked at approximately 17,000 during the provisioning storm.

Figure 21
**Node System Load**

Figure 22 and Figure 23 show the CPU and FPGA loads of each Hitachi NAS Platform 4080 head during the 440 user provisioning storm.

- Node 1 CPU load peaked at approximately 51% during the provisioning storm.
- Node 1 FPGA load peaked at approximately 89% during the provisioning storm.
- Node 2 CPU load peaked at approximately 69% during the provisioning storm.
- Node 2 FPGA load peaked at approximately 77% during the provisioning storm.

![Node 1 System Load](image)

*Figure 22*
Figure 23

Node 2 System Load

Percent

Time in 10 Second Intervals

Node 2 FPGA
Node 2 CPU
Node File System Operations

Figure 24 and Figure 25 show the individual file system operations for each type of cell storage used in the solution during the 440 user provisioning storm.

- Cell 1 linked clone file system operations peaked at approximately 13,500 during the provisioning storm.
- Cell 2 linked clone file system operations peaked at approximately 9,500 during the provisioning storm.
- Cell 3 linked clone file system operations peaked at approximately 14,000 during the provisioning storm.
- Cell 4 linked clone file system operations peaked at approximately 14,500 during the provisioning storm.
- Cell 1 replica file system operations peaked at approximately 5,200 during the provisioning storm.
- Cell 2 replica file system operations peaked at approximately 4,300 during the provisioning storm.

Figure 24
Metrics for the resource cell for VMware Horizon View user data file system were not collected since there was no I/O being issued to the file system during provisioning operations.

Storage Infrastructure

Multiple performance metrics were collected from the Hitachi Unified Storage VM storage subsystem during the 440 user provisioning storm. Figure 26 through Figure 29 show the performance data for the 440 user provisioning storm. Metrics were analyzed from the Hitachi Unified Storage VM controllers to ensure the following:

- Physical disks were not saturated
- Processor cores and cache performed well

Physical disk performance was acceptable during the 440 user provisioning storm.
Parity Group IOPS

Figure 26 shows the total read and write IOPS for the parity groups associated with the linked clone file systems.

- The read IOPS peaked at approximately 7,800 during the provisioning storm.
- The write IOPS peaked at approximately 4,900 during the provisioning storm.

Figure 26
Figure 27 shows the total read and write IOPS for the parity groups associated with the replica file systems.

- The read IOPS peaked at approximately 6,700 during the provisioning storm.
- The write IOPS peaked at approximately 2,500 during the provisioning storm.

![Replica IOPS](image)
Processor and Cache

Figure 28 shows the processor and cache efficiency during the 440 user provisioning storm.

- Cache write pending rate does not rise above 33% during the provisioning storm.
- Average MPU utilization does not rise above 4% during the provisioning storm.

![Processor and Cache Performance](image)

Figure 28
Physical Disk

Figure 29 shows the average disk busy rate for the parity groups associated with the linked clone and replica file systems during the 440 user provisioning storm.

- Average disk busy rate for the linked clone parity groups does not rise above 8% during the provisioning storm.
- Average disk busy rate for the replica parity groups does not rise above 53% during the provisioning storm.

![Average Disk Busy Rate](image)

**Figure 29**

Test Results - Boot Storm

These are the test results for the environment operating during a boot storm. The 440 user boot storm took three minutes forty seconds to complete. This time was measured from when the desktops were directly powered on from within VMware vCenter until the Horizon View desktops were flagged as available in Horizon View Administrator.
Hitachi NAS Platform Infrastructure

Multiple performance metrics were collected from the Hitachi NAS Platform System Management Unit (SMU) during the test. Figure 30 through Figure 34 show the performance data for the 440 user boot storm.

- NAS Platform leverages field-programmable gateway arrays (FPGA) to provide hardware acceleration of processing for certain operations. CPU load and FPGA load were captured to provide an indicator of overall performance.

- Individual file system operations are shown to demonstrate the difference in NFS operations between the different disk/data types used in this solution.

Node NFS Operations

Figure 30 shows the number of NFS operations per node during the 440 user boot storm.

- Node 1 NFS operations peaked at approximately 46,500 during the boot storm.
- Node 2 NFS operations peaked at approximately 40,000 during the boot storm.

![Node NFS Operations](image_url)

**Figure 30**
Node System Load

Figure 31 and Figure 32 show the CPU and FPGA loads of each Hitachi NAS Platform 4080 head during the 440 user boot storm.

- Node 1 CPU load peaked at approximately 85% during the boot storm.
- Node 1 FPGA load peaked at approximately 99% during the boot storm.
- Node 2 CPU load peaked at approximately 82% during the boot storm.
- Node 2 FPGA load peaked at approximately 99% during the boot storm.

Figure 31
Node 2 System Load

Time in 10 Second Intervals

Percent

Node 2 FPGA
Node 2 CPU

Figure 32
Node File System Operations

Figure 33 and Figure 34 show the individual file system operations for each type of cell storage used in the solution during the 440 user boot storm.

- Cell 1 linked clone file system operations peaked at approximately 22,000 during the boot storm.
- Cell 2 linked clone file system operations peaked at approximately 24,500 during the boot storm.
- Cell 3 linked clone file system operations peaked at approximately 24,500 during the boot storm.
- Cell 4 linked clone file system operations peaked at approximately 15,000 during the boot storm.
- Cell 1 replica file system operations peaked at approximately 12,500 during the boot storm.
- Cell 2 replica file system operations peaked at approximately 10,000 during the boot storm.

Figure 33
Metrics for the resource cell for VMware Horizon View user data file system were not collected since there was no I/O being issued to the file system during provisioning operations.

Storage Infrastructure
Multiple performance metrics were collected from the Hitachi Unified Storage VM storage subsystem during the 440 user boot storm. Figure 35 through Figure 38 show the performance data for the 440 user boot storm. Metrics were analyzed from the Hitachi Unified Storage VM controllers to ensure the following:

- Physical disks were not saturated
- Processor cores and cache performed well

Physical disk performance was acceptable during the 440 user boot storm.
Parity Group IOPS

Figure 35 shows the total read and write IOPS for the parity groups associated with the linked clone file systems.

- The read IOPS peaked at approximately 13,500 during the boot storm.
- The write IOPS peaked at approximately 11,000 during the boot storm.

![Linked Clone IOPS](image)
Figure 36 shows the total read and write IOPS for the parity groups associated with the replica file systems.

- The read IOPS peaked at approximately 340 during the boot storm.
- The write IOPS peaked at approximately one during the boot storm.

![Replica IOPS Graph](image-url)
**Processor and Cache**

Figure 37 shows the processor and cache efficiency during the 440 user boot storm.

- Cache write pending rate does not rise above 39% during the boot storm.
- Average MPU utilization does not rise above 9% during the boot storm.

![Processor and Cache Performance](image)

*Figure 37*
Physical Disk

Figure 38 shows the average disk busy rate for the parity groups associated with the linked clone and replica file systems during the 440 user boot storm.

- Average disk busy rate for the linked clone parity groups does not rise above 48% during the boot storm.
- Average disk busy rate for the replica parity groups does not rise above 13% during the boot storm.

![Average Disk Busy Rate](image)

**Figure 38**

Test Results - Login/Steady State/Logoff/Refresh

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

Compute Infrastructure

Multiple performance metrics were collected from the ESXi hypervisors during the test operations. Figure 39 through Figure 42 show the performance data for the 440 user test operations. Eight 520HA1 server blades provide sufficient hardware resources for the hypervisors to support 440 Horizon View linked clone desktops.
Hypervisor CPU Performance

Figure 39 shows the physical CPU metrics collected on the ESXi hypervisors while running the 440 user test operations.

- There are three operations occurring during this test executed by LoginVSI:
  - Login storm (minutes 1-41)
  - Steady state (minutes 41-261)
  - Logoff/Refresh (minutes 261-321)
- The performance metrics show the following:
  - Percent utilization peaks at approximately 80% during login storm.
  - Percent utilization peaks at approximately 76% during steady state.
  - Percent utilization peaks at approximately 70% during logoff/refresh.

This shows that there is still headroom on the 520HA1 server blades to support bursts in workloads while still maintaining acceptable end user performance.
Hypervisor Memory Performance

There are two 520HA1 server blades per cell tested, each containing 256 GB of RAM. Each 110-user desktop pool was split between two server blades, allowing commitment of 4096 MB to each virtual machine (55 virtual machines per server blade x 4096 MB per virtual machine is 225 GB per server blade). Swap metrics were not graphed as swap read per second and swap write per second were recorded at zero for the entirety of the test.

Figure 40 shows the memory utilization within the environment during the test operations. The performance metrics show the following:

- Once login storm subsided, shared virtual machine memory drops to zero. This shows the true randomness of the LoginVSI workload.
- Used physical RAM remains high throughout the test, showing that the 520HA1 server blades operate near the memory capacity configured.
Hypervisor Storage Performance

Figure 41 shows the storage latency statistics, as seen from the linked clone virtual machines for the linked clone and replica datastores. The performance metrics show the following:

- During login storm, latency does not rise above 5ms for either the linked clone or replica datastores.
- During steady state, latency does not rise above 8ms for the linked clone datastore.
- During steady state, latency does not rise above 3ms for the replica datastore.
- During logoff/refresh, latency rises to 81ms for the linked clone datastore.
- During logoff/refresh, latency rises to 19ms for the replica datastore.

![Datastore Latency - Guest](image)

Figure 41
Guest operating system metrics were collected for each virtual desktop during the 440 user test. Figure 42 illustrates five different virtual machines and the observed IOPS for the VMDKs during login and steady state. Since the virtual machine powers off during a refresh operation, those metrics are not visible. The performance metrics show the following:

- During login storm, guest IOPS average 140-160.
- During steady state, guest IOPS average 35.

![Guest Operating System IOPS](image)

**Figure 42**

**Hitachi NAS Platform Infrastructure**

Multiple performance metrics were collected from the Hitachi NAS Platform System Management Unit (SMU) during the test operations. Figure 43 through Figure 48 show the performance data for the 440 user test operations.

- NAS Platform leverages field-programmable gateway arrays (FPGA) to provide hardware acceleration of processing for certain operations. CPU load and FPGA load were captured to provide an indicator of overall performance.
- Individual file system operations are shown to demonstrate the difference in NFS operations between the different disk/data types used in this solution.
Node NFS Operations

Figure 43 shows the number of NFS operations per node during the 440 user test operations.

- There are three operations occurring during this test executed by LoginVSI:
  - Login storm (intervals 1-361)
  - Steady state (intervals 361-1681)
  - Logoff/Refresh (intervals 1681-1921)

- The performance metrics show the following:
  - Node 1 NFS operations peaked at approximately 35,000 during the login storm, 20,000 during steady state, and 17,000 during logoff/refresh.
  - Node 2 NFS operations peaked at approximately 27,000 during the login storm, 30,000 during steady state, and 27,000 during logoff/refresh.
Node System Load

Figure 44 and Figure 45 show the CPU and FPGA loads of each Hitachi NAS Platform 4080 head during the 440 user test operations.

- Node 1 CPU load peaked at approximately 75% during the login storm, 62% during steady state, and 58% during logoff/refresh.
- Node 1 FPGA load peaked at approximately 25% during the login storm, 35% during steady state, and 62% during logoff/refresh.
- Node 2 CPU load peaked at approximately 81% during the login storm, 75% during steady state, and 80% during logoff/refresh.
- Node 2 FPGA load peaked at approximately 33% during the login storm, 32% during steady state, and 71% during logoff/refresh.

Figure 44
Node 2 System Load

![Graph showing system load over time for Node 2 with two curves, one for FPGA and one for CPU.]

**Figure 45**
**Node File System Operations**

Figure 46 through Figure 48 show the individual file system operations for each type of cell storage used in the solution during the 440 user test operations.

- Cell 1 linked clone file system operations peaked at approximately 18,000 during the login storm, 10,000 during steady state, and 9,000 during logoff/refresh.
- Cell 2 linked clone file system operations peaked at approximately 14,000 during the login storm, 19,000 during steady state, and 11,500 during logoff/refresh.
- Cell 3 linked clone file system operations peaked at approximately 12,000 during the login storm, 10,000 during steady state, and 11,000 during logoff/refresh.
- Cell 4 linked clone file system operations peaked at approximately 13,000 during the login storm, 10,000 during steady state, and 10,000 during logoff/refresh.

**Figure 46**

- Cell 1 replica file system operations peaked at approximately 7,000 during the login storm, 4,000 during steady state, and 1,500 during logoff/refresh.
- Cell 2 replica file system operations peaked at approximately 4,000 during the login storm, 1,100 during steady state, and 1,600 during logoff/refresh.
Cell 1 user data file system operations peaked at approximately 5,000 during the login storm, 2,500 during steady state, and 7,000 during logoff/refresh.
Storage Infrastructure

Multiple performance metrics were collected from the Hitachi Unified Storage VM storage subsystem during the test operations. Figure 49 through Figure 54 show the performance data for the 440 user test operations. Metrics were analyzed from the Hitachi Unified Storage VM controllers to ensure the following:

- Physical disks were not saturated
- Processor cores and cache performed well

Physical disk performance was acceptable during the 440 user test operations.
Parity Group IOPS

Figure 49 shows the total read and write IOPS for the parity groups associated with the linked clone file systems.

- There are three operations occurring during this test executed by LoginVSI:
  - Login storm (minutes 1-41)
  - Steady state (minutes 41-261)
  - Logoff/Refresh (minutes 261-321)

- The performance metrics show the following:
  - The read IOPS peaked at approximately 24,000 during the login storm, 20,000 during steady state, and 25,000 during logoff/refresh.
  - The write IOPS peaked at approximately 5,100 during the login storm, 5,000 during steady state, and 7,500 during logoff/refresh.

![Linked Clone IOPS](image-url)
Figure 50 shows the total read and write IOPS for the parity groups associated with the replica file systems.

- The read IOPS peaked at approximately 625 during the login storm, 300 during steady state, and 250 during logoff/refresh.
- The write IOPS peaked at approximately one for the entirety of the test operations.
Figure 51 shows the total read and write IOPS for the parity groups associated with the user data file systems.

- The read IOPS peaked at approximately 100 during the login storm, 25 during steady state, and 5 during logoff/refresh.
- The write IOPS peaked at approximately 220 during the login storm, 250 during steady state, and 440 during logoff/refresh.
Processor and Cache

Figure 52 shows the processor and cache efficiency during the 440 user test operations.

- Cache write pending rate does not rise above 39% during the entirety of the test operations.
- Average MPU utilization does not rise above 11% during the entirety of the test operations.
Physical Disk

Figure 53 shows the average disk busy rate for the parity groups associated with the linked clone, replica, and user data file systems during the 440 user test operations.

- Average disk busy rate for the linked clone parity groups does not rise above 62% during the entirety of the test operations.
- Average disk busy rate for the replica parity groups does not rise above 21% during the entirety of the test operations.
- Average disk busy rate for the user data parity groups does not rise above 12% during the entirety of the test operations.
Figure 54 shows the average latency for the parity groups associated with the linked clone, replica, and user data file systems during the 440 user test operations.

- Average latency for the linked clone parity groups does not rise above 5.75ms for the entirety of the test operations.
- Average latency for the replica parity groups does not rise above 11ms for the entirety of the test operations.
- Average latency for the user data parity groups does not rise above 10ms for the entirety of the test operations.

**Figure 54**

**Application Experience**

LoginVSI 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 this reference architecture provides adequate user experience for 440 heavy power users.
Table 20 lists the operation abbreviations used in LoginVSI and a description of the action taken during the operation.

<table>
<thead>
<tr>
<th>LoginVSI 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 55 shows the application experience metrics as reported by LoginVSI.
Conclusion

This reference architecture guide shows how to design a Hitachi Unified Compute Platform Select for VMware Horizon View with heavy power user workloads using Hitachi NAS Platform with Hitachi Unified Storage VM. The Hitachi converged infrastructure cell design validated in the Hitachi Data Systems laboratory enables a build as you go model with performance-proven sets of hardware resources.

Using this cell approach, you can scale designs to support from 55 up to 2,640 heavy power users. Create a right-sized design that allows purchasing flexibility to meet changing business or project needs.

When designing your implementation of this environment, understand the I/O workload of a desktop in your existing environment to properly design the virtual desktop architecture. This can reduce costs and increase ROI by allowing you to implement the smallest environment possible.
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.

Live and recorded product demonstrations are available for many Hitachi products. To schedule a live demonstration, contact a sales representative. To view a recorded demonstration, see the Hitachi Data Systems Corporate Resources website. Click the Product Demos tab for a list of available recorded demonstrations.

Hitachi Data Systems Academy provides best-in-class training on Hitachi products, technology, solutions and certifications. Hitachi Data Systems Academy delivers on-demand web-based training (WBT), classroom-based instructor-led training (ILT) and virtual instructor-led training (vILT) courses. For more information, see the Hitachi Data Systems Services Education website.

For more information about Hitachi products and services, contact your sales representative or channel partner or visit the Hitachi Data Systems website.