Deploy Hitachi Unified Compute Platform Select for VMware vSphere using Hitachi NAS Platform with Hitachi Unified Storage VM

Reference Architecture Guide

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Deploy Hitachi Unified Compute Platform Select for VMware vSphere using Hitachi NAS Platform with Hitachi Unified Storage VM

Reference Architecture Guide

Hitachi Unified Compute Platform Select with VMware vSphere using Hitachi NAS Platform with Hitachi Unified Storage VM is a Network File System (NFS)-based storage solution. You can integrate this environment with an existing SAN solution.

This reference architecture guide contains advice on how to build a virtual infrastructure that meets the unique requirements of your organization. It provides the flexibility to scale out the environment as organizational needs grow. The benefits of this solution include the following:

- Faster deployment
- Reduced risk
- Predictability
- Ability to scale out
- Lower cost of ownership

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.

This reference architecture guide focuses on designing a virtual infrastructure capable of hosting virtual machines running general server application workloads.

Hitachi Data Systems strongly recommends that you run a server capacity-planning pilot to gather sizing and IOPS information before designing your environment.
You need familiarity with the use and configuration of the following to use this reference architecture guide:

- Hitachi NAS Platform
- Hitachi Unified Storage VM
- Hitachi Compute Blade 500
- VMware vSphere 5

**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 a VMware infrastructure supported by Hitachi and Brocade hardware to create a flexible and pre-validated end-to-end converged stack solution.

This solution validates the integration of the hardware stack (compute, storage and networking) with the software stack (hypervisor and management for software and hardware components).

The following components create this Unified Compute Platform Select for VMware vSphere environment:

- **Hitachi NAS Platform** — Network-attached storage solution used for file sharing, file server consolidation, data protection, and business-critical NAS workloads
- **Hitachi Unified Storage VM** — Storage virtualization system designed to manage storage assets more efficiently
- **Hitachi Compute Blade 500** — Enterprise-class server platform, containing internal Fibre Channel and network switch modules, that provides dense compute resources and high I/O throughput
- **VMware vSphere 5** — Virtualization technology providing the infrastructure for the data center
- **Brocade VDX 6720 Fabric Switch** — Provides connectivity to the data center network
- **Brocade 6510 Enterprise-class Fabric Switch** — Provides SAN connectivity for Hitachi Unified Storage VM
Figure 1 illustrates the high-level logical design of this reference architecture on Hitachi NAS Platform with Hitachi Unified Storage VM and Hitachi Compute Blade 500.
Key Solution Components

These are descriptions of the key hardware and software components used to deploy this Hitachi Unified Compute Platform Select for VMware vSphere reference solution with Hitachi NAS Platform.

Hardware Components

Table 1 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 4100</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>Hitachi Unified Storage VM</td>
<td>• Dual controllers</td>
<td>73-02-00-00/01</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>• 72 × 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: A0145-H-7304</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 6.3.2d1</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 2.0.1_kat4</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: 01-59</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>• 96 GB RAM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• 6 × 16 DIMMs</td>
<td></td>
<td></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 multi-protocol 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

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** — Simplify virtual machine backup, restoration, cloning, and NFS datastore management
- **VMware vSphere API for Array Integration** — Enables the ESXi host to offload certain storage operations to the storage array
- **VMware vSphere API for Storage Awareness** — Shows storage capabilities
- **Hitachi NAS Deduplication** — Reclaim up to 90% of unstructured data storage capacity, to extend the life of existing storage assets

### Table 1. Hardware Components (Continued)

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
</table>
| Hitachi Compute Rack 210H | - Rack mount server  
                         | - 2 × 6-core Intex Xeon E5-2620L processor, 2.0 GHz  
                         | - 96 GB RAM  
                     | - 1 × 2 port 10Gb/sec Emulex PCIe Ethernet  
                         | - 1 × 2 port 1 Gb/sec onboard Ethernet | 01-05-03 | 2        |
| Brocade 6510 switch    | - SAN switch with 48 × 8 Gb Fibre Channel ports | FOS 7.0.1a | 2        |
| Brocade VDX 6720 switch| - Ethernet switch with 24 × 10 Gb/sec ports | NOS 2.0.1b | 2        |
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 2 describes 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>5.1.0</td>
</tr>
<tr>
<td>VMware vSphere client</td>
<td>5.1.0</td>
</tr>
<tr>
<td>VMware ESXi</td>
<td>5.1.0</td>
</tr>
<tr>
<td>Microsoft Windows Server 2008</td>
<td>Enterprise edition, R2</td>
</tr>
<tr>
<td>Microsoft SQL Server 2008</td>
<td>Enterprise edition, R2</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.
Solution Design

This is design information on this reference solution for Hitachi Unified Compute Platform Select for VMware vSphere with Hitachi NAS Platform 4100. It includes detailed software and hardware information required to build the basic infrastructure for the virtualized data center environment.

This solution uses a cell architecture for scaling out in modular increments. This design defines compute and storage resource cells (groups) to support a specific usage scenario. Add cells to scale out the environment to meet your requirements.

Figure 2 provides a high-level concept of the cell architecture.
The architecture consists of preconfigured cells designed to support general server workload. These cells provide the following:

- **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 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.
- **Application cell for VMware vSphere** — Provides the resource for hosting virtual machines running general server application workloads.
- **Expansion cell for compute resources** — Provides the compute resources for scaling out the Unified Compute Platform Select for VMware vSphere environment.
- **Expansion cell for storage resources** — Provides the storage resources for scaling out the Unified Compute Platform Select for VMware vSphere environment.

These cells provide the compute and storage hardware needed to build this scalable Hitachi Unified Compute Platform Select for VMware vSphere solution.

Figure 3 on page 11 provides an overview of the infrastructure connectivity.
Figure 3

Infrastructure Cell for Compute Resources

The infrastructure cell for compute resources provides the foundation for building compute components in this solution.

Figure 4 on page 12 shows the infrastructure cell for compute resources.
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 Hitachi Unified Compute Platform Select management
- Application cell for VMware vSphere
- Expansion cell for compute resources

The infrastructure cell for compute resources and the infrastructure cell for storage resources are the core infrastructure cells required to build a scalable solution. Both infrastructure cells support up to two infrastructure cells for Hitachi NAS resources before requiring new infrastructure cells. Every infrastructure cell for compute resources requires one infrastructure cell for storage resources.
Table 3 shows the components of the infrastructure cell for compute resources.

Table 3. Hardware Components for the Infrastructure Cell for Compute Resources

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Detail Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi Compute Blade 500 Chassis</td>
<td>▪ 2 Brocade VDX6746 DCB switch modules</td>
<td>SVP: A0145-H-7304</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>▪ 2 Brocade 5460 6-port 8 Gb/sec Fibre Channel switch modules</td>
<td>5460: FOS 6.3.2d1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 2 chassis management modules</td>
<td>VDX6746: NOS 2.0.1_kat4</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>Brocade Ethernet Switch</td>
<td>▪ Brocade VDX6720-60 10 Gb/sec 60 port Ethernet Switch</td>
<td>NOS 2.0.1b</td>
<td>2</td>
</tr>
<tr>
<td>Brocade Fibre Channel Switch</td>
<td>▪ Brocade 6510-48 8 Gb/sec 48 port Fibre Channel switch</td>
<td>FOS 7.0.1a</td>
<td>2</td>
</tr>
<tr>
<td>Brocade Ethernet Switch</td>
<td>▪ Brocade FCX 648 10/100/1000 48 port Ethernet Switch</td>
<td>07.4.00c</td>
<td>1</td>
</tr>
</tbody>
</table>

The hardware in the infrastructure cell for compute resources makes up the core compute hardware in this Hitachi Unified Compute Platform Select for VMware vSphere 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
- An infrastructure cell for Hitachi NAS Platform resources
- Up to three expansion cells for compute resources
Figure 5 shows the physical network configuration of the infrastructure cell for compute resources.

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 on page 16 illustrates the physical SAN architecture of the infrastructure cell for compute.
Hitachi Compute Blade 500

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 shows the infrastructure cell for storage resources.

Figure 7

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

- Infrastructure cell for compute resources
- Infrastructure cell for Hitachi NAS Platform resources
- Application cell for Hitachi Unified Compute Platform Select management
- Application cell for VMware vSphere

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 4 shows the components of the infrastructure cell for storage resources.

Table 4. Infrastructure Cell for Storage Resources Hardware

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Detail Description</th>
<th>Version</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hitachi Unified Storage VM</td>
<td>▪ Dual controllers and Fibre Channel modules &lt;br&gt;▪ 16 × 8 Gb/sec Fibre Channel ports &lt;br&gt;▪ 32 GB cache</td>
<td>73-02-00-00/01</td>
<td>1</td>
</tr>
<tr>
<td>SFF disk expansion tray for Hitachi Unified Storage VM</td>
<td>▪ Contains disks for other cells</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

The infrastructure cell for storage resources contains a Hitachi Unified Storage VM controller and a disk expansion tray.

This disk expansion tray holds disks for this infrastructure cell. Add storage disks to this cell for the following:

- Application cell for Hitachi Unified Compute Platform Select management
- Hot spares (optional)

Each infrastructure cell for storage resources can physically support up to 11 application cells for VMware vSphere.

**Note** — Scalability limits depend on application workloads running on this infrastructure.
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 shows the infrastructure cell for Hitachi NAS Platform.

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 vSphere

The infrastructure cell for Hitachi NAS Platform resources provides multi-protocol file services for the other cells. The infrastructure cell for storage resources provides the back end physical disk resources for the Hitachi NAS Platform. One infrastructure cell for Hitachi NAS Platform resources supports up to two application cells for VMware vSphere.

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

There are two Hitachi NAS Platform 4100 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 4100 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 4100.

Table 5 shows the components of the 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 4100</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 all four 10 Gb/sec Ethernet ports into a single logical link to provide increased bandwidth, load balancing, and higher link availability.
  - The four 10 Gb/sec Ethernet ports on each node connect to two Brocade VDX6720 switches (2 connections each) in a Brocade VCS Fabric using link aggregation to provide high bandwidth and high availability 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 4100 controller can connect directly to the Hitachi Universal 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 Universal Storage VM controllers to the infrastructure

Figure 10 on page 22 shows the SAN configuration of the infrastructure cell for Hitachi NAS Platform resources.
Zone each Hitachi NAS Platform 4100 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 per port available to each Hitachi NAS 4100 Platform controller, providing the following:

- Resiliency to failure
- Redundant paths to the storage subsystem

Table 6 shows the zoning configuration used for the infrastructure cell for Hitachi NAS Platform resources.

Table 6. Infrastructure Cell for Hitachi NAS Platform Resources Zone 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>HNAS 1</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>
</tbody>
</table>
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 infrastructure management services.

Figure 11 shows the application cell for Unified Compute Platform Select management.

**Table 6. Infrastructure Cell for Hitachi NAS Platform Resources Zone Configuration (Continued)**

<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>HNAS 2</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>

**Figure 11**

Use an application cell for 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 vSphere

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

**Note** — Scalability limits depend on application workloads running on this infrastructure.
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 Unified Compute Platform Select management to ensure virtual machine failover in the event of a hardware failure.

Table 7 shows the details of the hardware configuration in the application cell for Unified Compute Platform Select management.

Table 7. Application Cell for Unified Compute Platform Select Management Hardware

<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 10Gb/sec PCIe Ethernet</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 1 Broadcom 2 port 1Gb/sec on-board Ethernet</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SFF disk drives</td>
<td>▪ RAID-6 (6D+2P)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 600 GB 10k RPM SAS drives</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>▪ Installed in the infrastructure cell for storage resources disk tray</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Hot spare</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>

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

Server Configuration Sizing Guidelines
Apply the proper resource allocation for virtual machines used to manage the Hitachi Unified Compute Platform Select for VMware vSphere environment. If using a separate environment outside of this solution for management, use the virtual machine sizing recommendations in Table 8 on page 26.

Table 8 lists the virtual machine configurations used for each component of the management infrastructure used in this reference architecture.
Application Cell for VMware vSphere

The application cell for VMware vSphere contains all compute and storage components necessary to run general server application workloads consisting of the following:

- 168 virtual CPUs
- 212 GB of virtual machine memory
- 18 TB of storage capacity

Figure 12 on page 27 shows the application cell for VMware vSphere.

<table>
<thead>
<tr>
<th>Virtual Machine</th>
<th>Configuration</th>
<th>Count</th>
</tr>
</thead>
</table>
| Microsoft Active Directory, DNS, DHCP | vCPU — 1  
vMemory — 4 GB | 1     |
| VMware vCenter  | vCPU — 2  
vMemory — 10 GB  | 1     |
| Microsoft SQL Server 2008 database for VMware vCenter | vCPU — 2  
vMemory — 8 GB | 1     |
Use the application cell for VMware vSphere in conjunction with the following cells:

- Infrastructure cell for compute resources
- Infrastructure cell for storage resources
- Infrastructure cell for Hitachi NAS Platform resources
- Expansion cell for compute resources (used for scale-out)

Add the compute components of the application cell for VMware vSphere to the infrastructure cell for compute and the storage components to the infrastructure cell for storage to start building a scalable Hitachi Unified Compute Platform Select for VMware vSphere environment.

To scale out the solution and increase capacity, add additional application cells for VMware vSphere to the following:

- Infrastructure cells for compute resources
- Expansion cells for compute resources

Figure 12
This physically supports up to four application cells for VMware vSphere before there is need to add new infrastructure cells with the following:

- 1 infrastructure cell for compute resources
- 1 infrastructure cell for storage resources
- 2 infrastructure cells for Hitachi NAS Platform resources

**Note** — Scalability limits depend on application workloads running on this infrastructure.

### Compute Infrastructure

The application cell for VMware vSphere supports a maximum density of the following:

- 168 virtual CPUs
- 212 GB of virtual machine memory

In a maximum density configuration, a cell cannot support the failover of virtual machines in case of a server blade failure. To provide high availability, do the following:

- Reduce the number of virtual CPUs and virtual machine memory per host up to 50%.
- Configure a VMware High Availability and VMware Distributed Resource Scheduler cluster dedicated to application cells for VMware vSphere.

Place additional hosts from each application cell for VMware vSphere into the cluster. When scaling the solution, increase the number of virtual machines per host as you add more resources to the cluster.

Based on VMware maximums, each High Availability and Distributed Resource Scheduler cluster can support up to 16 application cells for VMware vSphere (32 hosts).
Table 9 shows the details of the hardware used in the application cell for VMware vSphere.

### Table 9. Application Cell for VMware vSphere Hardware

<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>▪ 2 × 8-Core Intel Xeon E5-2680 processors, 2.7 GHz</td>
<td>BMC/EFI: 01-59</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>▪ 96 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>72</td>
</tr>
<tr>
<td></td>
<td>▪ 600GB 10k RPM SAS drives</td>
<td></td>
<td></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 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 NFS traffic

Following best practice, separate the management, vMotion, virtual machine, and NFS traffic to achieve greater security and 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 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 vSphere consists of seventy-two 600 GB 10k RPM SAS drives presented from Hitachi Unified Storage VM to each Hitachi NAS Platform 4100 heads with the following configuration:

- **Node 1 Pool 0** — 24 drives (1 tray) consisting of 6 RAID groups in a RAID-10 (2D+2D) configuration presented as 6 Hitachi NAS Platform system drives
- **Node 2 Pool 1** — 48 drives (2 trays) consisting of 12 RAID groups in a RAID-10 (2D+2D) configuration presented as 12 Hitachi NAS Platform system drives

The high random read and write nature of the server application workloads is the reason for using RAID-10.

Each Hitachi NAS Platform 4100 head contains one storage pool, one file system, and one enterprise virtual server (EVS). The EVS hosts these file systems. When requiring additional capacity, add additional system drives to the storage pool and file system capacity on the fly.

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.

Table 10 summarizes the Hitachi NAS Platform configuration for this reference architecture.

<table>
<thead>
<tr>
<th>System Disk Numbers</th>
<th>Storage Pool Name</th>
<th>Storage Pool Size</th>
<th>File System Name</th>
<th>Enterprise Virtual Server</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>Pool 0</td>
<td>5.5 TB</td>
<td>File System 1</td>
<td>EVS1 on Hitachi NAS Platform 4100 node 1</td>
</tr>
<tr>
<td>6-17</td>
<td>Pool 1</td>
<td>12 TB</td>
<td>File System 2</td>
<td>EVS2 on Hitachi NAS Platform 4100 node 2</td>
</tr>
</tbody>
</table>
Figure 13 shows the back-end storage and file system mapping for HNAS Node 1 on NAS Platform.

**HNAS Node 1 Storage Configuration**

- 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

**Hitachi NAS Platform System Objects**

- Each LDEV is a System Drive on NAS Platform 4100

- 6 System Drives create 1 Storage Pool

**NAS Platform 4100 File System**

- 1 NAS Platform 4100 File System is created from the Storage Pool

- 2 Datastores Exported as NAS Platform NFS Target

Figure 13
Figure 14 shows the back-end storage and file system mapping for HNAS 4100 node 2.

**HNAS Node 2 Storage Configuration**

- 48 Drives Configured in 12 RAID Groups
- 10 2D+2D Parity Groups
- Each RAID-10 (2D+2D) Parity Group Configured in an HUS VM LDEV

**HUS VM System Objects**

**Hitachi NAS Platform System Objects**

- 12 HNAS 4100 SD
- Each LDEV is a System Drive on NAS Platform 4100
- 12 System Drives create 1 Storage Pool
- 1 NAS Platform 4100 File System is created from the Storage Pool
- 9 Datastores Exported as NAS Platform NFS Targets

Figure 14
Configure Hitachi NAS Platform 4100 with the following best practice recommendations:

- Disable the read ahead cache on the Hitachi NAS Platform 4100 cluster.
- Use a 4 KB file system block size with VMware environments.
- Install and use VMware VAAI for NAS adapter for Hitachi NAS Platform.

**Storage Infrastructure**

The 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.

Table 11 shows the MPU to LDEV mapping.

<table>
<thead>
<tr>
<th>MPU</th>
<th>LDEV</th>
<th>NAS Platform Pool</th>
</tr>
</thead>
<tbody>
<tr>
<td>MPU-10</td>
<td>HNAS_SD0, HNAS_SD4</td>
<td>Pool 0</td>
</tr>
<tr>
<td></td>
<td>HNAS_SD8, HNAS_SD12, HNAS_SD16</td>
<td>Pool 1</td>
</tr>
<tr>
<td>MPU-11</td>
<td>HNAS_SD1, HNAS_SD5</td>
<td>Pool 0</td>
</tr>
<tr>
<td></td>
<td>HNAS_SD9, HNAS_SD13, HNAS_SD17</td>
<td>Pool 1</td>
</tr>
<tr>
<td>MPU-20</td>
<td>HNAS_SD2</td>
<td>Pool 0</td>
</tr>
<tr>
<td></td>
<td>HNAS_SD6, HNAS_SD10, HNAS_SD14</td>
<td>Pool 1</td>
</tr>
<tr>
<td>MPU-21</td>
<td>HNAS_SD3</td>
<td>Pool 0</td>
</tr>
<tr>
<td></td>
<td>HNAS_SD7, HNAS_SD11, HNAS_SD15</td>
<td>Pool 1</td>
</tr>
</tbody>
</table>
Engineering Validation

This is the test methodology used to validate this reference architecture and the results of the testing. These tests demonstrated the maximum utilization of the reference architecture.

The purpose of the tests was to determine maximum loads that the solution could support and still maintain an acceptable application performance.

Test Methodology

Testing of the core components of this Hitachi Unified Compute Platform Select for VMware vSphere reference architecture solution validated its performance and design. Testing validated a mixed workload of the following:

- Email messages
- Web pages
- Online transaction processing (OLTP)

The workload was grouped into a tile-based system to measure application performance and scalability. Each tile contained mixed workloads that stress critical compute and storage resources. These workloads represent a general purpose data center environment for VMware vSphere.

Each tile consists of the following virtual machines listed in Table 12.

Table 12. Virtual Machines for Each Testing Tile

<table>
<thead>
<tr>
<th></th>
<th>Microsoft Exchange 2007</th>
<th>Apache Olio Web Server</th>
<th>Apache Olio Database Server</th>
<th>Dell DVD Store 2 Database Server</th>
<th>Dell DVD Store 2 Web Server</th>
<th>Standby</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quantity</td>
<td>1 Virtual Machine</td>
<td>1 Virtual Machine</td>
<td>1 Virtual Machine</td>
<td>1 Virtual Machine</td>
<td>3 Virtual Machine</td>
<td>1 Virtual Machine</td>
</tr>
<tr>
<td>CPU</td>
<td>4 vCPUs</td>
<td>4 vCPUs</td>
<td>2 vCPUs</td>
<td>4 vCPUs</td>
<td>2 vCPUs</td>
<td>1 vCPUs</td>
</tr>
<tr>
<td>Memory</td>
<td>8192 MB</td>
<td>6144 MB</td>
<td>2048 MB</td>
<td>4096 MB</td>
<td>2048 MB</td>
<td>512 MB</td>
</tr>
</tbody>
</table>

Each tile represented a simulation of the following types of workloads:

- Microsoft Exchange 2007 mail servers for general email workloads
- Apache Olio web and database servers for Web 2.0 workloads
- Dell DVD Store 2 web and database servers for OLTP workloads
- Standby servers for idle general infrastructure workload
Testing involved these cells:

- Infrastructure cell for compute resources
- Infrastructure cell for Hitachi NAS Platform resources
- Infrastructure cell for storage resources
- Application cell for Unified Compute Platform Select management
- Application cell for VMware vSphere
  - 168 vCPUs
  - 212 GB vRAM
  - 18 TB capacity

Figure 15 shows the cells used to validate this reference architecture.

Figure 15

Testing used eight tiles between two ESXi hosts in the application cell for VMware vSphere. There were a total of the following:

- 64 virtual machines
- 168 virtual CPUs
- 212 GB of configured virtual machine memory

A single client controls each tile. A primary client controls each tile client. The clients ran in other hosts, outside of the ESXi hosts for the workload virtual machines.
Table 13 shows how the tiles were distributed.

Table 13. Tile Distribution Across Compute and Storage Resources

<table>
<thead>
<tr>
<th>HNAS Storage Pool 0, File System 1 (EVS1 on Node 1)</th>
<th>Tile</th>
<th>ESXi Host</th>
<th>HNAS Storage Pool 1, File System 2 (EVS2 on Node 2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>NFS Datastore 1: DVD Store 2 Database Servers 1-4</td>
<td>Tile 1 0</td>
<td>NFS Datastore 3: Mail Server 1</td>
<td>NFS Datastore 11:</td>
</tr>
<tr>
<td></td>
<td>Tile 2 1</td>
<td>NFS Datastore 4: Mail Server 2</td>
<td>Dell DVD Store 2 WebA Servers 1-8</td>
</tr>
<tr>
<td></td>
<td>Tile 3 0</td>
<td>NFS Datastore 5: Mail Server 3</td>
<td>Dell DVD Store 2 WebB Servers 1-8</td>
</tr>
<tr>
<td></td>
<td>Tile 4 1</td>
<td>NFS Datastore 6: Mail Server 4</td>
<td>Dell DVD Store 2 WebC Servers 1-8</td>
</tr>
<tr>
<td>NFS Datastore 2: DVD Store 2 Database Servers 5-8</td>
<td>Tile 5 0</td>
<td>NFS Datastore 7: Mail Server 5</td>
<td>Apache Olio Web Servers 1-8</td>
</tr>
<tr>
<td></td>
<td>Tile 6 1</td>
<td>NFS Datastore 8: Mail Server 6</td>
<td>Apache Olio Database Servers 1-8</td>
</tr>
<tr>
<td></td>
<td>Tile 7 0</td>
<td>NFS Datastore 9: Mail Server 7</td>
<td>Standby Servers 1-8</td>
</tr>
<tr>
<td></td>
<td>Tile 8 1</td>
<td>NFS Datastore 10: Mail Server 8</td>
<td></td>
</tr>
</tbody>
</table>

Due to their higher random read and I/O intensive workload characterization, the DVD Store 2 database servers were placed on Storage Pool 0 to do the following:

- Separate the workloads
- Dedicate only the required, specific resources for this workload

All other servers had similar higher random write workload characterization. They were placed on Storage Pool 1.

Table 14 shows the tile workload definitions.

Table 14. Tile Workload Definitions

<table>
<thead>
<tr>
<th>Workloads</th>
<th>Applications</th>
<th>Virtual Machine Platform</th>
<th>Simulated Load per Tile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mail Server</td>
<td>Microsoft Exchange 2007</td>
<td>Microsoft Windows Server® 2008 R2 (64 Bit)</td>
<td>1000 users with a heavy workload profile</td>
</tr>
<tr>
<td></td>
<td>Microsoft Exchange LoadGen</td>
<td>4 vCPU</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>8 GB RAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>More than 100 GB boot and data disks</td>
<td></td>
</tr>
<tr>
<td>Workloads</td>
<td>Applications</td>
<td>Virtual Machine Platform</td>
<td>Simulated Load per Tile</td>
</tr>
<tr>
<td>-----------</td>
<td>--------------</td>
<td>--------------------------</td>
<td>-------------------------</td>
</tr>
<tr>
<td>Standby</td>
<td>None</td>
<td>Microsoft Windows 2003 (32 Bit)</td>
<td>Non-load based functional test to activate idle resources for on-demand usage.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1 vCPU</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>512 MB RAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 GB boot disk</td>
<td></td>
</tr>
<tr>
<td>Web 2.0 load simulation</td>
<td>Apache Olio DB</td>
<td>SUSE Linux 11 64-bit</td>
<td>400 concurrent users</td>
</tr>
<tr>
<td></td>
<td>Web application servers</td>
<td>2 vCPU</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2-tier Java-based implementation of the Olio workload, including the following operations:</td>
<td>2 GB RAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td>HomePage</td>
<td>10 GB boot and 4 GB data disks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Login</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TagSearch</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>EventDetail</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>PersonDetail</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AddPerson</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AddEvent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-commerce simulation</td>
<td>DVD Store 2</td>
<td>SUSE Linux 11 (64-bit)</td>
<td>10 constant driver thread loads from one web server</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 vCPU</td>
<td>20 burst based driver threads from two web servers</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 GB RAM</td>
<td>Performance Metric is transactions per minute (TPM)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 GB boot and 35 GB data disks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Front end (×3):</td>
<td>SUSE Linux Enterprise Server 11 64-bit</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 vCPU</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2 GB RAM</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10 GB disk</td>
<td></td>
</tr>
</tbody>
</table>
Compute Infrastructure
Multiple performance metrics were collected from the ESXi hypervisor during the test.

With hyper-threading enabled on the two 8-Core Intel Xeon E5-2680 processors, 32 logical CPUs are available for each host. There were 32 virtual machines configured with 84 virtual CPUs which ran on each server blade.

Each 520HA1 server blade contained 96 GB of RAM. The 32 virtual machines were configured with a total of 106 GB of vRAM on each blade. Over commitment of memory allocation was 10 GB.

Guest operating system metrics for each type of server were also collected during the workload runs.

Hitachi NAS Platform Infrastructure
Multiple performance metrics were collected from Hitachi NAS Platform during the test. Analysis of the metrics from the Hitachi NAS Platform 4100 heads was performed to show the following:

- System load was at consistently optimal levels
- Impact of cluster node failover

Hitachi NAS Platform Infrastructure (High Availability)
High availability of the Hitachi NAS Platform cluster was tested during a separate test run. The following actions were performed on Node 2 to simulate failures and to ensure that a single node could handle the general server application workloads:

- All four 10 Gb/sec Ethernet connections were disconnected from Node 2.
- EVS migration from Node 2 to Node 1.
- Reboot of Node 2.

Storage Infrastructure
Multiple performance metrics from Hitachi Unified Storage VM were collected during the test. Analysis of the metrics from the Hitachi Unified Storage VM controllers was performed to verify the following:

- Physical disks were not saturated
- Storage processor and cache were not overwhelmed
- LDEVs (presented as Hitachi NAS Platform system drives) performance
Application Performance

Testing measured application performance using the following metrics:

- Application workload throughput
- Application workload latency was below 500 msec with the storage-optimized configuration described in Storage Infrastructure.

Test Results

These are the test results for the Application Cell for VMware vSphere environment operating in a steady state condition with an 8-tile workload.

Compute Infrastructure

Figure 16 on page 41 and Figure 17 on page 42 illustrate the physical CPU metrics collected on both ESXi hypervisors while running the 8-tile general server application workload.

- The CPU performance characteristics are nearly identical for each system. This indicates an even balance of the workload across hosts.
- With the core utilization averaging 89% during steady state, the server blades are running with high CPU utilization.
- The test was used to determine maximum loads per host in a maximum density environment.
  - For high availability, reduce the number of virtual CPUs and virtual machine memory by up to fifty percent and place them in a cluster with VMware High Availability and Distributed Resource Scheduler enabled.

![ESXi-1 CPU Performance](image)
Figure 17

Figure 18 on page 43 and Figure 19 on page 43 illustrate the physical memory usage collected on both ESXi hypervisors while running the 8-tile general server application workload.

- The memory usage is nearly identical for each system. This indicates an even balance of the workload across hosts.

- The difference in used physical RAM (with shared virtual machine RAM) and used physical RAM (without shared virtual machine RAM) indicates the amount of memory saved from transparent page sharing. Due to the variation in application workloads, benefit from transparent page sharing was minimal.

- The overall used memory throughout the test was relatively low. The 520HA1 server blade has adequate memory headroom for more memory intensive workloads.
Figure 20 on page 44 illustrates a sample of a mail server and Dell DVD Store 2 database server, showing the combined VMDK IOPS statistics for those specific virtual machines.

- All servers, with the exception of the mail servers and DVD Store 2 database servers, had relatively low I/O with none peaking over 70 IOPS. Therefore, these results were omitted from Figure 20.

- The DVD Store 2 database virtual machines averaged 564 IOPS and the mail server virtual machines averaged 807 IOPS.
Hitachi NAS Platform Infrastructure

Figure 21 on page 45 illustrates the system load and Figure 22 on page 45 illustrates total operations per second output on each Hitachi NAS Platform 4100 head during the steady state workload.

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

- The busiest node was the Node 2 CPU load, which peaked at 56% but averaged around 33%. This data shows that both nodes are running effectively and capable of handling a failover event.

- Figure 22 shows the front-end NFS operations per second handled by each node.
Hitachi NAS Platform Infrastructure (High Availability)

High availability of the Hitachi NAS Platform cluster was tested during a separate test run. The following actions were performed on Node 2 to simulate failures and to ensure that a single node could handle the general server application workloads:

- All four 10 Gb/sec Ethernet connections were disconnected from Node 2.
- EVS migration from Node 2 to Node 1.
- Reboot of Node 2.
- Figure 23 on page 46 shows the system load and Figure 24 on page 47 shows the total IOPS output on Hitachi NAS Platform 4100 Node 1 while the above actions were performed. As a result, three spikes can be seen in both graphs.
- The server application workload continued to run without disruption.
- System load was generally below 50% while all workloads were running on Node 1 indicating plenty of headroom during a failover event.

Figure 23
Figure 24

Storage Infrastructure

Figure 25 on page 48 illustrates the average performance for physical drives from both Hitachi NAS Platform storage pools. The percent busy statistic indicates the workloads are generating disk utilization that is well within an acceptable range. These disk performance graphs show the following:

- Disk utilization peaked at 78% for Pool 0 disk and 23% for Pool 1 disk.
- For Pool 1, the low disk utilization is attributed to a dramatic increase in sequential write operations after transferring the I/O from NAS Platform to the back-end storage. This shows the ability of NAS Platform 4100 to stage writes efficiently and to flush them quickly to the back-end storage system.
- The Pool 0 workload had a high random read I/O profile. It could not take advantage of write sequentialization.
Storage processor core utilization and write cache saturation on Hitachi Unified Storage VM was monitored throughout the entirety of the test.

Figure 26 on page 49 illustrates the processor utilization and Figure 27 on page 49 illustrates the cache performance metrics.

- There are eight processor cores per controller, totaling sixteen cores. The storage processor is operated as a logical pair of 4-core processors (MPUs), totaling 4 MPUs. Processor core performance was roughly even within a pair of 4-core processors. Therefore, the performance was averaged for each MPU.

- Processor utilization was very low, peaking at 5%. This indicates that the Hitachi NAS head is able to front-end the server application workload and send I/O operations to the back-end storage efficiently.

- Table 11 on page 34 shows that MPU-10 and MPU-11 contained 1 additional system drive when compared to MPU-20 and MPU-21. Therefore, MPU-10 and MPU-11 had slightly higher utilization.

- Write cache pending percentage maintained a steady average of 30%.

This data indicates the Hitachi Unified Storage VM controllers are capable of handling various server applications with minimal fluctuation in workload.
Figure 26 on page 50 illustrates the aggregated back-end performance for the six LDEVs dedicated to Storage Pool 0 for OLTP workloads.

- The average read IOPS were 3260 while the average write IOPS were 936. This indicates a 77% read to 23% write ratio.
- The I/O profile of the OLTP workload generated from the hypervisor to Hitachi NAS Platform was 99% random. However, the I/O profile from NAS Platform to the back-end storage was 75% random. This change in I/O profile is an indication of the ability of Hitachi NAS Platform to cache and to sequentially flush write workloads.

Figure 27
Figure 28

Figure 29 illustrates the aggregated back-end performance for the 12 LDEVs dedicated to Storage Pool 1, which hosted all other workloads.

- The average read IOPS were 680 while the average write IOPS were 3914. This indicates a 15% read to 85% write ratio.
- The I/O profile of the OLTP workload generated from the hypervisor to Hitachi NAS Platform was 99% random. However, the I/O profile from NAS Platform to the back-end storage was 27% random. This change in I/O profile is an indication of the ability of NAS Platform to cache and to sequentially save write workloads.
Separating workloads into different pools based on I/O profile did the following:

- Decreased the disk latency reported by the ESXi hosts
- Provided a boost in storage performance

**Application Performance**

Figure 30 shows the application workload throughput.

![Application Workload Throughput Average](image)

**Figure 30**

Figure 31 on page 52 analyzes the application workload latency.

- The observed application response latencies for all application workloads was below 500 msec. This met the defined quality of service requirements.
Figure 31

Application Workload Latency Average

<table>
<thead>
<tr>
<th>Service</th>
<th>Latency (Milliseconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mailserver</td>
<td>324</td>
</tr>
<tr>
<td>Olio</td>
<td>125</td>
</tr>
<tr>
<td>DVDStoreA</td>
<td>145</td>
</tr>
<tr>
<td>DVDStoreB</td>
<td>158</td>
</tr>
<tr>
<td>DVDStoreC</td>
<td>166</td>
</tr>
</tbody>
</table>
Conclusion

Validation testing proves that this Hitachi Unified Compute Platform Select for VMware vSphere reference architecture provides a build-as-you-go model using Hitachi Unified Storage VM, Hitachi NAS Platform 4100, and Hitachi Compute Blade 500. The modular design, using a cell architecture, permits you to start your implementation with an environment for modest needs. Later, you have the flexibility to scale out the environment as your IT needs grow.
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.

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