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Hitachi Unified Compute Platform 2000 for VMware vSphere

Reference Architecture Guide

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Revision History

Revision	Changes	Date
AS-580-00	Initial release	March 7, 2017

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Hitachi Unified Compute Platform 2000 for VMware vSphere

Reference Architecture Guide

Compare Hitachi Unified Compute Platform 2000 (UCP 2000) to other converged solutions for VMware vSphere. It is a pre-validated, integrated, and cloud-ready solution designed for use with remote offices and branch offices (ROBO). Combining server blades and storage from Hitachi Data Systems with Brocade network infrastructure, create building blocks that give you the flexibility to scale quickly with known results.

Hitachi Unified Compute Platform for VMware vSphere allows you to do the following:

- Have certainty with the predictable reliability of a robust cloud platform (private or hybrid) that is ROBO-aligned to business service levels.
- Reduce management cost and complexity with coordinated comprehensive provisioning, automation, and administration of cloud environments.
- Simplify the ordering and procurement process, as well as the deployment and management of physical and virtual resources.
- Increase your operational efficiency and resource utilization by aligning business processes to IT execution.

The design of Unified Compute Platform 2000 for VMware vSphere reduces the complexity of architecting and deploying a wide range of converged solutions for VMware environments. It includes a full range of storage adapters for VMware vCenter. The system supports live migration and disaster recovery with unique auto-resynch. Reap the benefits of VMware solutions quickly, with predictable performance, faster deployment, and less risk.

This reference architecture uses the following VMware vSphere capabilities:

- Host failover cluster
- Virtual machine live migration
- Storage live migration
- Template-based virtual machine provisioning
- Integration with VMware vCenter
- All Hitachi storage adapters for VMware

This reference architecture guide contains solution configurations, components, and a validated solution for use by IT architects, IT administrators, and others involved in data center planning and design of VMware vSphere infrastructures.

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

Solution Overview

Hitachi Unified Compute Platform 2000 for VMware vSphere is pre-validated, integrated, and cloud ready. As a complete converged solution for VMware environments, Unified Compute Platform deploys quickly to support mission-critical workloads, applications, and virtualized environments. With industry-leading automation, Unified Compute Platform helps to simplify infrastructure management and to improve operational efficiencies.

Hitachi Unified Compute Platform 2000 for VMware vSphere is available in single-rack and multi-rack (scale-out) configurations.

Single Rack Configurations

Single rack configurations of Hitachi Unified Compute Platform 2000 include the following:

- Direct connected with Hitachi Virtual Storage Platform (VSP) G200
- SAN connected with Virtual Storage Platform G200
- SAN connected with Virtual Storage Platform G400, VSP G600, VSP F400, or VSP F600
- Unified with Virtual Storage Platform G400 or VSP G600
- Unified performance with Virtual Storage Platform G400 or VSP G600
- iSCSI connect with Virtual Storage Platform G400 or VSP G600

Figure 1 on page 3 shows a Hitachi Unified Compute Platform 2000 single rack base unit.

Figure 1

Scale Out Configurations

Hitachi Unified Compute Platform 2000 for VMware vSphere provides configurations enabling architectures to scale out. Each configuration contains a dedicated storage rack and a base compute rack. You can add expansion compute racks to scale out to contain 128 compute nodes.

Scale out configurations of Hitachi Unified Compute Platform 2000 include the following:

- SAN connected scale out with Hitachi Virtual Storage Platform (VSP) G400 or VSP G600
- Unified scale out with Virtual Storage Platform G400 or VSP G600
- United performance with Virtual Storage Platform G400 or VSP G600
- iSCSI connected scale out with Virtual Storage Platform G400 or VSP G600

Figure 2 shows a fully populated Hitachi Unified Compute Platform 2000 scale-out infrastructure.

Figure 2

Solution Components

This is a complete listing of the key hardware and software components available for single rack and scale out configurations of Hitachi Unified Compute Platform 2000 for VMware vSphere.

Hardware Components

These are the key hardware components.

TABLE 1. HITACHI UNIFIED COMPUTE PLATFORM 2000 FOR VMWARE VSPHERE KEY HARDWARE COMPONENTS

Hardware	Description	Version
Rack Optimized Server for Solutions, 2U Four Node	4-node chassis 2 power supplies	N/A
	2 Intel Xeon Processors: ■ E5-2620 v4, 8C, 2.1 GHz ■ E5-2620 v3, 6C, 4 GHz ■ E5-2650 v4, 12C, 2.20 GHz ■ E5-2650 v3, 10C, 2.3 GHz ■ E5-2680 v4, 14C, 2.3 GHz ■ E5-2680 v3, 12C, 2.3 GHz	BMC: 3.42.00 BIOS: S2S_3B06 CPLD: 08 CMC: 3.37
	192 GB to 512 GB DDR4-2,133 MHz memory	
	Emulex LP 12002 8 Gb/sec PCIe HBA dual port card	Emulex LPe12002 Boot: 2.20a5
	Intel 82599 10 GbE OCP dual port card	Intel 82599 3.7.13.7.14 (inbox driver)
	MellanoxConnectX-3 EN10/40/56GbE dual port mezzanine card (Available in iSCSI and unified performance configurations)	Mellanox ConnectX-3: 3.0.0.0-1 (inbox driver)
Hitachi Virtual Storage Platform G200 (VSP G200)	Dual controller 16 × 8 Gb/sec Fibre Channel 64 GB cache memory	83-03-25-40/00
Virtual Storage Platform G400 (VSP G400) or Virtual Storage Platform F400 (VSP F400)	Dual controller 16 × 8 Gb/sec Fibre Channel or 8 × 16 Gb/sec Fibre Channel 128 GB cache memory	83-03-25-40/00

TABLE 1. HITACHI UNIFIED COMPUTE PLATFORM 2000 FOR VMWARE VSPHERE KEY HARDWARE COMPONENTS (CONTINUED)

Hardware	Description	Version
Hitachi Virtual Storage Platform G600 (VSP G600) or Virtual Storage Platform F600 (VSP F600)	Dual controller 16 × 8 Gb/sec Fibre Channel or 8 × 16 Gb/sec Fibre Channel 256 GB cache memory	83-03-25-40/00
SFF disk tray for expansion (for VSP G400, VSP G600, VSP F400, VSP F600)	24 × 1.2 TB 10k RPM SAS disks 9 × 1.6 TB FMD DC2 flash-module drives (VSP F-series) Up to 7 disk expansion trays (single rack solutions) Up to 15 disk expansion trays (scale out solutions)	N/A
Brocade VDX 6740 switch	48-port 10 GbE switch	nos 7.0.0a
Brocade VDX 6940-36Q switch	36-port 40 GbE switch	nos 7.0.0a
Brocade ICX 7450	48-port 1 GbE switch	08.0.30G
Brocade 6505 (VSP G200 only)	24-port 8 Gb/sec Fibre Channel switch	7.4.1d
Brocade 6510 (VSP G400, VSP G600, VSP F400, or VSP F600)	48-port 16 Gb/sec Fibre Channel switch	7.4.1d

Hitachi Virtual Storage Platform Gx00 Models

Hitachi Virtual Storage Platform Gx00 models are based on industry-leading enterprise storage technology. With flash-optimized performance, these systems provide advanced capabilities previously available only in high-end storage arrays. With the Virtual Storage PlatformGx00 models, you can build a high performance, software-defined infrastructure to transform data into valuable information.

Hitachi Storage Virtualization Operating System (SVOS) provides storage virtualization, high availability, superior performance, and advanced data protection for all Virtual Storage Platform Gx00 models. The SVOS software provides common features to consolidate assets, reclaim space, extend life, and reduce migration effort.

This solution can use a high-performance, clustered file option for completely unified storage with added NAS modules. Automatic and user-transparent deduplication provides storage savings. You can combine the NAS modules with the data integrator to cloud feature to tier the storage of lesser-used files.

Hitachi Virtual Storage Platform Fx00 Models

Hitachi Virtual Storage Platform Fx00 models deliver superior all-flash performance for business-critical applications, with continuous data availability. High-performance network attached storage with nondisruptive deduplication reduces the required storage capacity by up to 90% with the power to handle large, mixed-workload environments.

Hitachi Storage Virtualization Operating System provides storage virtualization, high availability, superior performance, and advanced data protection for all Virtual Storage Platform Fx00 models. This proven, mature software provides common features to consolidate assets, reclaim space, extend life, and reduce migration effort.

This solution has the option of using Virtual Storage Platform F400 or Virtual Storage Platform F600. It can be used with NAS modules.

Brocade

Brocade and Hitachi Data Systems partner 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 solution uses the following Brocade products in Table 2.

TABLE 2. BROCADE SWITCHES USED IN HITACHI UNIFIED COMPUTE PLATFORM 2000 CONFIGURATIONS

	Model	Ports	Description
MGMT	**ICX 7450 (all configurations)**	48 × 1 Gb/sec Ethernet	Rack mounted switch that delivers the performance, flexibility, and scalability require for enterprise gigabit Ethernet access deployment.
LAN	**VDX 6740 (single rack)**	48 × 10 Gb/sec Ethernet	10 GbE rack mounted switch that delivers high performance and reduces network congestion with low latency, and deep buffers.
LAN	**VDX 6940-36Q (scale out only)**	36 × 40 Gb/sec Ethernet	40 GbE rack mounted switch providing connectivity between racks for scale out configurations.
Fibre Channel	**VDX 6505 (VSP G200 only)**	24 × 8 Gb/sec Fibre Channel	8 Gb/sec Fibre Channel rack mounted switch that delivers reliable and high performance storage area network.
Fibre Channel	**VDX 6510 (VSP G400, VSP G600, VSP F400, or VSP F600)**	48 × 16 Gb/sec Fibre Channel	16 Gb/sec Fibre Channel rack mounted switch that delivers reliable and high performance storage area network.

Software Components

This reference architecture for Hitachi Unified Compute Platform for VMware vSphere leverages the software in Table 3 to enhance agility, manageability, and cost savings. It delivers predictable reliability with a robust, enterprise converged-cloud infrastructure.

TABLE 3. SOFTWARE COMPONENTS OF HITACHI UNIFIED COMPUTE PLATFORM 2000 FOR VMWARE VCENTER

Software	Version
Hitachi Storage Virtualization Operating System with Hitachi Dynamic Provisioning	Microcode Dependent
Hitachi Storage Navigator	Microcode Dependent
Hitachi Unified Compute Platform Advisor	1.0
Hitachi VMware Adapters	
VMware ESXi	6.0.0 U2
VMware vCenter	6.0.0 U2

Hitachi Storage Virtualization Operating System

Hitachi Storage Virtualization Operating System (SVOS) spans and integrates multiple platforms. It integrates storage system software to provide system element management and advanced storage system functions. Used across multiple platforms, Storage Virtualization Operating System includes storage virtualization, thin provisioning, storage service level controls, dynamic provisioning, and performance instrumentation.

Storage Virtualization Operating System includes standards-based management software on a Hitachi Command Suite (HCS) base. This provides storage configuration and control capabilities for you.

Storage Virtualization Operating System uses Hitachi Dynamic Provisioning (HDP) to provide wide striping and thin provisioning. Dynamic Provisioning provides one or more wide-striping pools across many RAID groups. Each pool has one or more dynamic provisioning virtual volumes (DP-VOLs) without initially allocating any physical space. Deploying Dynamic Provisioning avoids the routine issue of hot spots that occur on logical devices (LDEVs).

Hitachi Unified Compute Platform Advisor

Hitachi Unified Compute Platform Advisor (UCP Advisor) brings simplified IT administration to virtualized, converged, and hyperconverged systems from Hitachi. UCP Advisor supports guided life-cycle management to the server, network, and storage elements within supported Unified Compute Platform systems.

Hitachi Adapters for VMware Environments

Hitachi adapters for VMware environments can centralize and automate management of all the hardware elements in VMware vSphere through a single pane of glass. Take advantage of intuitive performance information. Information on the health, risk and efficiency of your data center infrastructure simplifies maintenance and makes your team more proactive.

Solution Design

The basic configuration of Hitachi Unified Compute Platform 2000 for VMware vSphere starts with a four-node cluster that hosts a mix of infrastructure, management, and compute virtual machines. With the Hitachi and VMware software required to deploy virtual machines to the cluster, there are the products and tools to manage the VMware vSphere infrastructure components.

VMware vSphere Supported Features

This reference architecture enables the following capabilities of Hitachi Unified Compute Platform (UCP) for VMware vSphere with Hitachi Virtual Storage Platform (VSP):

- **Host failover cluster**

  Failover clusters provide high availability and scalability to the server workloads.

- **Virtual machine live migration**

  Live migration of running virtual machines moves from one physical server to another, preserving virtual machine availability.

- **Storage live migration**

  Live migration of storage for running virtual machines moves storage from one cluster to another with no impact on virtual machine availability to users.

- **Template-based virtual machine provisioning**

  Virtual machine templates allow administrators to deploy virtual machines rapidly.

- **Integration with VMware vCenter**

  Hitachi Data Systems provides monitoring packs for Hitachi Virtual Storage Platform Fx00 and Virtual Storage Platform Gx00, except for VSP G800.

- **All Hitachi Storage Adapters for VMware**

  Hitachi storage adapters for VMware allow you to extend Hitachi storage management functionality.

VMware vSphere Host Configuration

Install and configure VMware vSphere. Then, present volumes to all VMware ESXi hosts, as shown in Table 4.

TABLE 4. VOLUME CONFIGURATION

VMware ESXi Host	Pool Number	Pool Volume	Capacity	Purpose
All Hosts	3	0	100 GB	Boot from SAN
All Hosts	63	1	2 TB	Management
All Hosts	5	2	6 TB	Production virtual machines

VMware vSphere Cluster Configuration

Add all four VMware ESXi hosts for management to a datacenter in VMware vCenter. After creating a datacenter cluster, use vCenter to do the following:

- Validate that all hosts meet prerequisites, such as operating system version and domain membership
- Enable the failover clustering on each host and unmask storage logical units to each host
- Create the configured external virtual networks

TABLE 5. REQUIRED VIRTUAL MACHINES FOR VMWARE VCENTER CLUSTER CONFIGURATION

VMware ESXi Host	Virtual Machine Name	vCPU	vRAM (GB)	VMDK	vNIC	Purpose
0	UCPA	4	8	100	1	UCP Management
1	DC1	2	4			Primary domain controller for Microsoft® Active Directory®
2	DC2	2	4			Secondary domain controller for Active Directory
3	vCenter	8	24			Virtual Machine Manager

Virtual Network Configuration

In keeping with best-practice recommendations from VMware, do the following for virtual machine configuration:

- Break network traffic down into separate networks using subnetting.
- Achieve further isolation of network types by using VLAN isolation and dedicated network switches.
- Define identical virtual networks on all nodes. This is necessary so that a virtual machine is able to failover to any node and to maintain its connection to the network.

Virtual Machine Configuration

Table 6 contains a listing of virtual machines required for solution management. Configure the vCPU, vRAM, VMDK, and vNIC for the virtual machines shown in Table 5 on page 10.

TABLE 6. REQUIRED VIRTUAL MACHINES FOR MANAGEMENT

Number of Virtual Machines Required	Purpose	Virtual Machine Names
2	Domain controllers	DC1, DC2
1	Hitachi Unified Compute Platform Advisor	UCPA
1	VMware vCenter	vCenter

Compute Architecture

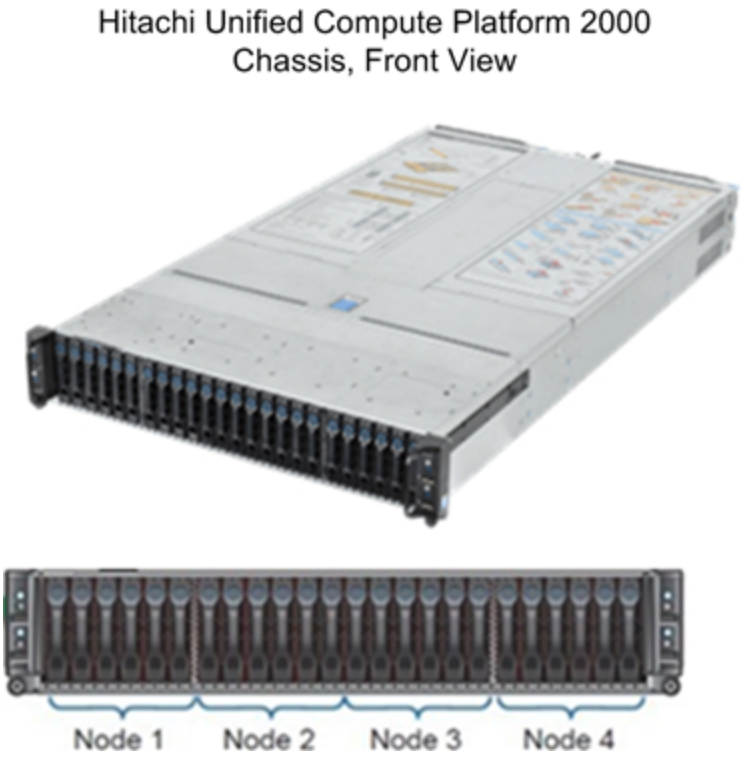
Hitachi Unified Compute Platform 2000 for VMware vSphere contains at least one rack optimized server for solutions, 2U four node. This compute chassis and server blade architecture is a critical component of the virtualized infrastructure. Powered by the Intel Xeon processor E5-2600 v4 and v3 product families and DDR4-2, 133 MHz memory modules, the rack optimized server provides the flexibility needed to scale out to 32 chassis containing 128 nodes.

The rack optimized server for solutions, 2U four node, configurations can contain components from the following hardware components:

- 2 Intel Xeon Broadwell or Haswell processors:
  - E5-2620 v4, 8 core, 2.1 GHz
  - E5-2620 v3, 6 core, 4 GHz
  - E5-2650 v4, 12 core 2.20 GHz
  - E5-2650 v3, 10 core, 2.3 GHz
  - E5-2680 v4, 14 core, 2.3 GHz
  - E5-2680 v3, 12 core, 2.3 GHz
- Up to 512 GB of memory using DDR4-2, 133 MHz, memory modules
- Emulex LP 12002, 8 Gb/sec, dual port PCIe HBA
- Intel 82599, 10 GbE OCP, dual port card
- (Optional) Mellanox Connect X-3 EN 10/40/56 GbE, dual port mezzanine card (iSCSI and NAS configurations)

Figure 3 on page 12 shows the front view of the chassis for Unified Compute Platform 2000 for VMware vSphere.

Figure 3



Storage Architecture

Hitachi Unified Compute Platform 2000 for VMware vSphere can be deployed along with the following Hitachi Virtual Storage Platform storage systems:

- VSP G200 direct-connect
- VSP G200, VSP G400, VSP G600, VSP F400, or VSP F600 SAN-connect
- VSP G400, VSP G600 iSCSI-connect
- VSP G200, VSP G400, VSP G600, VSP F400, or VSP F600 with NAS modules

Use Hitachi Dynamic Provisioning, a part of Hitachi Storage Virtualization Operating System, to provision the storage pools. Using Hitachi Dynamic Provisioning provides the following benefits for you:

- **Wide striping**—Dynamic Provisioning avoids routine issue of hot spots that occur on logical devices (LDEVs). These occur within individual RAID groups when the host workload exceeds the IOPS or throughput capacity of that RAID group. Dynamic Provisioning distributes the host workload across many RAID groups, which provides a smoothing effect that dramatically reduces hot spots.
- **Thin provisioning functionalities**—Physical space assignment from the pool to the dynamic provisioning volume happens, as needed using 42 MB pages, up to the logical size specified for each dynamic provisioning volume. There can be a dynamic expansion or reduction of pool capacity without disruption or downtime. You can rebalance an expanded pool across the current and newly added RAID groups for an even striping of the data and the workload.

Each server blade uses the port configuration listed in Table 7.

TABLE 7. STORAGE PORT PROPERTIES

For This	Use This
Port Attribute	**Target**
Port Security	**Enable**
Port Speed	**Auto (8 Gb/sec)**
Fabric	**ON**
Connection Type	**P-to-P**

Use VMware vCenter Path Selection, using the **round-robin** policy. Round-robin load balancing in Multipath I/O automatically selects a path by rotating through all available paths. By balancing the load across all available paths, you optimize IOPS and response time.

Pool Configuration

Create three dynamic provisioning pools with Hitachi Dynamic Provisioning, as shown in Table 8.

TABLE 8. DYNAMIC PROVISIONING POOL CONFIGURATION

Dynamic Provisioning Pool	RAID	Parity Groups	Disks	Capacity	Purpose
3	RAID-10 (2D+2D)	2	8	4 TB	SAN operating system boot
63		1	4	2 TB	Management virtual machines
5	User Configurable				Production virtual machines

NAS Module File Sharing Configuration (Optional)

The optional use of NAS modules in this reference architecture allow for the allocation and use of file shares by virtual machines hosted in the compute virtual machine pool. Configure the LUNs from compute storage pools as system drives for allocation as file shares to the compute virtual machines. The system drives must reside in a pool defined to the NAS modules and presented to the front-end ports of the NAS module.

- Select the LUNs from the compute storage pool to be part of the NAS module pool.
- Assign to ports on the storage array.
- Create a file system on the NAS modules within the NAS module pool.
- Create and assign an EVS to the storage pool.
- Create a CIFS share on the Hitachi NAS storage pool.

Network Architecture

A Hitachi Unified Compute Platform 2000 for VMware vSphere configuration uses a combination of the following networking components:

- Brocade ICX 7450 switch for management traffic (48 × 1 GbE ports)
- Brocade VDX 6740 switch for LAN traffic in a single rack configuration (48 × 10 GbE ports)
- Brocade VDX 6940-36Q switch for spine/leaf inter-rack traffic in a scale-out configuration (36 × 40 GbE ports)
- Brocade VDX 6505 Fibre Channel switch in Hitachi Virtual Storage Platform G200 configurations (24 × 8 Gb/sec Fibre Channel ports)
- Brocade VDX 6510 Fibre Channel switch in Hitachi Virtual Storage Platform G400, Virtual Storage Platform G600, Virtual Storage Platform F400, and Virtual Storage Platform F600 configurations (48 × 16 Gb/sec Fibre Channel ports)

For optimum performance and security, configure the networks using the following VLANs:

- **Management Network**

  The switches provide connectivity between the VMware ESXi hosts and VMware vCenter. The recommendation is leave management network as untagged.

- **VMware vMotion Network**

  VLAN 102 provides virtual machine live migration.

- **Compute (Production VMs) Customer Network**

  VLAN 103 provides virtual machine connectivity.

- **Hitachi NAS Network (only for unified solutions)**

  VLAN 104 for communication with Hitachi NAS modules in those configurations using NAS modules on Hitachi Virtual Storage Platform.

Each rack optimized server for solutions, 2U four node, uses the following:

- Onboard 10/100 GbE adapter for management
- Intel 82599 10 GbE OCP dual port card
- Emulex LP12002 8 Gb/sec dual port PCIe HBA
- (Optional) Mellanox ConnectX-3 EN 10/40/56 GbE dual port mezzanine card for unified performance configurations using NAS modules

Use VMware vCenter to configure the logical network, logical switches, and port profiles. Configure the network adapters as follows for NIC teaming:

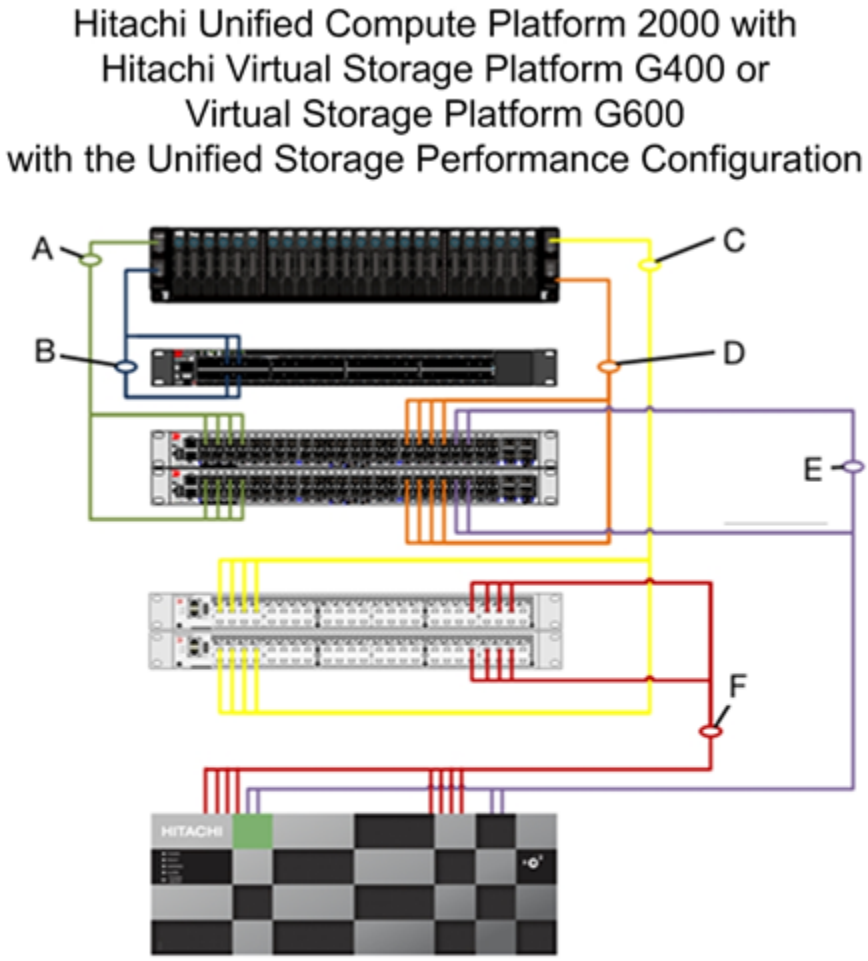
- **Team mode** — Switch independent
- **Load balancing mode**—Dynamic
- **Standby adapter** — None (all adapters active)

Unified Performance Configuration for Hitachi Virtual Storage Platform G400 or Virtual Storage Platform 600

The following diagrams show the details of the network architecture for a sample Hitachi Unified Compute Platform 2000 for VMware vSphere architecture using NAS modules in a unified performance configuration.

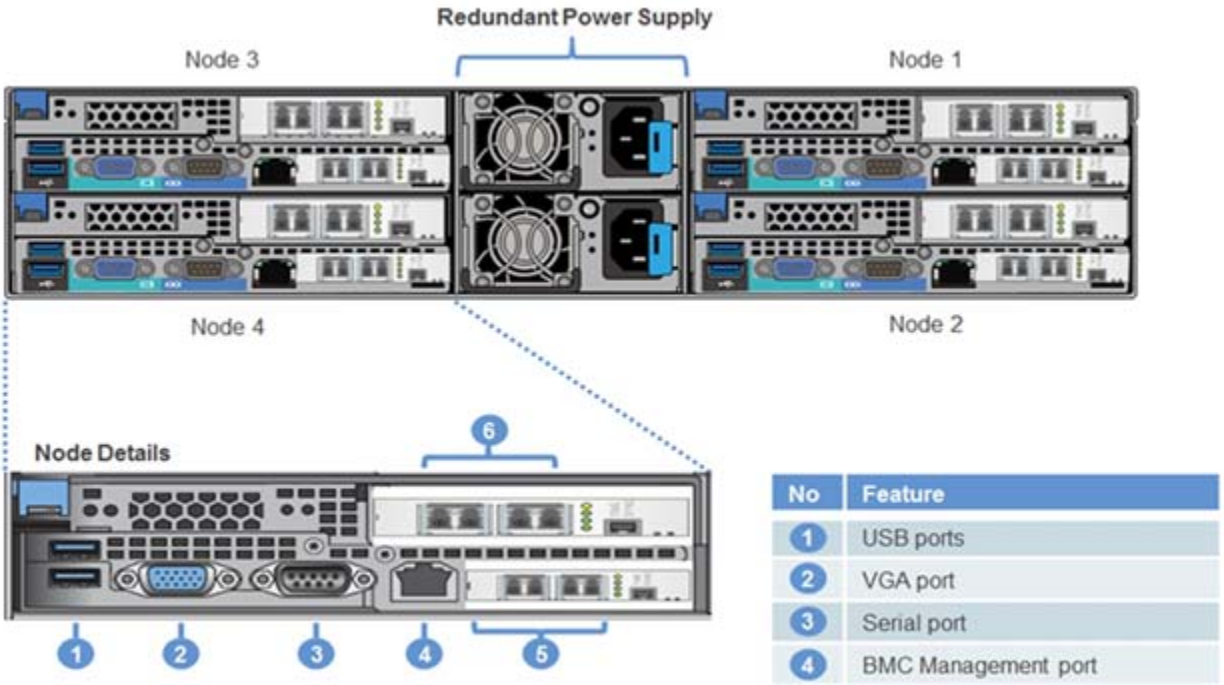
Figure 4 on page 15 shows the unified performance configuration, along with network cabling. Figure 5 on page 16 shows the rear view of chassis and node.

Figure 4



A – 8 × 10 GbE from Intel dual-port OCP card to Brocade 6740 switches
B – 4 × 1 GbE RJ45 from the rack optimized server for solutions, 2U four node, to Brocade 7450 switches
C – 8 × 8 Gb/sec Fibre Channel from Emulex HBAs to Brocade 6520 switches
D – 8 × 10 GbE Mellanox dual port mezzanine switch to Brocade 6740 switches
E – 4 × 10 GbE from Hitachi Virtual Storage Platform G400 with NAS modules to Brocade 6740 switches
F – 8 × 8 Gb/sec Fibre Channel from Virtual Storage Platform G400 or VSP G600 to Brocade 6510 switches

Figure 5



No	Feature
1	USB ports
2	VGA port
3	Serial port
4	BMC Management port
5	10GbE dual port
6	Emulex 8Gb dual port HBA

Management Architecture

Managing the infrastructure for Hitachi Unified Compute Platform 2000 for VMware vSphere is critical to the health and operation of the compute, storage, and networking. Use these software tools for management in conjunction with VMware vCenter:

- “Hitachi Unified Compute Platform Advisor” on page 16
- “Hitachi Storage Adapters for VMware” on page 17

Hitachi Unified Compute Platform Advisor

Use Hitachi Compute Unified Compute Platform Advisor to do the following tasks:

- **Power management options**
  - Turn on the power of a managed server and start the operating system.
  - Stop the operating system and turn off the power of a managed server.
- **Firmware management options**
  - Update the compute BIOS.
  - Update the compute BMC.

- **Monitor managed servers**
  - Make the SNMP trap reception settings.
  - Make the SNMP trap forward settings.
- **Storage management options**
  - Create and manage parity groups.
  - Create and manage dynamic provisioning pools.
  - Automate complex tasks.

Hitachi Storage Adapters for VMware

Use Hitachi storage adapters for VMware to automate complex tasks.

Solution Validation

This describes the tools, test methodology, and test results used to validate this Hitachi Unified Compute Platform 2000 for VMware vSphere solution.

The goal of this engineering validation was to perform a holistic validation on the compute, network, and storage components in this Unified Compute Platform 2000 for VMware vSphere solution. This validation ensures that all of the hardware components and software components function together. It provides a modest baseline example of performance for a single virtual machine running on the solution.

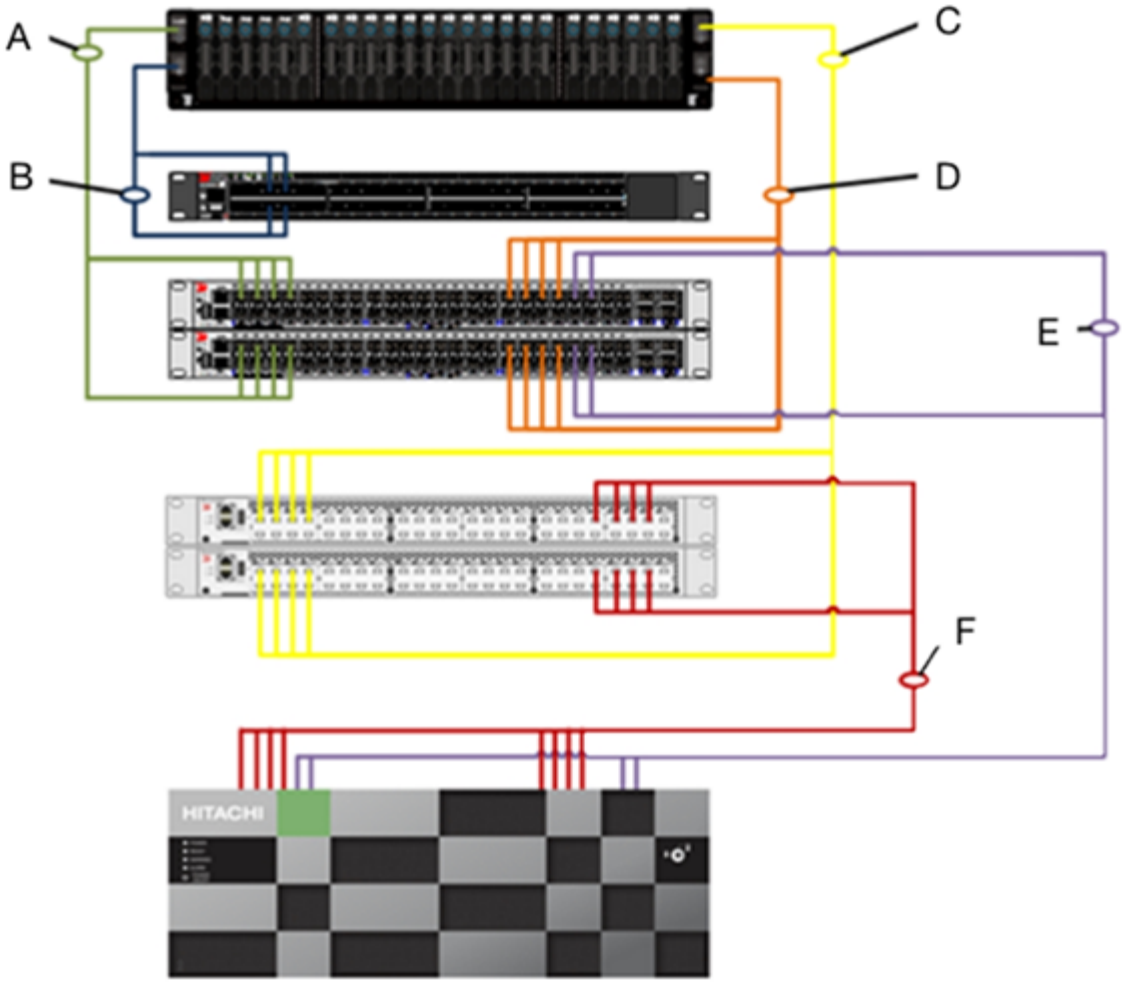
Though the validation process does involve a measure of performance testing to ensure end-to-end functionality, it is not intended to be considered a replacement for industry standard performance evaluations.

Test Infrastructure

Figure 6 on page 18 shows the configuration of Hitachi Unified Compute Platform 2000 for VMware vSphere in a unified performance configuration using Hitachi Virtual Storage Platform G600.

Figure 6

Hitachi Unified Compute Platform 2000 in a United Performance Configuration
Using Hitachi Virtual Storage Platform G600



A - 8 × 10 GbE Dual Port OCP Cards from Intel to Brocade 6740 switches
B - 4 × 1 GbE RJ45 from the rack optimized server for solutions, 2U four node, to Brocade 7450 switches
C - 8 × 8 Gb/sec Fibre Channel from Emulex HBAs to Brocade 6510 switches
D - 8 × 10 GbE Mellanox dual port mezzanine cards to Brocade 6750 switches
E - 4 × 10 GbE from the unified modules for Hitachi Virtual Storage Platform G600 to Brocade 6740 switches
F - 8 × 8 Gb/sec Fibre Channel from Virtual Storage Platform to Brocade 6510 switches

Hardware Components

The following section contains a listing of the hardware used in this reference architecture.

TABLE 9. TEST ENVIRONMENT HARDWARE COMPONENTS

Hardware	Description	Version

4 Rack Optimized Servers for Solutions, 2U Four Node	■ 4-node chassis
	■ 2 power supplies
	■ 16 compute nodes, each containing the following:
	  ■ 2 Intel Xeon E5-2620 v3 processors @ 2.40 GHz
	  ■ 128 GB DDR4-2, 133 MHz
	  ■ Emulex LP 12002, 8 Gb/sec dual port PCIe HBA
	  ■ Intel 82599 10 GbE OCP dual port card
	  ■ Mellanox ConnectX-3 EN 10/40/56 GbE dual port mezzanine card
		BMC: 3.42.00
		BIOS: S2S_3B06
		CPLD: 08
		CMC: 3.37
		Intel 82599: 3.7.13.7.14 (inbox driver)
		Mellanox ConnectX-3: 3.0.0.0-1 (inbox driver)
		Emulex LPe12002 Boot: 2.20a5
		Emulex LPe12002 Firmware: 2.02a0

Hitachi Virtual Storage Platform G600	■ Dual controller ■ 16 × 8 Gb/sec Fibre Channel ■ 256 GB cache memory ■ 24 × 1.2 TB, 10k RPM SAS disks ■ 8 SFF disk expansion tray ■ 24 × 1.2 TB, 10k RPM SAS disks	83-03-25-40/00
2 Brocade VDX 6740 switches	■ 48-port 10 GbE switch	nos 7.0.0a
1 Brocade ICX 7450 switch	■ 48-port 1 GbE switch	08.0.30G
2 Brocade 6510 switches	■ 48-port 8 Gb/sec Fibre Channel switch	7.4.1d

Software Components

The following section contains a listing of the software used in this reference architecture.

TABLE 10. TEXT ENVIRONMENT SOFTWARE COMPONENTS

Software	Version
Hitachi Storage Virtualization Operating System with Hitachi Dynamic Provisioning	Microcode Dependent
Hitachi Storage Navigator	Microcode Dependent
Hitachi Storage Adapter for VMware	
VMware ESXi	6.0.0 U2
VMware vCenter	6.0.0 U2
Vdbench	5.04
Java	1.7

Test Methodology

These test scenarios were intended to validate the compute, network, and storage aspects of Hitachi Unified Compute Platform 2000 for VMware vSphere configured with Hitachi Virtual Storage Platform G600 storage array in a united performance configuration.

Each test run consisted of using Vdbench to generate workloads representative of the most common enterprise application storage I/O workload types. Each workload was tested against a Fibre Channel LUN, presented from a dynamic provisioning pool containing parity groups of 1.2 TB 10k RPM SAS disks in RAID-10 (2D + 2D) arrangements to reflect common usage scenarios.

Test Machine

The test scenarios completed in this validation consisted of a single virtual machine with the following configuration and software:

- A Microsoft® Windows Server® 2012 R2 virtual machine
- 2 vCPUs
- 4 GB memory
- 2 SCSI controllers (operating system, data)
- 1 disk for the guest operating system
- 1 disk for validation testing
- Vdbench 5.04.06
- Java 1.7

Workloads

Validation consisted of multiple test runs using Vdbench to generate storage I/O matching the distinctive I/O characteristics of common enterprise application workloads.

This validation sought to identify the maximum IOPS for a single virtual machine running an 8-thread Vdbench workload while keeping application latency at or below 20 msec.

Table 11 contains the workload definitions used for this validation effort.

TABLE 11. TEST ENVIRONMENT WORKLOAD CONFIGURATION

Workload	Block Size	Read Percent	Write Percent	Random Percent	Worker Threads
Exchange	8 kb	55	45	80	8
SQL	64 kb	60	40	100	8
OLTP	8 kb	70	30	100	8
Web	8 kb	95	5	75	8

Storage Configuration

For this validation, each workload from Table 11 was tested against a single Fibre Channel LUN (LDEV), presented from a Hitachi Virtual Storage Platform G600 storage array.

Each LDEV contained between 1 to 4 parity groups that were presented using dynamic provisioning pools. Each pool was backed by RAID-10 (2D + 2D) arrangements of 1.2 TB 10k RPM SAS disks, reflecting common usage scenarios.

Table 12 contains the storage configuration for validation.

TABLE 12. TEST ENVIRONMENT FIBRE CHANNEL LUN CONFIGURATION

Storage	Parity Groups	RAID Configuration	Disk Type	Disk Model	Disk Count	Capacity
Hitachi Virtual Storage Platform G600 Cache size 213.75 GB Microcode: 83-03-25-40/00	1	RAID-10 (2D + 2D)	1.2 TB 10k RPM SAS	DKR5E-J1R2SS	4	2 TB
	2	RAID-10 (2D + 2D)	1.2 TB 10k RPM SAS	DKR5E-J1R2SS	8	4 TB
	3	RAID-10 (2D + 2D)	1.2 TB 10k RPM SAS	DKR5E-J1R2SS	12	6 TB
	4	RAID-10 (2D + 2D)	1.2 TB 10k RPM SAS	DKR5E-J1R2SS	16	8 TB

Test Results

The results below display average performance numbers for each of the storage I/O workload types used in this validation.

Each test configuration contained a single virtual machine attached to a single LDEV containing single and multiple parity groups.

Each test configuration sought to identify the maximum storage I/O throughput from a single virtual machine running an 8 thread workload while application latency was at or below 20 msec.

Alternate configurations presenting multiple LDEVs and increasing the queue depth throughout the storage I/O path can be leveraged to increase workload performance. These results indicate a baseline for performance prior to any of these optimizations.

TABLE 13. MICROSOFT EXCHANGE SYNTHETIC WORKLOAD RESULTS

Storage	IOPS	Throughput (MB/sec)	Latency	Queue Depth	CPU
1 × RAID-10 (2D + 2D)	486	4	16	8	3
2 × RAID-10 (2D + 2D)	821	6	7	6	2
3 × RAID-10 (2D + 2D)	1240	10	6	8	7
4 × RAID-10 (2D + 2D)	1487	12	5	8	4

TABLE 14. OLTP SYNTHETIC WORKLOAD RESULTS

Storage	IOPS	Throughput (MB/sec)	Latency	Queue Depth	CPU
1 × RAID-10 (2D + 2D)	605	5	12	7	2
2 × RAID-10 (2D + 2D)	938	7	8	8	3
3 × RAID-10 (2D + 2D)	1193	9	7	8	3
4 × RAID-10 (2D + 2D)	1305	10	6	8	3

TABLE 15. MICROSOFT SQL SERVER® SYNTHETIC WORKLOAD RESULTS

Storage	IOPS	Throughput (MB/sec)	Latency	Queue Depth	CPU
1 × RAID-10 (2D + 2D)	567	35	14	8	2
2 × RAID-10 (2D + 2D)	875	55	9	8	3
3 × RAID-10 (2D + 2D)	1144	71	7	8	4
4 × RAID-10 (2D + 2D)	1284	80	6	8	4

TABLE 16. WEB APPLICATION SYNTHETIC WORKLOAD RESULTS

Storage	IOPS	Throughput (MB/sec)	Latency	Queue Depth	CPU
1 x RAID-10 (2D + 2D)	770	6	10	8	3
2 x RAID-10 (2D + 2D)	977	8	8	8	3
3 x RAID-10 (2D + 2D)	1053	8	8	8	4
4 x RAID-10 (2D + 2D)	1163	9	7	8	3

If you are implementing this solution, work with your Hitachi Data Systems representative to determine appropriate sizing and solution hardware alignment.

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 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 Resources website.

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