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Hitachi Unified Compute Platform for the SAP HANA Platform on VMware vSphere in a Medium Scale-Up VMware vMotion Configuration with 1 TB Nodes Using Hitachi Compute Blade 500 and Hitachi Unified Storage VM

Reference Architecture Guide

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Hitachi Data Systems

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Hitachi Unified Compute Platform for the SAP HANA Platform on VMware vSphere in a Medium Scale-Up VMware vMotion Configuration with 1 TB Nodes Using Hitachi Compute Blade 500 and Hitachi Unified Storage VM

Reference Architecture Guide

This defines a medium size scale-up configuration with 1 TB nodes for Hitachi Unified Compute Platform for the SAP HANA Platform. This scale-up configuration uses the following:

- Hitachi Compute Blade 500, with 520X B1 server blades
- Hitachi Unified Storage VM
- SAP HANA
- VMware vSphere with VMware vMotion

Hitachi Unified Compute Platform for the SAP HANA Platform is a pre-configured analytical virtual appliance ready to plug into a network to provide real-time access to operational data for use in analytic models.

This technical paper assumes familiarity with the following:

- SAN-based storage systems
- General storage concepts
- SAP HANA
- VMware vSphere 5.5 update 1
- Common IT storage practices

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

The medium size scale-up configuration with 1 TB nodes for Hitachi Unified Compute Platform for SAP HANA on VMware vSphere using VMware vMotion uses the following:

- **Hitachi Compute Blade 500** — An enterprise-class server platform.
  - This solution uses four 520X B1 server blades.
- **Hitachi Unified Storage VM** — Storage virtualization system designed to manage storage assets more efficiently. The persistent storage of the SAP HANA server resides on this storage device.
- **SAP HANA** — A multi-purpose, in-memory database to analyze transactional and analytical data.
- **VMware vSphere** — A cloud computing virtualization operating system platform.

Figure 1 shows the topology of this reference architecture.

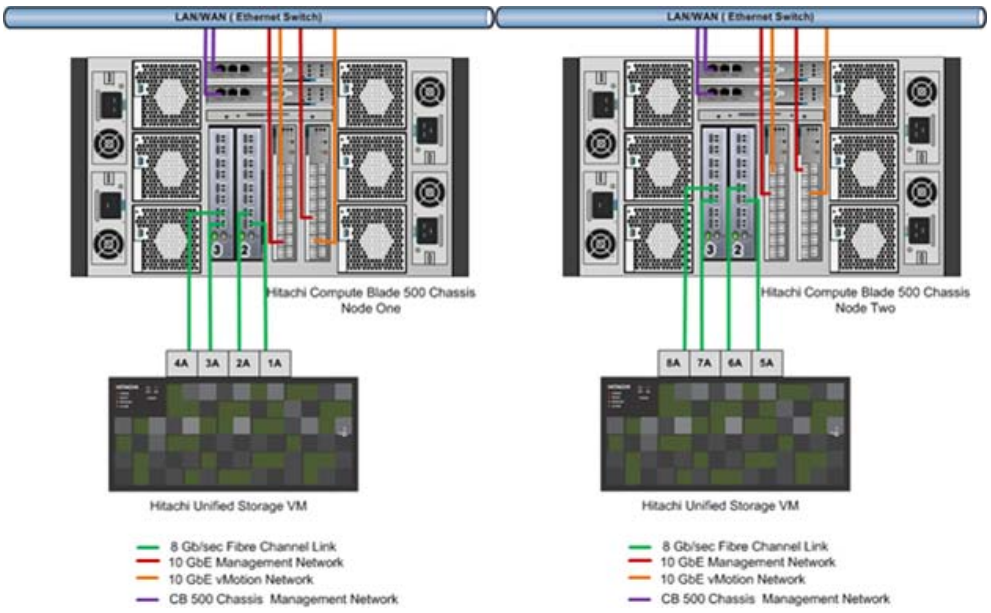

Figure 1

Figure 2 shows the setup between the server and storage.

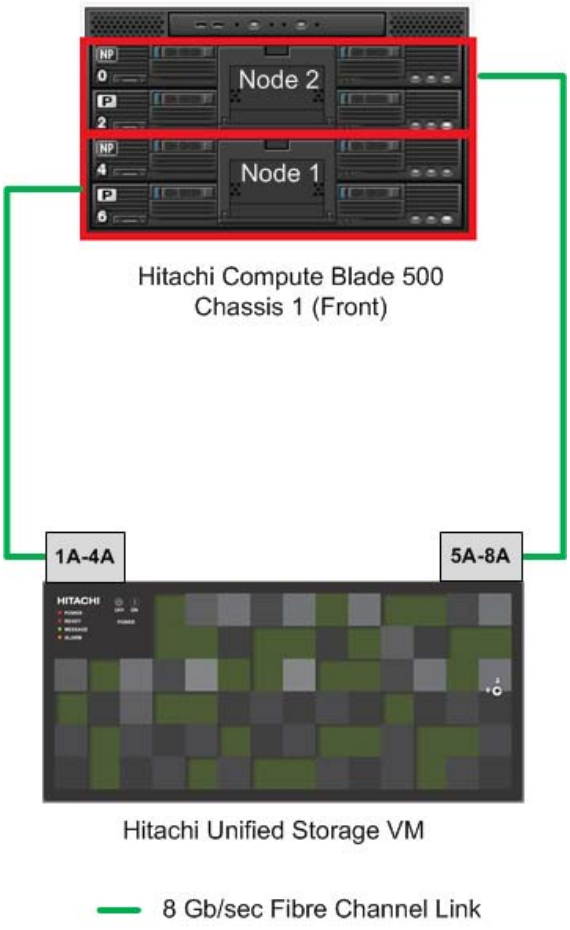

Figure 2

Key Solution Elements

These are the key hardware and software components used in this reference architecture.

Note — This solution assumes that a management server already exists in the landscape and is available for use with this solution. Make sure that the landscape has a VMware vCenter infrastructure set up and available.

Hardware Elements

Table 1 describes the hardware used to deploy the medium scale-up configuration with 1 TB nodes of the Hitachi Unified Compute Platform for SAP HANA on VMware vSphere with VMware vMotion.

Table 1. Hardware Elements

Hardware	*Quantity*	*Configuration*	*Role*
Hitachi Compute Blade 500 chassis	1	■ 4-blade chassis ■ 2 management modules ■ 6 cooling fan modules ■ 4 × power supply modules (3+1 reliable model) ■ 2 × 10 Gb/sec LAN pass-through modules ■ 2 × 16 Gb/sec Brocade Fibre Channel switch module	Server blade chassis

520X B1 server blade	4	■ 2 × 15 core processors
		■ 0.5 TB RAM
		■ On server blades 4 and 6:
		  ■ 1 × 4 port 10 GbE onboard LAN on motherboard (LOM)
		  ■ 1 × 2 port Hitachi 8 Gb/sec Fibre Channel mezzanine on mezzanine slot 2
			SAP HANA server

SMP connector module	2	■ 2-blade SMP connection board	SMP connector
Hitachi Unified Storage VM	1	■ Single frame	Block storage for SAP HANA nodes

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.

This configuration uses four 520X B1 server blades in the Hitachi Compute Blade 500 chassis connected with an SMP connector to create two servers.

Table 2 has the specifications for the 520X B1 server blades used in this solution.

Table 2. 520X B1 Server Blade Configuration

Feature	*Configuration*
Processors	■ Intel Xeon processor E7-8880 V2 ■ 2 processors per server blade
Processor SKU	■ Intel Xeon processor E7-8880 V2
Processor frequency	■ 2.50 GHz
Processor cores	■ 15 cores
Memory DIMM slots	■ Total of 48 with 32 populated
Memory	■ 512 GB RAM (32 × 16 GB DIMMs)
Network ports	■ 4 × 10 Gb Ethernet LAN on motherboard (LOM) on all blades
Fibre Channel Mezzanine ports	■ 1 × 2 port Hitachi 8 GB 2-port Fibre Channel mezzanine on mezzanine slot 2 (On all blades)
Other interfaces	■ 1 × USB 3.0 port ■ KVM connector (VGA, COM, USB 2.0, 2 ports)

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

The operating system LUNs, data LUNs, and log LUNs reside on this storage device.

This solution uses a single Hitachi Unified Storage VM.

Symmetric Multiprocessing (SMP) Connector

Symmetric multiprocessing (SMP) connector technology combines multiple server blade resources into a single server, subject to product limitations.

This solution uses two 2-server blade SMP connection interfaces to connect two server blades. This combination acts as two single SAP HANA virtual machine server nodes for the medium size configuration with the following:

- 8 CPUs (4 CPUs per node)
- 120 cores (60 cores per node)
- 2048 GB of RAM (1024 GB of RAM per node)

Software Elements

Table 3 describes the software products used to deploy the one active node configuration.

Table 3. Software Elements

Software	*Version*
SUSE Linux Enterprise Server for SAP Applications	11 SP3
SAP HANA	1.0 SPS09, Rev. 91 or later
VMware vSphere	5.5 update 1

SAP HANA

SAP HANA is a flexible, multipurpose in-memory database. It combines SAP software components optimized to specific hardware. These components come from leading hardware partners of SAP, including Hitachi. The use of the SAP HANA appliance does not depend on the data source.

The SAP HANA appliance enables the analysis of huge volumes of detailed business information in real-time from almost any data source. It captures operational data in memory as it occurs. Flexible views quickly expose analytic information. External data can be added to analytic models from across an entire organization.

This hardware and software combination integrates a number of SAP components, including the following:

- **SAP In-Memory Database**

  This hybrid in-memory database combines row-based, column-based, and object-based database technology. It takes advantage of parallel processing capabilities of multi-core CPU architectures.

  SAP customers can download more information on the SAP HANA Platform at the SAP Service Marketplace. See the installation and upgrade guides download section for SAP In-Memory Computing (SAP In-Memory Appliance — SAP HANA).

- SAP HANA Master Guide

  This is the central starting point for the technical implementation of the SAP HANA platform. Use this for basic concepts and for planning the SAP HANA application system landscape.

- **SAP HANA Installation and Initial Configuration Guides**

  Use the various installation guides to install the required SAP In-Memory Database and the other software components for the different replication technologies. Refer to the SAP HANA Server Installation Guide for an overview on how to install SAP HANA.

- SAP HANA Technical Operations Manual

  This provides an end-to-end picture of the available administration tools with SAP HANA appliance and the key tasks for a system administrator to perform.

- SAP HANA Master Update Guide

  This explains how to update SAP HANA and its components.

- SAP Integration and Certification Center (SAP ICC)

  This page provides information about SAP certified HANA appliances by SAP hardware partners.

SAP HANA Platform has documents related to SAP.

SAP on VMware has documents related to SAP and VMware.

SUSE Linux Enterprise Server (SLES) for SAP Applications

The medium size scale-up configuration with 1 TB nodes for Hitachi Unified Compute Platform for SAP HANA runs on a 64-bit SUSE Linux Enterprise Server (SLES) for SAP Applications 11 SP3. The kernel version is 3.0.101-0.35 or later.

The initially delivered configuration of the guest operating system should persist. Changing the configuration settings can cause significant performance problems to occur.

Do not make any modifications to the operating system, except as noted or approved by SAP and Hitachi/HDS. Before updating operating system components, especially the Linux kernel and standard libraries like glibc, please consult the relevant information provided by SAP in the respective SAP notes. Make sure the SAP notes are SAP HANA related and not generally for SAP systems. SAP note 1944799 is a good starting point for this information.

For more details, see section 2.1.4.1, “Updating and Patching the Operating System,” in the SAP HANA Technical Operations Manual.

VMware vSphere

VMware vSphere is a virtualization platform that provides a datacenter infrastructure. It features vSphere Distributed Resource Scheduler (DRS), high availability, and fault tolerance.

VMware vSphere has the following components:

- **ESXi**

  This is a hypervisor that runs directly on a physical server. It partitions one physical machine into many virtual machines that share hardware resources.

- **vCenter Server**

  vCenter Server manages the vSphere environment through a single user interface. With vCenter, there are additional features available such as vMotion, Storage vMotion, Storage Distributed Resource Scheduler, High Availability, and Fault Tolerance.

- **VMware vSphere 5.5**

  This is an enterprise virtualization solution to create a dynamic and flexible data center with integrated management and reporting capability for a high level of server, service, and client uptime.

This Hitachi Unified Compute Platform for the SAP HANA Platform solution using VMware vSphere combines the benefits of the Unified Compute Platform appliance with the flexibility and manageability of VMware vSphere.

VMware vSphere customers can download more information about the ESXi Platform on VMware vSphere Documentation. See the vSphere installation and setup guide in the ESXi and vCenter Server Product Documentation section for ESXi documentation. In addition, you can download Performance Best Practices for VMware vSphere 5.5 (PDF).

For more information on SAP HANA on VMware best practices, see Best Practices and Recommendations for Scale-Up Deployments of SAP HANA on VMware vSphere.

For more information on vMotion best practices, see VMware vSphere vMotion Architecture, Performance and Best Practices in VMware vSphere 5.

Note — This solution assumes that a management server already exists in the landscape and is available for use with this solution. Make sure that the landscape has a VMware vCenter infrastructure set up and available.

Solution Design

This is the detailed design a medium scale-up configuration with 1 TB nodes for Hitachi Unified Compute Platform for the SAP HANA Platform with VMware vSphere using VMware vMotion.

Hitachi Compute Blade 500 Chassis Configuration

Figure 3 shows the front and back view of the Hitachi Compute Blade 500 chassis.

Hitachi Compute Blade 500
Chassis 1 (Front)

Hitachi Compute Blade 500
Chassis 1 (Back)

10 GbE LAN Pass Through Module
Brocade 16Gb Fibre Channel Switch Module

Figure 3

This solution uses one Hitachi Compute Blade 500 chassis with four 520X B1 server blades.

There are four switch modules on the Hitachi Compute Blade 500 chassis. They have the following components:

- Switch Module 0 and Switch Module 1 are slotted with 10 Gb/sec LAN pass-through modules.
- Switch Module 2 and Switch Module 3 are slotted with 16 Gb/sec Brocade Fibre Channel switch modules.

520X B1 Server Blade Architecture

A SAP HANA node is a server with two server blades connected using the 2-server blade SMP interface connector. This creates two single four-socket SMP nodes with 60 cores and 1 TB of memory.

Table 4 lists the server blade configuration.

Table 4. Server Blade Configuration

Server Blades	Total of 4 server blades ■ Blade 0 (non-primary) ■ Blade 2 (primary) ■ Blade 4 (non-primary) ■ Blade 6 (primary)
Total Number of CPU Cores	120 (60 per node)
Total Memory (TB)	2 (1 TB per node)

Note — Due to SAP and VMware requirements for the production 1 TB virtual machine, the actual virtual machine is only allocated with 980 GB of RAM. VMware ESXi processes use the remaining memory. For TDI, quality assurance, and development uses with SAP HANA on VMware, see “Multiple Virtual Machine Configurations” on page 25.

Fibre Channel SAN Architecture

This solution uses 2-port Hitachi 8 GB/sec Fibre Channel mezzanine card in the mezzanine slots on each of the 520X B1 server blades. The Fibre Channel SAN architecture consists one of these mezzanine cards placed on each of the following server blades in Mezzanine Slot 2:

- Server Blade 0
- Server Blade 2
- Server Blade 4
- Server Blade 6

The each 2-port Hitachi 8 GB/sec mezzanine card connects to the Brocade 16 GbE Fibre Channel switch modules installed in Switch Slot 2 and Switch Slot 3 through the backplane within the Hitachi Compute Blade 500 server chassis.

With the scale-up medium-sized SAP HANA configuration with 1 TB nodes, there are four dedicated Fibre Channel ports on the Hitachi Unified Storage VM for Fibre Channel connection to each VMware ESXi node. Table 5 shows the storage port mapping.

Table 5. Storage Port Mapping

Switch Module, Port	*Hitachi Unified Storage VM Ports*
Switch module 2, Port 16	1A
Switch module 2, Port 17	2A
Switch module 3, Port 16	3A
Switch module 3, Port 17	4A
Switch module 2, Port 18	5A
Switch module 2, Port 19	6A
Switch module 3, Port 18	7A
Switch module 3, Port 19	8A

This configuration supports high availability by providing multiple paths from the host within Hitachi Compute Blade 500 to multiple ports on Hitachi Unified Storage VM.

Figure 1 on page 3 shows the direct-connect Fibre Channel architecture. Set the port properties for the point-to-point connection between Hitachi Compute Blade 500 and Hitachi Unified Storage VM as shown in Table 6.

Table 6. Port Properties

Property	*Value*
Port Attribute	**Target**
Port Security	**Enabled**
Port Speed	**Auto (8 Gb/sec)**
Fabric	**ON**
Connection Type	**P-to-P**

Note — Refer to “Brocade 5460 Switch Module Cabling and Port Mapping” on page 27 for the storage port mappings for the Brocade 8 Gb/sec Fibre Channel switch modules.

On Hitachi Unified Storage VM, do the following:

- Use the default host storage group for each port listed in Table 7.
- Assign the World Wide Name of the Hitachi 8 GB/sec Fibre Channel mezzanine port as the host to the corresponding host group.

Table 7. Host Storage Group WWN Port Mapping on Hitachi Unified Storage VM

Host Storage Group (Ports)	*Chassis, Server Blade, Mezzanine Card, Mezzanine Port WWN*
1A-G00	Chassis 1, Server Blade 6, Mezzanine 2, Port 0 WWN
2A-G00	Chassis 1, Server Blade 4, Mezzanine 2, Port 0 WWN
3A-G00	Chassis 1, Server Blade 6, Mezzanine 2, Port 1 WWN
4A-G00	Chassis 1, Server Blade 4, Mezzanine 2, Port 1 WWN
5A-G00	Chassis 1, Server Blade 2, Mezzanine 2, Port 0 WWN
6A-G00	Chassis 1, Server Blade 0, Mezzanine 2, Port 0 WWN
7A-G00	Chassis 1, Server Blade 2, Mezzanine 2, Port 1 WWN
8A-G00	Chassis 1, Server Blade 0, Mezzanine 2, Port 1 WWN

Network Architecture

This solution uses two 10 Gb/sec LAN pass-through modules on Switch Slot 0 and Switch Slot1 of the Hitachi Compute Blade 500 chassis.

The 520X B1 server blades (Server 0, Server 2, Server 4, and Server 6) each have one 4-port 10 GbE onboard LOM. The LOM pass-through connectors installed on 520X B1 server blades connect the onboard LAN to the 10 GbE LAN pass-through switch modules installed in Switch Slot 0 and Switch Slot1.

The SAP HANA appliance scale-up medium 1 TB configuration has a total of eight 10 GbE LOM ports. Make the following network connections for the management and uplink network setup of the SAP HANA node:

- Connect the external switch to the following:
  - Port 0 and Port 8 of the LAN pass-through module on Switch Slot 0
  - Port 4 and Port 12 of the LAN pass-through module on Switch Slot 1
- Configure the corresponding two ports vmnic1 and vmnic2 of Node 1 and Node 2 as uplinks in the virtual distributed switch using active-active mode. The ports vmnic1 and vmnic2 appear at the ESXi level. These ports act as the management network for the ESXi node as well as the network for the guest operating system for the two nodes.

- Connect Port 4 and Port 12 of the LAN pass-through module on Switch Slot 0 and Port 0 and Port 8 of the LAN pass-through module on Switch Slot 1 to the external switch.
- Configure the corresponding two ports vmnic0 and vmnic5 of Node 1 and Node 2 as uplinks in the virtual distributed switch using active-active mode. The ports vmnic0 and vmnic5 appear at the ESXi level. These ports act as the VMware vMotion network system for the two nodes.
- The following are free for the appliance to connect to the 10 GbE external switches for use as uplink network ports:
  - Switch Slot 0 LAN pass-through Module Port 2, Module Port 6, Module Port 10, and Module Port 14
  - Switch Slot 1 LAN pass-through Module Port 2, Module Port 6, Module Port 10, and Module Port 14

The compute network setup uses the ports on the 10 GbE LAN pass-through modules, as listed in Table 8.

Initially, the installation will create a vSwitch that manages the following:

- Virtual machine connection
- vmkernel connection
- vMotion connection

When integrating with the VMware vCenter environment and converting to the virtual distributed switch, set up 2 different port groups. Each port group has its own active-active LAG, consisting of four physical connections.

Table 8 shows the two different port groups:

1. Node operating system, which consists of the following:
   - vmkernels
   - Virtual machine uplinks for Node 1 and Node 2
2. vMotion, dedicated ports for vMotion for Node 1 and Node 2

Table 8. Network Setup Using 10 GbE LAN Passthrough Modules

Server Blade	*LAN Pass-through Switch Module*	*Switch Module Port*	*Network Description*
0	Switch 0	0	Operating system management network for SAP HANA, Node 2
		2	Free for use as uplink network
2	Switch 0	4	VMware vMotion network, Node 2
		6	Free for use as uplink network

Table 8. Network Setup Using 10 GbE LAN Passthrough Modules (Continued)

Server Blade	*LAN Pass-through Switch Module*	*Switch Module Port*	*Network Description*
0	Switch 1	0	VMware vMotion network, Node 2
		2	Free for use as uplink network
2	Switch 1	4	Operating system management network for SAP HANA node, Node 2
		6	Free for use as uplink network
4	Switch 0	8	Operating system management network for SAP HANA, Node 1
		10	Free for use as uplink network
6	Switch 0	12	VMware vMotion network, Node 1
		14	Free for use as uplink network
4	Switch 1	8	VMware vMotion network, Node 1
		10	Free for use as uplink network
6	Switch 1	12	Operating system management network for SAP HANA, Node 1
		14	Free for use as uplink network

The Hitachi Compute Blade 500 chassis has two management modules for redundancy. Each module supports the following:

- An independent management LAN interface from the data network for remote and secure management of the chassis and all server blades
- A serial command line interface and a web interface
- Hot swappable replacements
- Live firmware updates without the need for shutting down the server blades

The standard network configuration used on Hitachi Compute Blade 500 chassis is shown in the following:

- Figure 4 on page 18 for Node 1
- Figure 5 on page 18 for Node 2

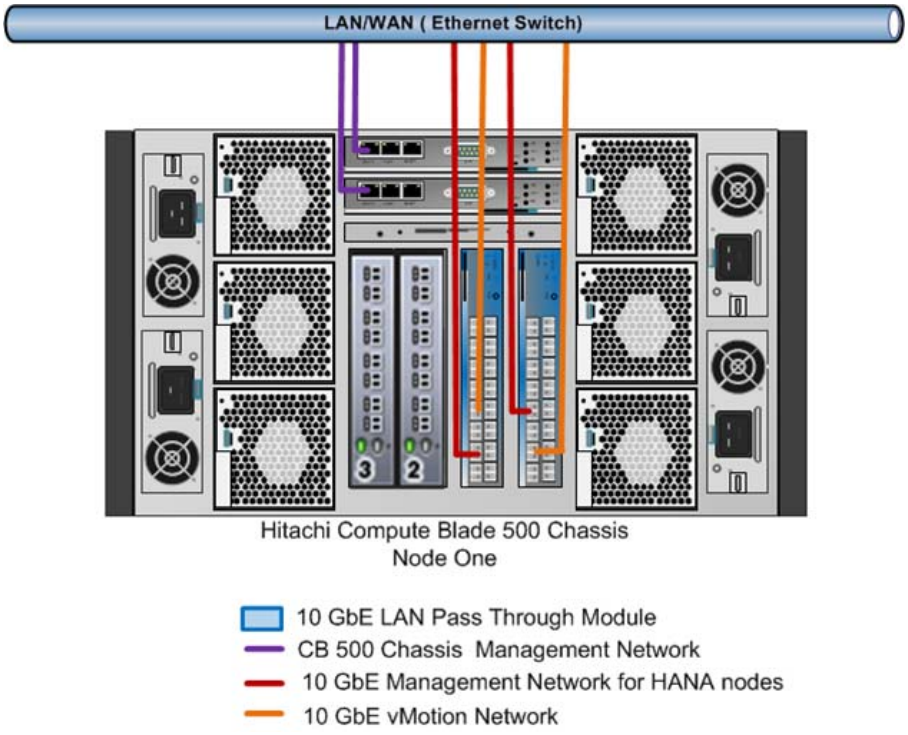

Figure 4

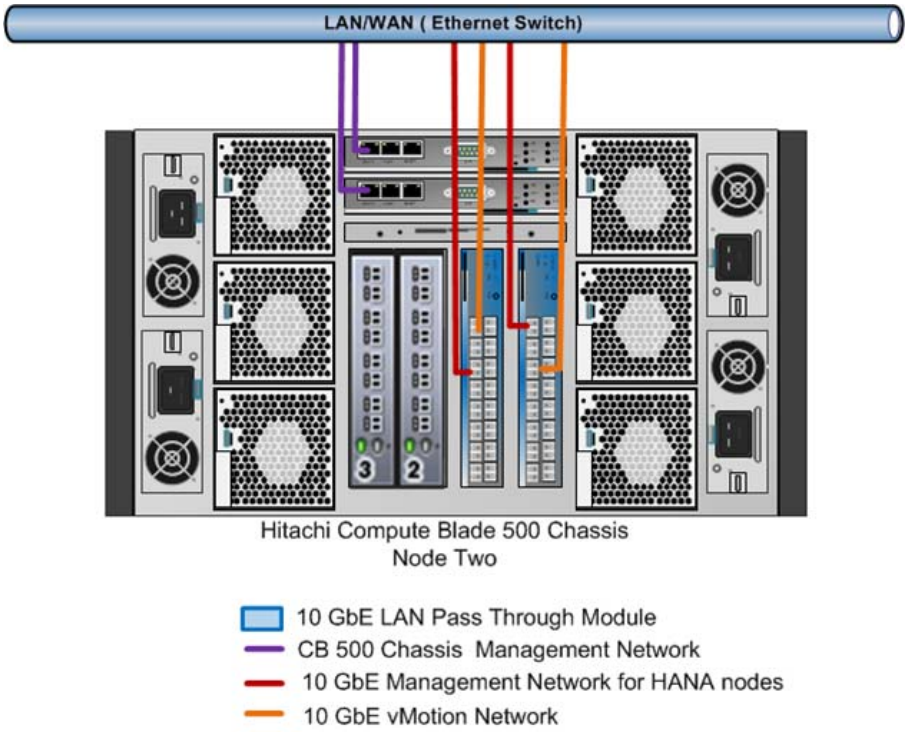

Figure 5

Storage Architecture

Many factors drive the sizing and configuring of storage for use with the medium scale-up configuration reference solution with 1 TB nodes of Hitachi Unified Compute Platform for SAP HANA on VMware vSphere. This includes I/O and capacity requirements.

The storage layout presented uses five parity groups configured as RAID-6 (6D+2P). It supports eight virtual machines running batch loads in parallel.

To run seven more virtual machines at the same time, for a total of 15 virtual machines of 64 GB running SAP HANA, then Hitachi Data Systems recommends purchasing four more parity groups for data LUNs and log LUNs. If performance is not an issue or requirement, one set of parity groups has enough storage capacity to host 15 virtual machines of 64 GB running SAP HANA.

Figure 6 shows the disk configuration of the storage subsystem.

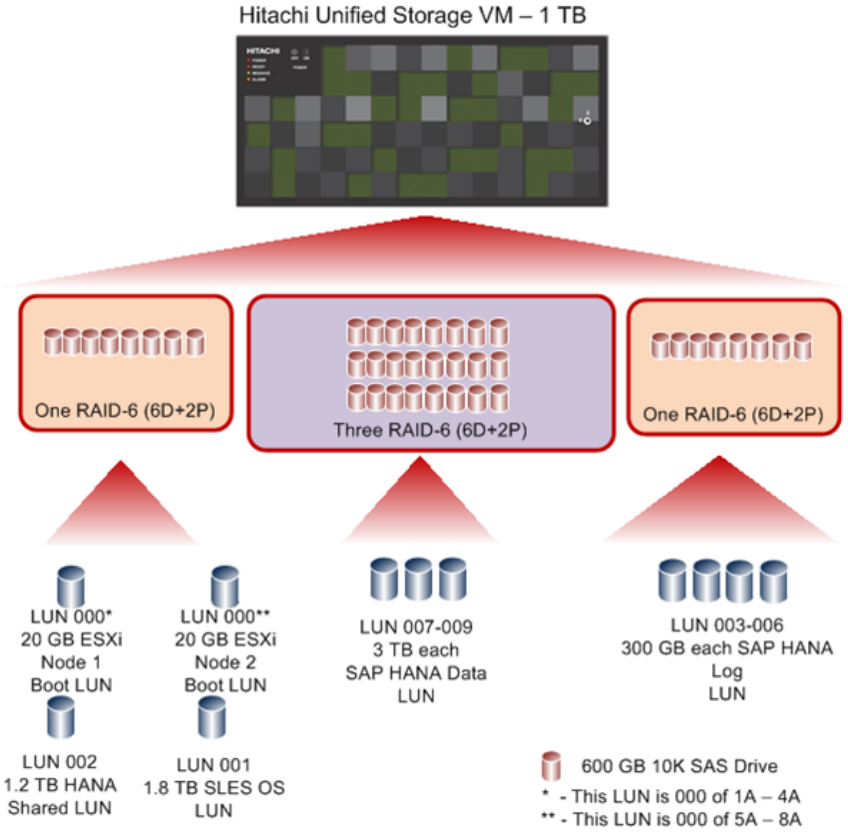

Figure 6

RAID and LUN Configuration

This reference architecture for Hitachi Unified Compute Platform for the SAP HANA Platform on VMware vSphere in a scale-up medium 1 TB configuration uses the following RAID configuration on Hitachi Unified Storage VM:

- Five RAID-6 (6D+2P) groups created using 32 × 600 GB 10k RPM SAS drives
- One 600 GB SAS 10k RPM spare drive

This reference solution contains the following:

- One 20 GB LUN to host the VMware ESXi 5.5 U1 Node 1 hypervisor
- One 20 GB LUN to host the VMware ESXi 5.5 U1 Node 2 hypervisor
- One 1.8 TB LUN to host the SAP HANA virtual machine server operating system and virtual machine storage
- One 1.2 TB LUN to host the SAP HANA shared volume
- Four 300 GB LUNs to host the SAP HANA log volume
- Three 3 TB LUNs to host the SAP HANA data volume

Table 9 on page 20 has the parity groups and LDEV assignments for Node 1 (Port 1A, Port 2A, Port 3A, and Port 4A) in this medium configuration with 1 TB nodes. Table 10 on page 22 has the parity groups and LDEV assignments for Node 2 (Port 5A, Port 6A, Port 7A, and Port 8A) in this medium configuration with 1 TB nodes.

Table 9. Storage Configuration for Ports 1A-4A

Parity Group	*Parity Group RAID Level and Disks*	*LDEV ID*	*LDEV Size*	*MPU ID*	*LUN Assignment*	*Description*
1	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	0:00:00	20 GB	MPU-10	000	ESXi operating system Node 1
1	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	0:01:00	1.8 TB	MPU-21	001	SLES OS Storage
1	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:01:01	1.2 TB	MPU-20	002	SAP Shared

Table 9. Storage Configuration for Ports 1A-4A (Continued)

Parity Group	Parity Group RAID Level and Disks	LDEV ID	LDEV Size	MPU ID	LUN Assignment	Description
2	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:02:00	300 GB	MPU-10	003	SAP HANA Log Volume VMFS_1
2	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:02:01	300 GB	MPU-11	004	SAP HANA Log Volume VMFS_2
2	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:02:02	300 GB	MPU-20	005	SAP HANA Log Volume VMFS_3
2	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:02:03	300 GB	MPU-21	006	SAP HANA Log Volume VMFS_4
3	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:03:00	3 TB	MPU-10	007	SAP HANA Data Volume VMFS_1
4	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:03:01	3 TB	MPU-11	008	SAP HANA Data Volume VMFS_2
5	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:03:02	3 TB	MPU-20	009	SAP HANA Data Volume VMFS_3

For Node 1, follow the LUN path assignment in Table 9 for the four host groups on Hitachi Unified Storage VM in Table 7 on page 15. To support high availability, each LUN has four paths from the host within Hitachi Compute Blade 500 to the four ports (1A, 2A, 3A, 4A) on Hitachi Unified Storage VM.

Table 10. Storage Configuration for Ports 5A-8A

Parity Group	Parity Group RAID Level and Disks	LDEV ID	LDEV Size	MPU ID	LUN Assignment	Description
1	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	0:00:01	20 GB	MPU-10	000	ESXi operating system Node 2
1	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	0:01:00	1.8 TB	MPU-21	001	SLES OS Storage
1	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:01:01	1.2 TB	MPU-20	002	SAP Shared
2	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:02:00	300 GB	MPU-10	003	SAP HANA Log Volume VMFS_1
2	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:02:01	300 GB	MPU-11	004	SAP HANA Log Volume VMFS_2
2	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:02:02	300 GB	MPU-20	005	SAP HANA Log Volume VMFS_3
2	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:02:03	300 GB	MPU-21	006	SAP HANA Log Volume VMFS_4
3	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:03:00	3 TB	MPU-10	007	SAP HANA Data Volume VMFS_1
4	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:03:01	3 TB	MPU-11	008	SAP HANA Data Volume VMFS_2
5	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:03:02	3 TB	MPU-20	009	SAP HANA Data Volume VMFS_3

For Node 2, follow the LUN path assignment in Table 10 for the four host groups on the Hitachi Unified Storage VM in Table 7 on page 15. To support high availability, each LUN has four paths from the host within Hitachi Compute Blade 500 to four ports (5A, 6A, 7A, 8A) on Hitachi Unified Storage VM.

The SLES OS Storage, SAP Shared, Data LUNs and LOG LUNs are assigned to eight paths. Only the first LUN assignment is different. LUN 000 for Node 1 is assigned to Ports 1A-4A and LUN 000 of Node 2 is assigned to Ports 5A-8A.

VMware vSphere ESXi Configuration

This describes the VMware vSphere ESXi configuration.

SAN Operating System Boot Configuration

This two server blade SMP configuration requires using SAN boot. The 1 TB node uses one 20 GB LUN from Hitachi Unified Storage VM as the operating system boot volume to host the hypervisor of the medium size SAP HANA virtual machine appliance.

The Hitachi 8 GB/sec 2-port Fibre Channel mezzanine ports in Table 7 on page 15 have the 20 GB ESXi boot LUN configured as the primary boot device. The installation of ESXi version 5.5 update 1 is on the boot LUN.

Activate Round Robin Multipathing Policy

This reference architecture uses the round robin multipathing policy, a component of the VMware ESXi operating system.

Using the round robin multipathing policy allows the configuration of multiple I/O paths between the server blades and Hitachi Unified Storage VM. Round robin aggregates all physical I/O paths into a single logical path, providing high availability and load balancing for the block devices. The LUNs are always available unless all four paths fail.

The round robin multipathing policy is used for the following I/O paths:

- VMware ESXi operating system LUN
- SAP HANA server operating system LUN
- SAP HANA data volume LUN
- SAP HANA log volume LUN
- SAP HANA shared volume LUN

VMware vMotion Configuration

VMware vMotion adds the capability of real-time migration with virtually zero down time. Hitachi Data Systems recommends enabling VMware vSphere High Availability and Distributed Resource Scheduler.

Each ESXi node is set up with two network ports dedicated to VMware vMotion. On each ESXi host, create two vmkernels for vMotion. With the two nodes, there are four vmkernels aggregated under one link aggregated group set for Active-Active. Add this link aggregated group to a dedicated port group, on which resides on a virtual distributed switch.

This solution also supports the architectural design for the storage vMotion with SAP HANA on VMware. See Figure 2 on page 4.

Perform storage migration during low traffic times to reduce the time needed to migrate. You can now move seamlessly from a non-production environment into a virtualized production environment, and vice versa, Storage vMotion.

SAP HANA Configuration

This describes the medium-sized configuration for the 1 TB node appliance.

SAN Operating System Boot Configuration

This virtualized SAP HANA configuration requires SAN boot. Hitachi Unified Storage VM provisions a 1.8 TB LUN called SLES OS Storage.

VMware ESXi sees the LUN and creates a virtual machine file system (VMFS). From the VMFS, create a 100 GB virtual machine disk (VMDK) to be used for the operating system for the 1 TB virtual machine. This includes creating the **/usr/sap/ directory for SAP application related files**.

SAP HANA Volume Configuration

This SAP HANA virtual machine configuration uses the following LUNs from Hitachi Unified Storage VM:

- **Three 3 TB SAP HANA data LUNs.** This creates three 1 TB VMDKs for the SAP HANA data.
- **Four 300 GB SAP HANA log LUNs.** This creates four 150 GB VMDKs for the SAP HANA log.
- **One 1.2 TB SAP HANA shared LUN.** This creates one shared 1 TB VMDK for SAP HANA.

The logical volume manager (LVM) configures the SAP HANA persistent storage volumes from virtual machines.

- With three VMDKs for the SAP HANA data, the LVM creates a single 3-way striped volume on which the XFS file system is created to store the SAP HANA data volume.
- With four VMDKs for the SAP HANA log, the LVM creates a single 4-way striped volume on which the XFS file system is created to store the SAP HANA log volume.

For SAP HANA shared, SLES OS creates an XFS file system to store SAP HANA binaries, configuration, and trace files.

SAP HANA Software Installation

After configuring the file system for the SAP HANA data volume and log volume, the latest version of SAP HANA 1.0 SPS09 is installed on the SAP HANA virtual machine server.

The following SAP HANA software components are installed on the SAP HANA virtual machine server node:

- SAP HANA Database
- SAP HANA Client
- SAP Host Agent
- LM Structure

Multiple Virtual Machine Configurations

For non-production environments that are used for development and quality assurance, these are the size configurations of multiple virtual machines for a 1 TB solution using SAP HANA in a VMware environment.

Note — Multiple virtual machines are only applicable for non-production environments. The production environment only allows one SAP HANA virtual machine.

SAP and VMware require that the production 1 TB virtual machine only use 980 GB of RAM. VMware ESXi processes use the remaining memory.

To allocate memory evenly to all virtual machines and keep within the limitation of 980 GB of RAM for the production virtual machine, use the following sizes for the maximum number of virtual machines for SAP HANA:

- 1024 GB virtual machine uses 980 GB RAM
- 768 GB virtual machine uses 735 GB RAM
- 512 GB virtual machine uses 490 GB RAM
- 256 GB virtual machine uses 245 GB RAM
- 192 GB virtual machine uses 183 GB RAM
- 128 GB virtual machine uses 122 GB RAM
- 64 GB virtual machine uses 64 GB RAM

To create more than eight virtual machines and to maintain performance, Hitachi Data Systems recommends using four more parity groups configured as RAID-6 (6D+2P) to host data LUNs and log LUNs.

If performance is not an issue or requirement, one parity group set has enough storage capacity to host up to 15 virtual machines running as 64 GB SAP HANA databases. For more information, refer to SAP Note 2024433.

Table 11 lists SAP HANA virtual machines that fit within the 980 GB limitation.

Table 11. Virtual Machine Allocation

Number of Virtual Machines	*Virtual Machine Size*							
	1st	*2nd*	*3rd*	*4th*	*5th*	*6th*	*7th*	*15th*
2	490 GB	490 GB						
3	490 GB	245 GB	245 GB					
4	490 GB	245 GB	122 GB	122 GB				
5	490 GB	245 GB	64 GB	64 GB	64 GB			
6	490 GB	122 GB	122 GB	122 GB	122 GB			
7	490 GB	122 GB	122 GB	64 GB	64 GB	64 GB		
15 (Maximum)	64 GB	64 GB	64 GB	64 GB	64 GB	64 GB	64 GB	64 GB

Brocade 5460 Switch Module Cabling and Port Mapping

If your shipment includes Brocade 5460 8 Gb/sec Fibre Channel switch modules, this defines the cabling and port mapping.

- Figure 7 displays the physical cabling.
- Table 12 defines the port mapping.

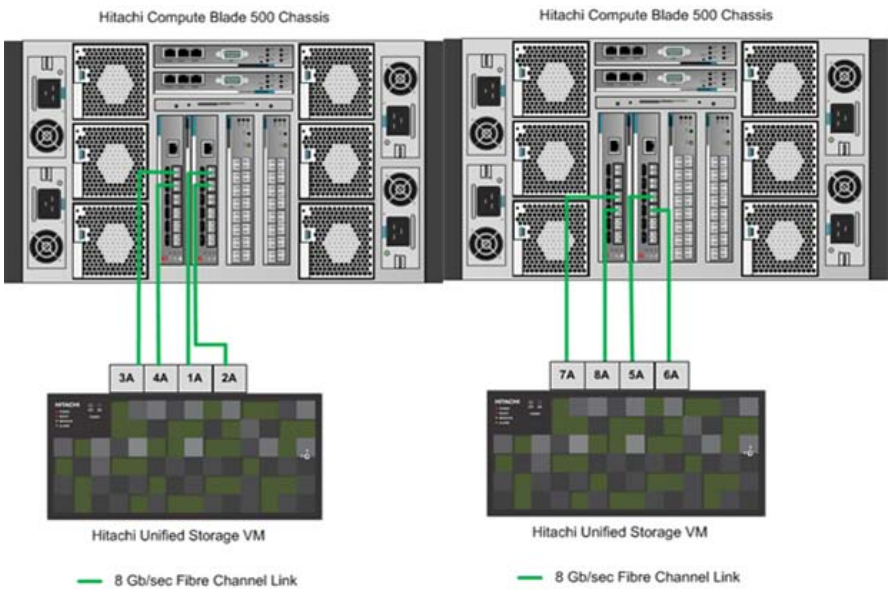

Figure 7

Table 12. Storage Port Mapping

Switch Module, Port	*Hitachi Unified Storage VM Ports*
Switch module 2, Port 0	1A
Switch module 2, Port 1	2A
Switch module 3, Port 0	3A
Switch module 3, Port 1	4A
Switch module 2, Port 2	5A
Switch module 2, Port 3	6A
Switch module 3, Port 2	7A
Switch module 3, Port 3	8A

For More Information

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

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