

# Hitachi Unified Compute Platform for the SAP HANA® Platform in a Large 2 TB Scale-Up Configuration using Hitachi Compute Blade 500 and Hitachi Unified Storage VM

## Reference Architecture Guide

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# Hitachi Unified Compute Platform for the SAP HANA® Platform in a Large 2 TB Scale-Up Configuration using Hitachi Compute Blade 500 and Hitachi Unified Storage VM

## Reference Architecture Guide

Hitachi Unified Compute Platform for the SAP HANA® Platform in a Scale-Up Large 2 TB configuration is a pre-configured analytical appliance ready to plug into a network to provide real-time access to operational data for use in analytic models.

This reference architecture guide for the large size 2 TB configuration describes how to deploy UCP for SAP HANA in a Scale-Up configuration using the following:

- Hitachi Compute Blade 500 (with 520X B1 server blades)
- Hitachi Unified Storage VM (HUS VM)
- SAP High-Performance Analytic Appliance (HANA)

This technical paper assumes familiarity with the following:

- Storage area network (SAN)-based storage systems
- General storage concepts
- SAP HANA
- Common IT storage practices

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**Note** — This document is for internal use only. It supports sales, support, and appliance building in order to understand the architecture and deployment of the Hitachi Unified Compute Platform for the SAP HANA in a Scale-Up configuration.

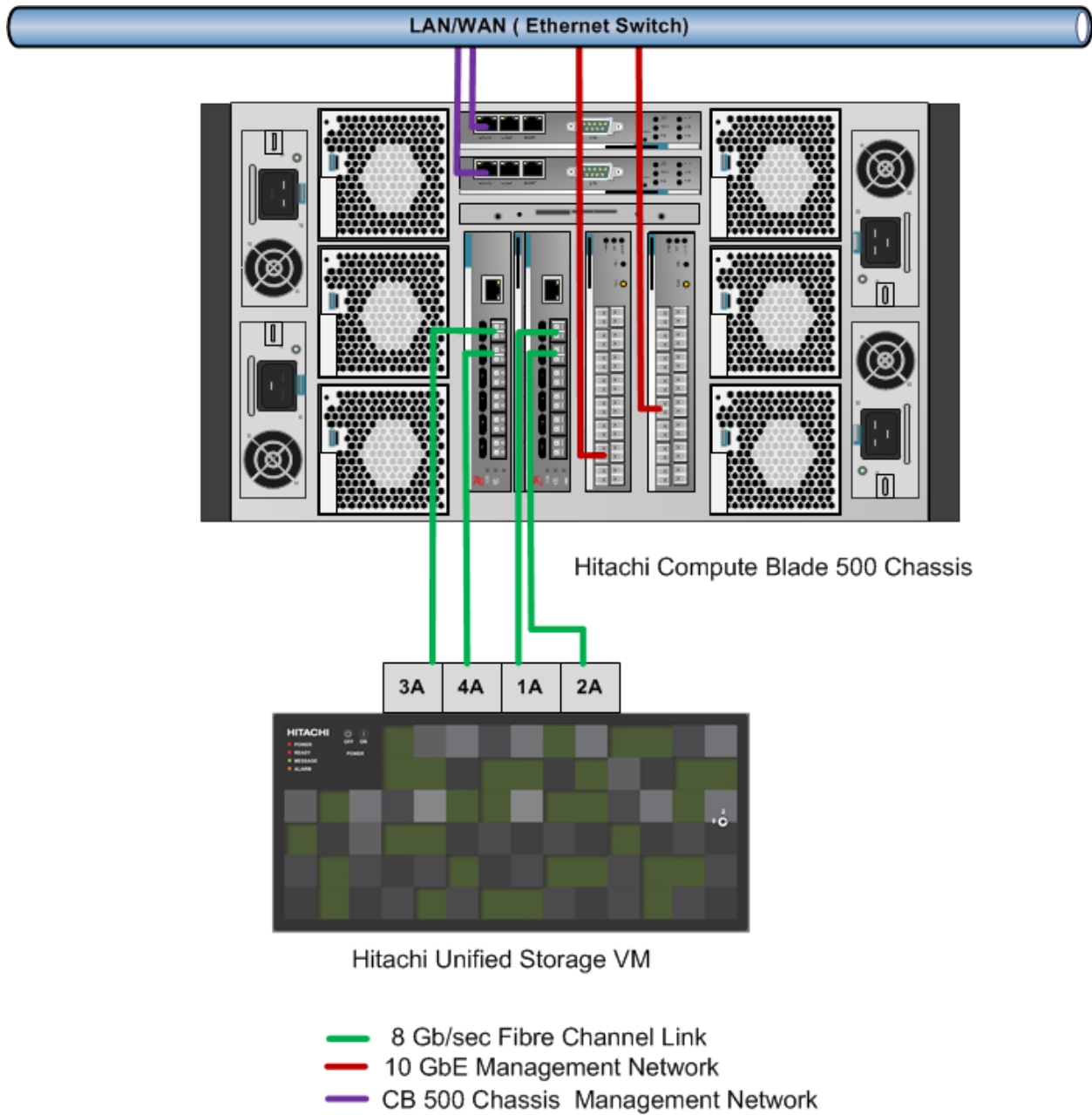
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## Solution Overview

The 2 TB large size UCP for SAP HANA in a Scale-Up configuration reference solution is a blade server solution for SAP HANA. This reference architecture uses the following:

- **Hitachi Compute Blade 500 (CB 500)** — an enterprise-class server platform.
    - This solution uses four 520X B1 server blades.
  - **Hitachi Unified Storage VM (HUS VM)** — Storage virtualization system designed to manage storage assets more efficiently. The persistent storage of the HANA server resides on this storage device.
  - **SAP HANA Platform** — A multi-purpose, in-memory database appliance to analyze transactional and analytical data.
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Figure 1 shows the topology of this reference architecture.



**Figure 1**

## Key Solution Elements

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

### Hardware Elements

Table 1 describes the hardware used to deploy the large 2 TB UCP for SAP HANA in a Scale-Up configuration.

**Table 1. Hardware Elements**

<i>Hardware</i>	<i>Quantity</i>	<i>Configuration</i>	<i>Role</i>
Hitachi Compute Blade 500 (CB 500) chassis	1	<ul style="list-style-type: none"> <li>■ 4-blade chassis</li> <li>■ 2 management modules</li> <li>■ 6 cooling fan modules</li> <li>■ 2 × 10 Gb/sec LAN pass-through modules</li> <li>■ 2 x 8 Gb/sec Brocade Fibre Channel switch modules</li> </ul>	Server blade chassis
520X B1 server blade	4	<ul style="list-style-type: none"> <li>■ 2 × 15-core processors</li> <li>■ 512 GB RAM</li> <li>■ On Blade 4 and 6 - 1 × 4 port 10 GbE Onboard LAN on Motherboard (LOM)</li> <li>■ On Blade 4 and 6 - 1 × 2 port Hitachi FIVE-EX Fibre Channel Mezzanine on Mezzanine Slot 2</li> </ul>	SAP HANA server
SMP connector module	1	<ul style="list-style-type: none"> <li>■ 4-blade SMP connector board</li> <li>■ SMP expansion module</li> <li>■ SMP connector cover</li> </ul>	SMP connector
Hitachi Unified Storage VM	1	<ul style="list-style-type: none"> <li>■ Single frame</li> </ul>	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.

Table 2 has the specifications for the Hitachi Compute Blade 520X server blades used in this solution.

**Table 2. 520X B1 Server Blade Configuration**

<i>Feature</i>	<i>Configuration</i>
Processors	<ul style="list-style-type: none"> <li>■ Intel Xeon processor E7-8800</li> <li>■ 2 processors per server blade</li> </ul>
Processor SKU	<ul style="list-style-type: none"> <li>■ Intel Xeon processor E7-8880 v2</li> </ul>
Processor frequency	<ul style="list-style-type: none"> <li>■ 2.50 GHz</li> </ul>
Processor cores	<ul style="list-style-type: none"> <li>■ 15 cores</li> </ul>
Memory DIMM slots	<ul style="list-style-type: none"> <li>■ Total of 48 with 32 populated</li> </ul>
Memory	<ul style="list-style-type: none"> <li>■ 512 GB RAM</li> <li>■ 16 GB DIMMs</li> </ul>
Network ports	<ul style="list-style-type: none"> <li>■ 4 × 10 Gb Ethernet LOM (Only on Blade 4 and 6)</li> </ul>
Fibre Channel Mezzanine ports	<ul style="list-style-type: none"> <li>■ 1 × 2 port Hitachi FIVE-EX Fibre Channel Mezzanine on Mezzanine Slot 2 (Only on Blade 4 and 6)</li> </ul>
Other interfaces	<ul style="list-style-type: none"> <li>■ 1 × USB 3.0 port</li> <li>■ KVM connector (VGA, COM, USB2.0 2port)</li> </ul>

### Hitachi Symmetric Multiprocessing Connector

Use Hitachi symmetric multiprocessing (SMP) technology to combine multiple server blade resources into a single server. SMP connectors combine server blade resources, subject to product limitations.

Hitachi Compute Blade 520X uses symmetric multiprocessing in one of two ways:

- Combine the resources of two server blades with a 2-blade SMP connector
- Combine the resources of four server blades with a 4-blade SMP connector



This solution uses a four-blade SMP connection interface to connect four server blades. This combination acts as a single HANA server node for the large size configuration with the following:

- 8 CPUs
- 120 cores
- 2048 GB of RAM

### 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 Hitachi 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 for the Hitachi NAS Platform reside on this storage device.

This solution uses a single Hitachi Unified Storage VM.

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## Software Elements

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

**Table 3. Software Elements**

<i>Software</i>	<i>Version</i>
SUSE Linux Enterprise Server for SAP Applications	11 SP3
SAP HANA Platform	1.0 SPS09, Rev. 97 or later
Hitachi Storage Navigator Modular 2	Microcode dependent
Hitachi Command Suite	8.0.0-04

### SAP High Performance Analytic Appliance (HANA)

The SAP High Performance Analytic Appliance™ (HANA) platform is flexible, multipurpose in-memory software. 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 the parallel processing capabilities of multi-core CPU architectures.
- **SAP LT (Landscape Transformation)** — this replicates source system data to the SAP HANA appliance.

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). The following are available:

- [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 Overall Installation Guide](#) for an overview on how to install SAP HANA.
- [SAP HANA Technical Operations Manual](#) — this is a picture of the available administration tools with SAP HANA appliance and the key tasks for a system administrator.
- [SAP HANA Update Guide](#) — this explains how to update SAP HANA and its components.
- [SAP HANA Product Availability Matrix](#) — this provides information about SAP HANA-supported software and hardware platforms. Search for "HANA" on this page.

### **SUSE Linux Enterprise Server (SLES) for SAP Applications**

The large size 2 TB UCP for SAP HANA in a Scale-Up configuration runs on a 64-bit SUSE Linux Enterprise Server (SLES) for SAP Applications 11 SP3. The kernel version is 3.0.101-0.29.

The initially delivered configuration of the 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. Specifically, SAP must validate and approve any updates related to the kernel or runtime libraries (**glibc**). You must wait for all the other operating system patches until officially released by SAP HANA.

For more details, see section 2.1.4.1, "Updating and Patching the Operating System," in the [SAP HANA Technical Operations Manual](#).

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## Solution Design

The detailed design for this Hitachi Unified Compute Platform for the SAP HANA in a Scale-Up Large 2 TB configuration reference solution includes the following:

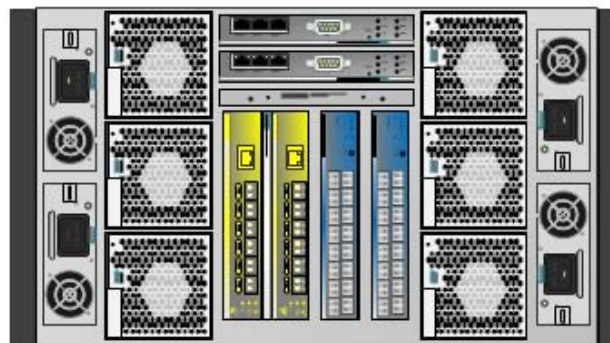
- Hitachi Compute Blade 500 Chassis Configuration
  - Hitachi Compute Blade 520X Server Architecture
  - Fibre Channel SAN Architecture
  - Network Architecture
  - Storage Architecture
  - SAP HANA Configuration
-

## Hitachi Compute Blade 500 Chassis Configuration

Figure 2 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
- 8 Gb/sec Brocade Fibre Channel Switch Module

### Figure 2

In this solution, we use one Hitachi Compute Blade 500 chassis and it consists of a total of four 520X B1 server blades.

There are four switch modules on the Hitachi Compute Blade 500 chassis, and it has the following components:

- Switch Module 0 and Switch Module 1 have 10 GbE LAN pass through modules.
- Switch Module 2 and 3 have 8 Gb/sec Brocade Fibre Channel switch modules.

## Hitachi Compute Blade 520X Server Architecture

Each SAP HANA node is a four-server blade connected using the four-blade SMP interface connector. This creates a single eight-socket SMP node with 120 cores and 2 TB of memory.

Table 4 lists the server blade configuration.

**Table 4. Server Blade Configuration**

<i>Server Blades</i>	Total 4 server blades <ul style="list-style-type: none"> <li>■ Blade 0 (non-primary)</li> <li>■ Blade 2 (non-primary)</li> <li>■ Blade 4 (non-primary)</li> <li>■ Blade 6 (primary)</li> </ul>
<i>Total Number of CPU Cores</i>	120
<i>Total Memory (TB)</i>	2

## Fibre Channel SAN Architecture

The Fibre Channel SAN architecture consists of the following components on 520X blades.

- Blade 4 has 1 × 2-port Hitachi FIVE-EX Fibre Channel mezzanine card on mezzanine slot 2
- Blade 6 has 1 × 2-port Hitachi FIVE-EX Fibre Channel mezzanine card on mezzanine slot 2

The mezzanine card installed in mezzanine slot 2 of server blades 4 and 6 connects to the 8 Gb/sec Brocade Fibre Channel switch modules installed in switch slots 2 and 3 through the backplane within the Hitachi Compute Blade 500 server chassis.

With the HANA scale-up large 2 TB configuration, there are four dedicated Fibre Channel ports on the Hitachi Unified Storage VM for Fibre Channel connection with the SAP HANA node. Table 5 shows the storage port mapping.

**Table 5. Storage Port Mapping**

<i>Switch Module, Port</i>	<i>Hitachi Unified Storage VM Ports</i>
Switch module 2, Port 0	1A
Switch module 2, Port 1	2A
Switch module 3, Port 0	3A
Switch module 3, Port 1	4A

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.

Table 5 shows the direct connect Fibre Channel architecture.

### Hitachi Compute Blade 500 Chassis

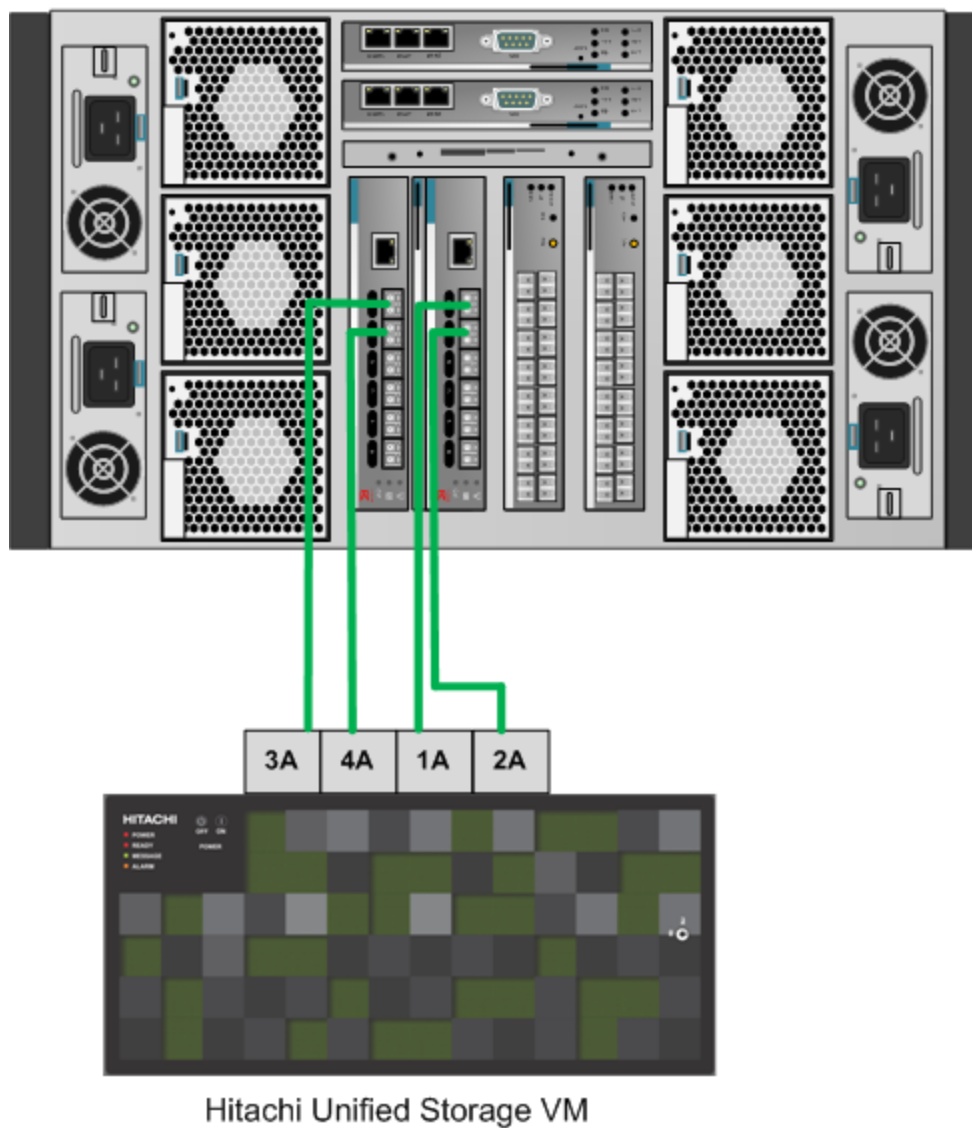


Figure 3

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**

<i>Property</i>	<i>Value</i>
Port Attribute	Target
Port Security	Enabled
Port Speed	Auto (8 Gbps)
Fabric	ON
Connection Type	P-to-P

On the Hitachi Unified Storage VM, use the default host storage group for each port mentioned in Table 7 and assign the World Wide Names of the Hitachi FIVE-EX Fibre Channel mezzanine ports as the host to the corresponding host group.

**Table 7. Host Storage Group WWN Port Mapping**

HUS VM	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

## Network Architecture

Use two 10 Gb/sec LAN pass-through modules on switch slot 0 and 1 of the Hitachi Compute Blade 500 chassis. The 520X B1 server blades 4 and 6, each have one 4-port 10 GbE onboard LOM. 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 1.

The HANA scale-up large 2 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 HANA node:

- Connect the port 8 of LAN pass through module on switch slot 0 and port 12 of LAN pass through module on switch slot 1 to the external switch.
- Bond the corresponding two ports eth9901 and eth9902 as bond 0 at the operating system level using mode active backup, which acts as the management network for the HANA node.
- Switch slot 0 LAN pass-through module ports 10, 12 and 14, and also the switch slot 1 LAN pass-through module ports 8, 10, and 14 are free for the appliance to connect to the 10 GbE external switch for use as an uplink network.



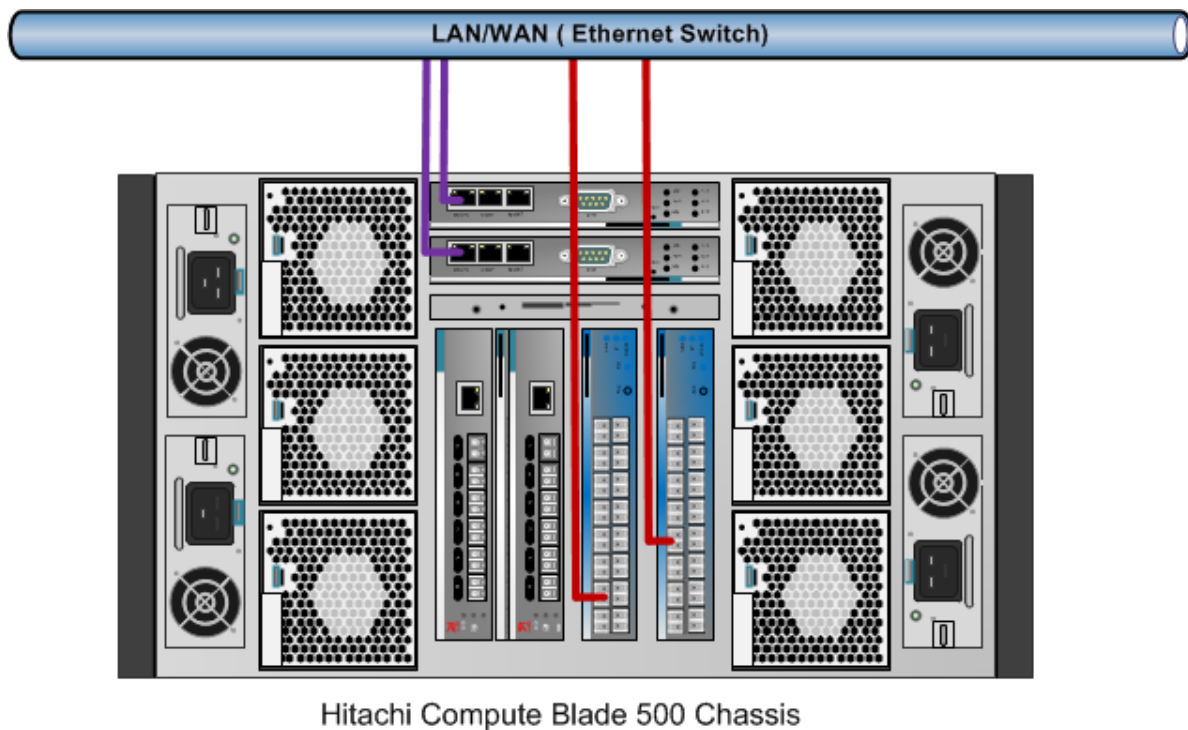
The compute network setup uses the ports on the 10 GbE LAN pass-through modules, listed in Table 8.

**Table 8. Network Setup Using 10 GbE LAN Pass-through Modules**

<i>Blades</i>	<i>LAN Pass-through Switch Module</i>	<i>Switch Module Port</i>	<i>Network Description</i>
4	Switch 0	8	Operating system management network for HANA node
4	Switch 0	10	Free for use as uplink network
6	Switch 0	12	Free for use as uplink network
6	Switch 0	14	Free for use as uplink network
4	Switch 1	8	Free for use as uplink network
4	Switch 1	10	Free for use as uplink network
6	Switch 1	12	Operating system management network for HANA node
6	Switch 1	14	Free for use as uplink network

The Hitachi Compute Blade 500 chassis has two management modules for redundancy. Each module supports an independent management LAN interface from the data network for remote and secure management of the chassis and all blades. Each module supports a serial command line interface and a web interface. Each module is hot swappable and supports live firmware updates without the need for shutting down the blades.

Figure 4 shows the standard network configuration used for Hitachi Compute Blade 500 chassis.



- 10 GbE LAN Pass Through Module
- CB 500 Chassis Management Network
- 10 GbE Management Network for HANA nodes

**Figure 4**

## Storage Architecture

Many factors drive the sizing and configuring of storage for use with the large 2 TB configuration of Hitachi Unified Compute Platform for the SAP HANA in a Scale-Up configuration reference solution. This includes I/O and capacity requirements.

Figure 5 shows the disk configuration of the storage subsystem.

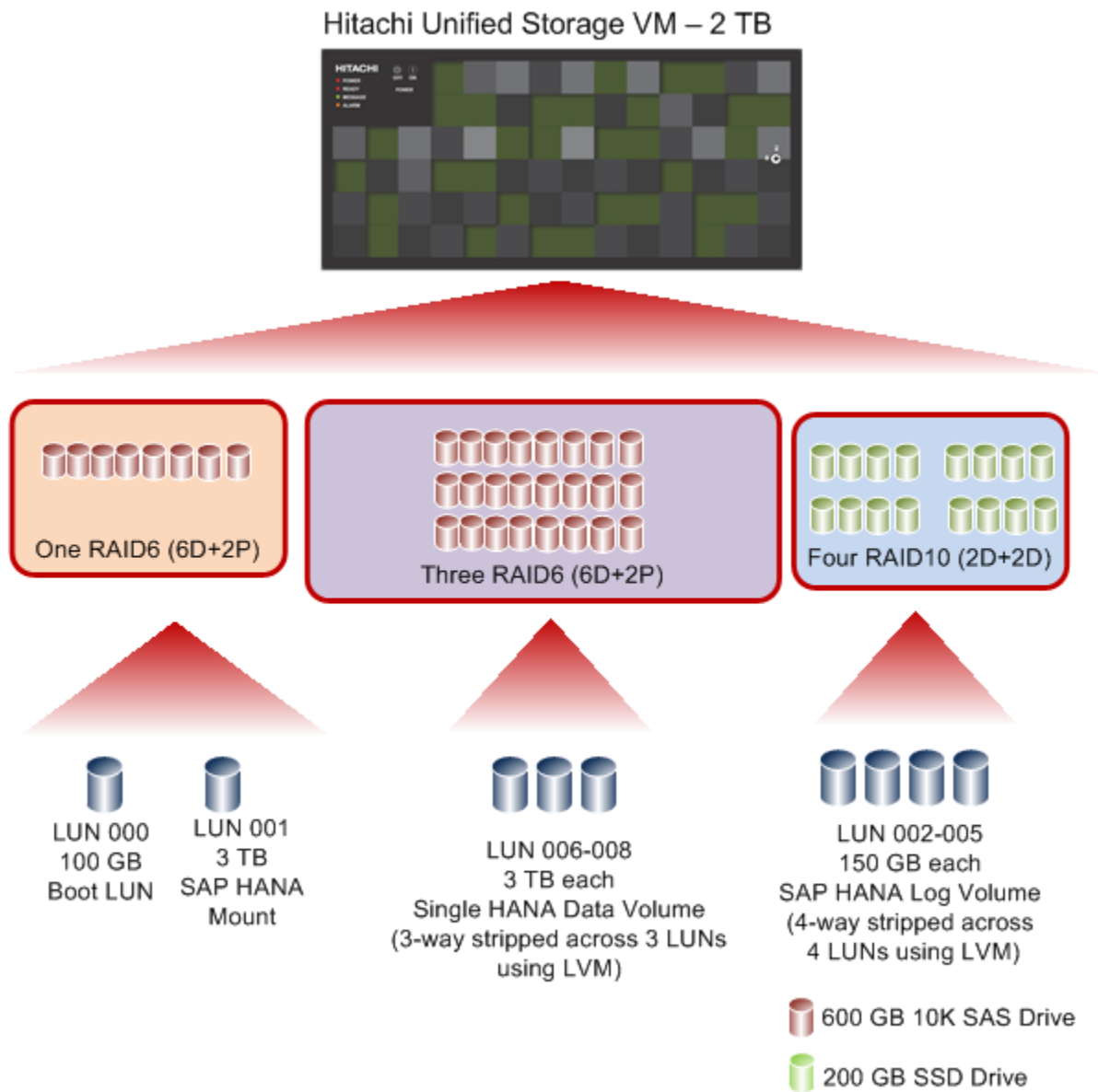


Figure 5

## RAID and LUN Configuration

This reference architecture uses the following RAID configuration on Hitachi Unified Storage VM.

- Four RAID-6 (6D+2P) groups created using 32 × 600 GB SAS 10k RPM drives.
- Four RAID-10 (2D+2D) groups created using 16 × 200 GB SSD drives.
- This solution has 1 × 600 GB SAS 10k RPM spare drive and 1 × 200 GB SSD spare drive.

Hitachi Unified Compute Platform for the SAP HANA in a Scale-Up Large 2 TB configuration reference solution contains the following:

- One 100 GB boot LUN to host the HANA server operating system
- One 3 TB LUN to host the SAP mount directory
- Three LUNs with a capacity of 3 TB each to host the HANA data volumes
- Four LUNs with a capacity of 150 GB each to host the HANA log volumes
- Table 9 has the parity groups and LDEV assignment for the large 2 TB configuration.

**Table 9. Storage Configuration**

<i>Parity Group</i>	<i>Parity Group RAID Level and Disks</i>	<i>LDEV ID</i>	<i>LDEV Size</i>	<i>LUN Assignment</i>	<i>MPU ID</i>	<i>Description</i>
1	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:01:00	100 GB	000	<b>MPU-10</b>	SAP HANA Boot LUN
		00:00:01	3 TB	001	<b>MPU-11</b>	SAP HANA mount directory
2	RAID-10 (2D+2D) on 200 GB SSD drives	00:01:01	150 GB	002	<b>MPU-20</b>	SAP HANA Log Volume
3	RAID-10 (2D+2D) on 200 GB SSD drives	00:01:02	150 GB	003	<b>MPU-10</b>	
4	RAID-10 (2D+2D) on 200 GB SSD drives	00:01:03	150 GB	004	<b>MPU-11</b>	
5	RAID-10 (2D+2D) on 200 GB SSD drives	00:01:04	150 GB	005	<b>MPU-21</b>	
6	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:0A:01	3 TB	006	<b>MPU-21</b>	
7	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:0A:02	3 TB	007	<b>MPU-10</b>	
8	RAID-6 (6D+2P) on 600 GB 10k RPM SAS drives	00:0A:03	3 TB	008	<b>MPU-20</b>	

Follow the LUN path assignment in Table 9 for the four host groups on the Hitachi Unified Storage VM listed in Table 7. To support high availability, each LUN has four paths from the host within Hitachi Compute Blade 500 to multiple ports on Hitachi Unified Storage VM.

## SAP HANA Configuration

This explains the SAP HANA configuration.

### SAN OS Boot Configuration

This four server blade configuration requires SAN boot. It uses one 100 GB LUN on Hitachi Unified Storage VM for the OS boot volume for the large size 2 TB SAP HANA appliance.

The Hitachi FIVE-EX Fibre Channel mezzanine ports mentioned in Table 5, “Storage Port Mapping,” on page 11 have the 100 GB SAP HANA boot LUN configured as the primary boot device. The installation of SUSE Linux for SAP Applications version 11 SP3 is on the boot LUN. The boot LUN also has the installation directory for SAP HANA named **/usr/sap/**.

### Activate Device-Mapper Multipath

This reference architecture uses Device-mapper Multipath, a component of the native Linux operating system.

Using Device-mapper Multipath allows the configuration of multiple I/O paths between the server blades and Hitachi Unified Storage VM. Multipathing aggregates all physical I/O paths into a single logical path. The LUN is always available unless all four paths fail.

Device-mapper Multipath is used for the following I/O paths:

- SAP HANA server boot LUN
- SAP HANA data volume LUN
- SAP HANA log volume LUN
- SAP HANA mount directory LUN

### HANA Data Volume Configuration

The Logical Volume Manager for the Linux operating system is used to configure the SAP HANA persistent storage volumes. With the three 3 TB SAP HANA data volume LUNs, Logical Volume Manager is used to create a single 3-way striped volume on the XFS file system to store the SAP HANA data volume. The striped volume acts as the persistent storage for the SAP HANA server.

### HANA Log Volumes Configuration

This reference architecture uses logical volume manager to configure the SAP HANA log volumes. With the four 150 GB SAP HANA log volume LUNs, Logical Volume Manager is used to create a single 4-way striped volume on the XFS file system to store the SAP HANA log volume.

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### **SAP HANA Mount Directory**

This reference architecture uses one 3 TB LUN for the SAP mount directory. Based on testing, the XFS file system is used on these LUNs.

### **SAP HANA Appliance 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 or later is installed on the SAP HANA server.

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

- SAP HANA database
  - SAP HANA client
  - SAP Host Agent
  - LM structure
  - SAPCAR
  - SAP JVM
  - SUM for SAP HANA
-

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