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Hitachi Virtual Storage Platform Cisco and Hitachi Adaptive Solutions for SAP HANA TDI using MDS with VSP 5200/5200H or VSP 5600/5600H

Reference Architecture Guide

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Revision history

Changes	Date
Initial release	December 17, 2021

Reference Architecture Guide

Use this reference architecture to create a best-practices-based enterprise environment with Cisco and Hitachi Adaptive Solutions for SAP HANA Tailored Data Center Integration (TDI). Developed through collaboration between Hitachi Vantara and Cisco Systems, this solution orchestrates efficiency across the data path with an intelligent system that helps you anticipate and navigate challenges as they grow.

This architecture builds a self-optimizing data center that automatically spreads workloads across devices to ensure consistent utilization and performance. This solution helps you to effectively plan infrastructure growth and eliminate budgeting guesswork with predictive risk profiles that identify historical trends.

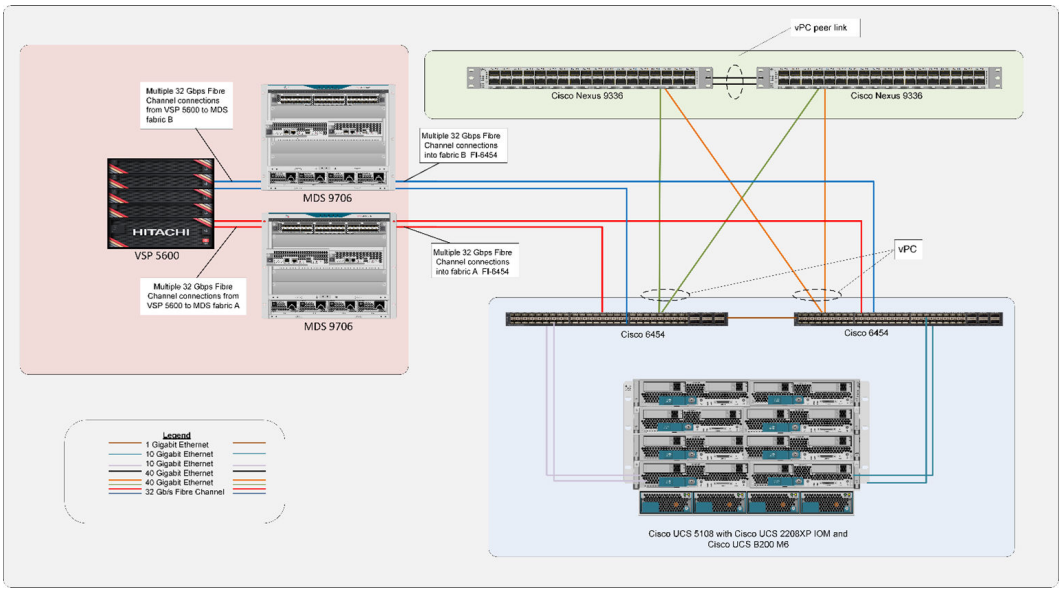
This solution architecture implements Adaptive Solutions for SAP HANA TDI to support Cisco Unified Computing System (Cisco UCS), and it uses the following components:

- Cisco UCS 5108 Blade Server Chassis
- Cisco UCS B-Series Blade Servers
- Cisco MDS 9706
- Cisco UCS 6454 Fabric Interconnects
- Cisco Nexus 9000 series switches
- Hitachi Virtual Storage Platform
  - VSP 5200/5200H
  - VSP 5600/5600H
- SAP HANA

These components form a powerful and scalable design, built on the best practices of both companies to create an excellent environment for a SAP HANA deployment. This architecture supports SUSE Linux Enterprise Server (SLES) and Red Hat Enterprise Linux (RHEL) for SAP applications.

The validation of this environment used Hitachi Virtual Storage Platform 5600/5600H.

The following figure shows the topology of this architecture for Cisco and Hitachi Adaptive Solutions for SAP HANA TDI with a Hitachi Virtual Storage Platform 5200/5200H or 5600/5600H storage system.



This architecture was validated with 32 Gbps Fibre Channel capability.

This document assumes that you are familiar with the following technologies:

- Cisco UCS
- General storage concepts
- Common IT storage practices
- Hitachi Virtual Storage Platform (VSP)
- SAP HANA

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.

Key solution elements

The following sections list the key hardware and software components used in this reference architecture.

Note: Do not change the layout of any of the components in this environment without consulting your Hitachi Vantara account representative. Changing this layout can require manual configuration of the network or using different components.

Hardware elements

The following table lists the hardware and firmware versions validated to deploy Cisco and Hitachi Adaptive Solutions for SAP HANA TDI using the Cisco UCS MDS configuration. The substitution of hardware and software versions other than those listed here is acceptable within this reference architecture, but substitutions must comply with the hardware and software compatibility matrices from Cisco, Hitachi, and SAP. For more information, see .

Table 1 Key hardware components

Hardware component		Firmware version
Network	Cisco Nexus 9336C-FX2 switch	7.0(3) I7 (9)
	Cisco UCS Virtual Interface Card (VIC) 1440 (network adapter)	UCSB-MLOM-40G-04
	Cisco UCS 6454 Fabric Interconnect	4.2(1f)
Compute	Cisco UCS 2208XP Fabric Extender I/O module (IOM)	4.2(1e)
	Cisco UCS B200 M6 Blade Servers	4.2(1a)
	Cisco UCS VIC (Fibre Channel)	5.0 (3a)
Fibre Channel SAN	MDS 9706	8.4(2b)
Storage	Hitachi Virtual Storage Platform 5600/5600H	

Table 2 Storage system specifications

Item	Type		VSP 5600/VSP 5600H specifications
Storage System	SVOS Version		Hitachi Storage Virtualization Operating System v9.8
	Maximum number of drives, including spares	NVMe SSD	288 NVMe SSDs 2304 SFF SSDs
	Maximum flash media trays (in packages of 4)		12 NVMe SSDs 96 SAS SSDs
	Drive Options	NVMe SSD	1.9 TB, 3.8 TB, 7.6 TB, 15.3 TB, 30.6 TB

Item	Type		VSP 5600/VSP 5600H specifications
		SAS SSD	1.9 TB, 3.8 TB, 7.6 TB, 15.3 TB, 30.6 TB
	RAID Level		RAID 10, RAID 5, RAID 6
	RAID group configuration	RAID-10	2D+2D, 4D+4D
		RAID-5	3D+1P, 7D+1P
		RAID-6	6D+2P, 14D+2P
	Maximum number of LDEVs		65280
	Maximum storage capacity per pair node		20.5 PB
	Maximum external configuration		255 PB
Memory	Cache memory capacity		2 TB for VSP 5600/5600H 1 TB for VSP 5200/5200H
Device I/F	Supported channel type	Fibre Channel	32/node for VSP 5600/5600H 16/node VSP 5200/5200H
		Data transfer rate	4/8/16/32 Gbps
	Maximum number of CHB		8/node for VSP 5600/5600H 4/node VSP 5200/5200H
Non-stop maintenance	Control PCB		Supported
	Cache memory		Supported
	Cache flash memory		Supported
	Power supply, fan		Supported
	Microcode		Supported
	Flash drive		Supported
	Flash module drive		Supported

Table 3 VSP 5600/5600H components

	Storage components
VSP 5600/5600H (NVMe SSDs)	▪ CTL: 2 pairs ▪ CHB: 4 pairs CHB ▪ (32 Gbps) ▪ MPU: 2 pairs ▪ Cache: 2 TB ▪ SAS SSDs: 96 × 1.9 TB

Software elements

The following table describes the software products used to deploy this solution.

Software		Software or Firmware Version
Operating system options	SUSE Linux Enterprise Server for SAP applications	SLES 15 SP2 ▪ eNIC: 4.1.0.3-868.9 ▪ fNIC: 2.0.0.72-186.0
	Red Hat Enterprise Linux for SAP Solutions	RHEL 8.2 ▪ eNIC: 4.1.0.3-868.9 ▪ fNIC: 2.0.0.72-186.0
Database	SAP HANA	2.0 SPS 05

Solution design

Cisco and Hitachi Adaptive Solutions for SAP HANA TDI on Cisco UCS with Hitachi Virtual Storage VSP 5000 series storage systems in an MDS configuration uses the following design components:

- Cisco UCS 5108 Chassis with Cisco UCS 2208XP Fabric Extender (on page 8)
- Cisco UCS B200 M6 Blade Server (on page 8)
- Network architecture (on page 9)
- Storage configuration (on page 10)
- SAP HANA Configuration (on page 16)

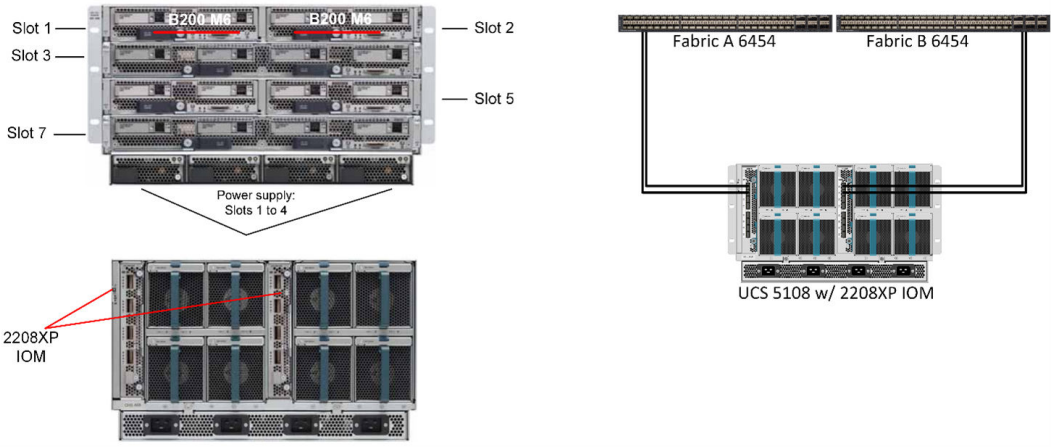
Cisco UCS 5108 Chassis with Cisco UCS 2208XP Fabric Extender

The 6RU Cisco UCS 5108 Blade Server Chassis can accommodate up to eight half-width, four full-width, or any combination of blade form factors (M1 to M5 generation) that fit in the available number of blade slots.

Each Cisco UCS B200 M6 Blade Server in this topology is hosted on a Cisco UCS 5108 Blade Server Chassis, and they connect to the fabric interconnects from the chassis using Cisco UCS 2208XP Fabric Extender IOMs.

Each Cisco 2208XP Fabric Extender IOM supports 10 Gbps connections into the 10/25 Gbps ports of each Cisco UCS 6454 Fabric Interconnect, delivering high port availability.

The following figure shows the front and rear view of a Cisco UCS 5108 Blade Server Chassis with Cisco B200 M6 Blade Servers:

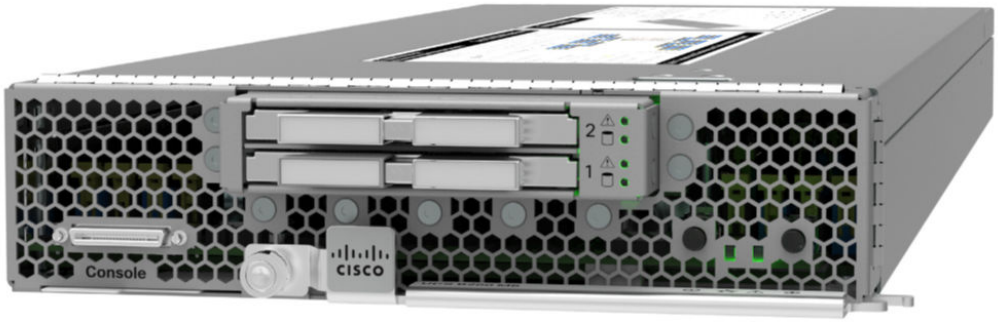


Cisco UCS B200 M6 Blade Server

The enterprise-class Cisco UCS B200 M6 Blade Server extends the capabilities of the Cisco UCS portfolio in a half-width blade form factor. The B200 M6 server harnesses the power of the latest Intel Xeon Scalable processors, with the following:

- Up to 4 TB of RAM per CPU (using 16 × 256 GB DRAMs) or up to 6 TB per CPU using 8 × 256 GB DRAMs and 8 × 512 GB Intel Optane Persistent Memory Modules (PMEMs)
- Two solid-state drives (SSDs), or PCIE NVMe drives
- Mini storage carrier with M.2 SATA drives
- Up to 80 Gbps throughput connectivity

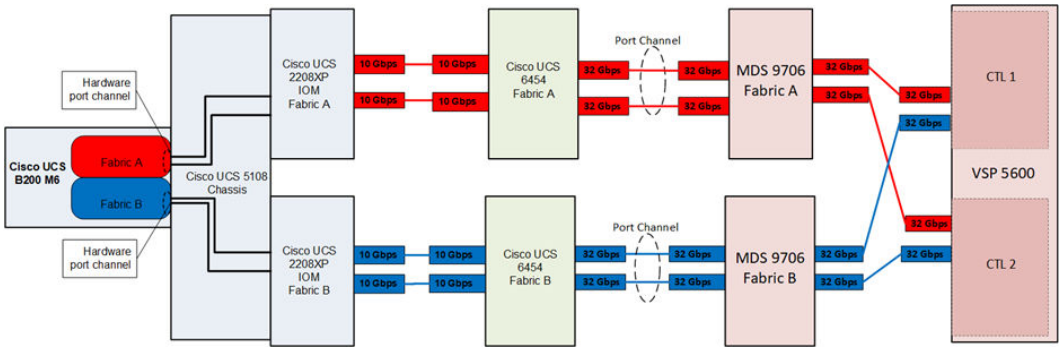
The following figure shows a Cisco UCS B200 M6 Blade Server:



Network architecture

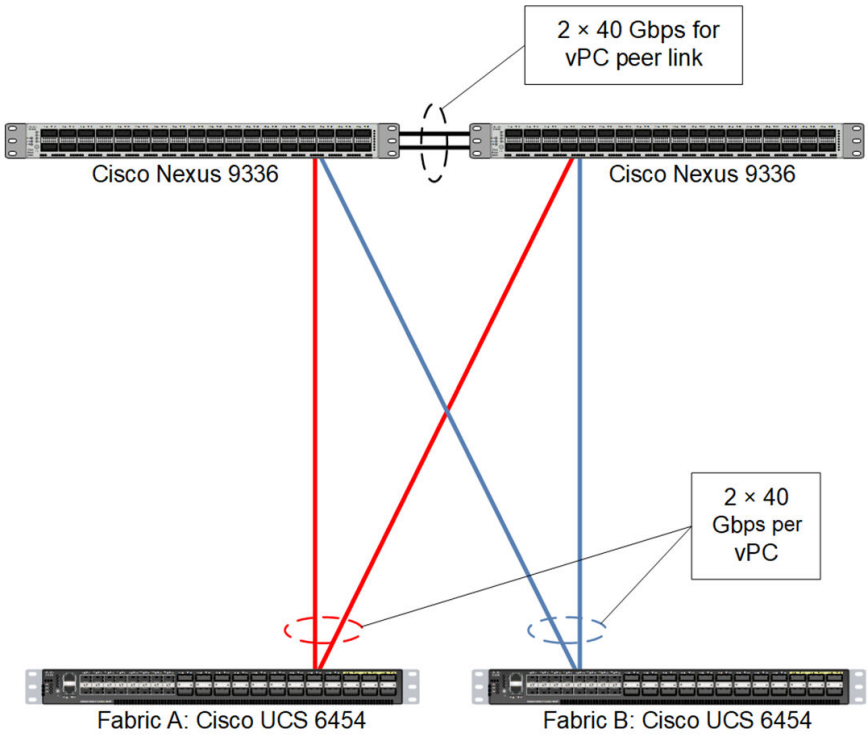
The Cisco UCS B200 M6 Blade Server systems used in this topology are hosted within a Cisco UCS 5108 Blade Server Chassis. They connect into the fabric interconnects from the chassis using Cisco UCS 2208XP Fabric Extender IOMs. The 2208XP IOMs support 10 Gbps connections to the 10/25 Gbps ports of the Cisco UCS 6454 Fabric Interconnects, delivering high port availability.

The following figure shows the network topology from the UCS Blade Servers to the VSP 5600/5600H through the 2208XP IOMs:



The application gateways are hosted by the pair of Cisco Nexus 9336 switches, but the primary routing is passed on to an existing router that is upstream of the converged infrastructure for the SAP HANA environment.

The following figure shows the upstream network for the application gateway:



For the SAP HANA nodes, you must make network connections for the SAP HANA nodes to the Cisco Nexus 9336 switches or to any other external switches. Bond the corresponding two ports, ethX and ethY, as bond0 at the operating system level using the active-active network bond mode with the following options:

```
mode=802.3ad miimon=100 xmit_hash_policy=2 lacp_rate=fast mtu=9000
```

This network acts as the client network for the SAP HANA node.

Storage configuration

Note: Each implementation of this reference architecture can use a different storage architecture. Validation for this environment used Hitachi Virtual Storage Platform 5600/5600H as external storage.

You must have the following storage components to implement a scale-up SAP HANA system with Cisco UCS B200 M6 Blade Servers in a Cisco UCS 5108 Blade Server Chassis using Hitachi Virtual Storage Platform 5600/5600H:

- Cisco VIC FCoE host bus adapter (HBA)
- Storage
- Storage drive box trays (DBS drive boxes)
- Spare drives

Use the port properties listed in the following table.

Table 4 Port settings

For this setting	Use this value
Port Security	Enabled
Port Speed	32 Gbps
Fabric	OFF
Connection Type	P-to-P

The SAP HANA node must have the following storage layout:

- Operating system volume
- SAP HANA shared volume
- SAP HANA log volume
- SAP HANA data volume

This reference architecture uses a dynamic provisioning pool design for the storage layout that ensures maximum utilization and optimization at a lower cost.

Use two dynamic provisioning pools with the specific parity groups listed in the following table for the storage layout:

Table 5 Dynamic provisioning pools

Dynamic provisioning pool name	Purpose	Parity group RAID level and disks
OS_SH_Data_Pool	Operating system LUN SAP HANA shared LUN Data LUN	RAID 6 (6D+2P), 1.9 TB SSD drives
Log_Pool	Log LUN	RAID 6 (6D+2P), 1.9 TB SSD drives

The example layout in the following table uses the dynamic provisioning pool layout on the VSP 5600/VSP 5600H used for validation for a SAP HANA TDI solution with 512 GB and a 1 TB scale-up system:

Table 6 Example of dynamic provisioning pools for a SAP HANA TDI solution

Dynamic provisioning pool	Parity group ID	Parity group RAID level and disks	LDEV ID	LDEV name	LDEV size (GB)	MPU assignment
OS_SH_Data_Pool	1	RAID 6 (6D +2P), 1.9 TB SSD Drives	00:00:01	OS_SH_DA_Pool_1	1536	MPU-10
			00:00:02	OS_SH_DA_Pool_2	1536	MPU-20
			00:00:03	OS_SH_DA_Pool_3	1536	MPU-10
			00:00:04	OS_SH_DA_Pool_4	1536	MPU-20
Log_Pool	2	RAID 6 (6D +2P), 1.9 TB SSD Drives	00:01:01	Log_Pool_1	878	MPU-10
			00:01:02	Log_Pool_2	878	MPU-20
			00:01:03	Log_Pool_3	878	MPU-10
			00:01:04	Log_Pool_4	878	MPU-20

Provision the virtual volumes for the operating system, SAP HANA shared, data, and log volumes. While mapping the LUN path assignment for each node, add volumes in the following order:

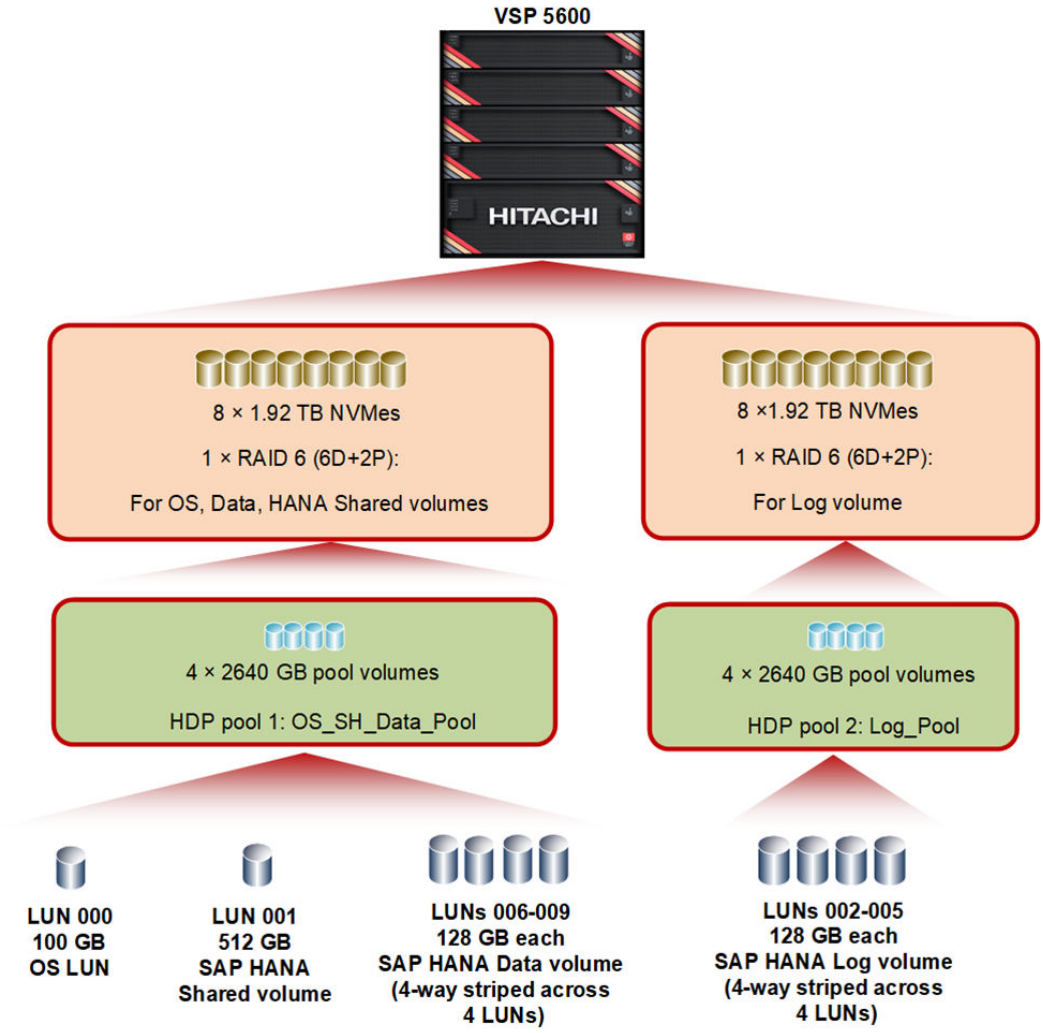
1. The operating system volume
2. The SAP HANA shared volume
3. The log volume
4. The data volume

The following table lists the settings used during validation for a SAP HANA TDI solution with 512 GB and a 1 TB scale-up system:

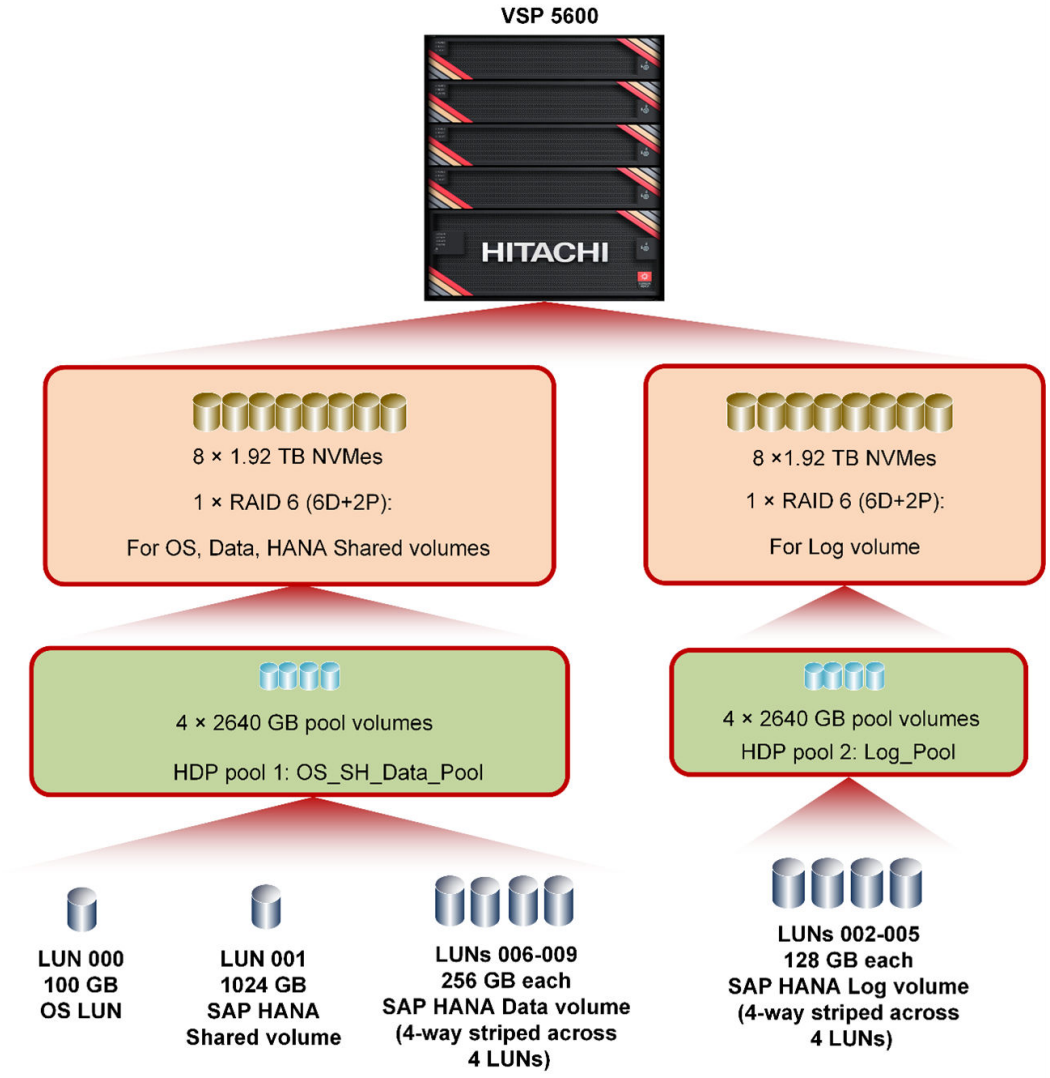
Table 7 Virtual volumes for SAP HANA nodes for 512 GB and 1 TB memory sizes

Dynamic provisioning pool	Virtual volume ID	Virtual volume name	Virtual volume size	MPU assignment	System memory
OS_SH_Data_Pool	00:02:00	HANA_OS	100 GB	MPU-10	512 GB
	00:03:00	HANA_OS	100 GB	MPU-20	1024 GB
	00:02:01	HANA_SH	512 GB	MPU-10	512 GB
	00:03:01	HANA_SH	1024 GB	MPU-20	1024 GB
Log_Pool	00:02:02	HANA_LOG_1	128 GB	MPU-10	512 GB
	00:02:03	HANA_LOG_2	128 GB	MPU-20	
	00:02:04	HANA_LOG_3	128 GB	MPU-10	
	00:02:05	HANA_LOG_4	128 GB	MPU-20	
Log_Pool	00:03:02	HANA_LOG_1	128 GB	MPU-10	1024 GB
	00:03:03	HANA_LOG_2	128 GB	MPU-20	
	00:03:04	HANA_LOG_3	128 GB	MPU-10	
	00:03:05	HANA_LOG_4	128 GB	MPU-20	
OS_SH_Data_Pool	00:02:06	HANA_DATA_1	128 GB	MPU-10	512 GB
	00:02:07	HANA_DATA_2	128 GB	MPU-20	
	00:02:08	HANA_DATA_3	128 GB	MPU-10	
	00:02:09	HANA_DATA_4	128 GB	MPU-20	
OS_SH_Data_Pool	00:03:06	HANA_DATA_1	256 GB	MPU-10	1024 GB
	00:03:07	HANA_DATA_2	256 GB	MPU-20	
	00:03:08	HANA_DATA_3	256 GB	MPU-10	
	00:03:09	HANA_DATA_4	256 GB	MPU-20	

The following figure shows the storage layout for a SAP HANA system with 512 GB memory size used for validation:



The following figure shows the storage layout for a SAP HANA system with 1 TB memory size used for validation:



The following table lists the LUN path assignments used when validating this environment:

Table 8 LUN path assignment example

LUN ID	LDEV ID	LDEV name
0000	00:02:00	HANA_OS
0001	00:02:01	HANA_SH
0002	00:02:02	HANA_LOG_1
0003	00:02:03	HANA_LOG_2
0004	00:02:04	HANA_LOG_3
0005	00:02:05	HANA_LOG_4
0006	00:02:06	HANA_DATA_1
0007	00:02:07	HANA_DATA_2
0008	00:02:08	HANA_DATA_3
0009	00:02:09	HANA_DATA_4

SAP HANA Configuration

See the SAP HANA Server Installation Guide which describes the installation process. Click here to view all SAP installation and administration documentation.

Install the following SAP HANA software components on the Cisco B200 M6:

- Database
- Client

Engineering validation

The test methodology for validating the SAP HANA TDI solution using a Cisco UCS 5108 Blade Server Chassis and Cisco B200 M6 Blade Servers in an enterprise storage configuration with Hitachi Virtual Storage Platform 5600/5600H used the following:

- SAP HANA Hardware and Cloud Measurement Tools HCMT-057_0 was used for testing the following volumes for SLES 15 SP2 and RHEL 8.2:
  - Data volume
  - Log volume

For optimal use of the SAP HANA database, use the parameters listed in the following *global.ini* file. Refer to SAP Note 2399079 to define the parameters in the *global.ini* file for SAP HANA 2.0:

```
 [communication]
tcp_backlog = 2048

[fileio]
max_parallel_io_requests[data] = 128
max_submit_batch_size[data] = 64
size_kernel_io_queue[data] = 512
async_read_submit[data] = on
async_write_submit_blocks[data] = all
min_submit_batch_size[data] = 16
async_write_submit_active[data] = auto
max_parallel_io_requests[log] = 128
max_submit_batch_size[log] = 64
size_kernel_io_queue[log] = 512
async_read_submit[log] = on
async_write_submit_blocks[log] = all
min_submit_batch_size[log] = 16
async_write_submit_active[log] = auto

[multidb]
mode = multidb
database_isolation = low
singletenant = yes

[persistence]
basepath_datavolumes = /hana/data/HIT
basepath_logvolumes = /hana/log/HIT
```

Product descriptions

These products are used in this reference architecture.

Cisco Unified Computing System

The Cisco Unified Computing System is a next-generation data center platform that unites compute, network, storage access, and virtualization into a cohesive system designed to reduce total cost of ownership (TCO) and increase business agility. Managed as a single system, whether it has one server or hundreds of servers with thousands of virtual machines, the Cisco Unified Computing System decouples scale from complexity. The Cisco Unified Computing System accelerates the delivery of new services simply, reliably, and securely through end-to-end provisioning and migration support for both virtualized and nonvirtualized systems.

Hitachi Virtual Storage Platform 5000 series

This enterprise-class, flash array evolution storage, Hitachi Virtual Storage Platform 5000 series (VSP) has an innovative, scale-out design optimized for NVMe and storage class memory. It achieves the following:

- **Agility using NVMe:** Speed, massive scaling with no performance slowdowns, intelligent tiering, and efficiency.
- **Resilience:** Superior application availability and flash resilience. Your data is always available, mitigating business risk.
- **Storage simplified:** Do more with less, integrate AI (artificial intelligence) and ML (machine learning), simplify management, and save money and time with consolidation.

Hitachi Storage Virtualization Operating System RF

Hitachi Storage Virtualization Operating System RF powers the Hitachi Virtual Storage Platform (VSP) family. 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.

Flash performance is optimized with a patented flash-aware I/O stack, which accelerates data access. Adaptive inline data reduction increases storage efficiency while enabling a balance of data efficiency and application performance. Industry-leading storage virtualization allows SVOS RF to use third-party all-flash and hybrid arrays as storage capacity, consolidating resources for a higher ROI and providing a high-speed front end to slower, less-predictable arrays.

SAP HANA

SAP HANA converges database and application platform capabilities in-memory to transform transactions, analytics, text analysis, predictive and spatial processing so businesses can operate in real-time. This combines database, data processing, and application platform capabilities in a single in-memory platform. Also, the platform provides libraries for predictive, planning, text processing, spatial, and business analytics — all on the same architecture. This architecture comes from leading hardware partners of SAP, including Hitachi Vantara. For more information, see https://www.sap.com/products/hana.html.

By eliminating the divide between transactions and analytics, SAP HANA allows you to answer any business question anywhere in real time.

As a SAP customer, you can download more information, including the following:

- SAP HANA Master Guide

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

- SAP HANA Server Installation and Update Guide

  Use the various installation guides to install the required SAP In-Memory Database and the other software components for the different replication technologies.

- SAP HANA Administration Guide

  This provides the central operations documentation for the on-premises deployment of the SAP HANA Platform.

SAP HANA hardware directory provides information about SAP HANA appliances certified by SAP hardware partners.

Operating system options for SAP HANA

SUSE Linux Enterprise Server for SAP Applications and Red Hat Enterprise Linux for SAP HANA are available operating systems when running SAP HANA.

- SUSE Linux Enterprise Server (SLES) for SAP Applications

  Compete more effectively through improved uptime, better efficiency, and accelerated innovation using SUSE Linux Enterprise Server for SAP Applications. This is a versatile server operating system for efficiently deploying highly available enterprise-class IT services in mixed IT environments with performance and reduced risk.

  SUSE Linux Enterprise Server was the first Linux operating system to be certified for use with SAP HANA. It remains the operating system of choice for most SAP HANA customers.

- Red Hat Enterprise Linux (RHEL) for SAP HANA

  Using the stability and flexibility of Red Hat Enterprise Linux for SAP HANA, reallocate your resources towards meeting the next challenges instead of maintaining the status quo. Deliver meaningful business results by providing exceptional reliability and military-grade security. Use Enterprise Linux to tailor your infrastructure as markets shift and technologies evolve.

Changing the configuration settings is only supported along the guidelines of SAP and the operating system distributor and may otherwise cause significant performance problems. The following SAP Notes for SUSE Linux Enterprise Server and Red Hat Enterprise Linux are a good starting point for information on this topic:

- 1944799 - SAP HANA Guidelines for SLES Operating System Installation
- 2009879 - SAP HANA Guidelines for Red Hat Enterprise Linux (RHEL) Operating System

For more details, see "Updating and Patching the Operating System" by searching in the "View SAP HANA document" from Technical Information and Best Practices.

References

Use the following references when designing your system.

- UCS Hardware and Software Compatibility from Cisco
- Release Notes from Cisco
- Recommended Cisco NX-OS Releases for Cisco Nexus 9000 Series Switches
- Hitachi Interoperability Reports
- Hitachi Virtual Storage Platform 5000 series (VSP 5000 Series)

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