Hitachi Solution for the SAP HANA Platform in a Scale-up TDI Configuration using the Eviden BullSequana SH Series

Reference Architecture Guide

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December 2024

Feedback

Please send comments to doc.feedback@hitachivantara.com. Include the document title and number, including the revision level (for example, -07), and refer to specific sections and paragraphs whenever possible. All comments become the property of Hitachi Vantara LLC.

Thank you!

Revision history

Changes	Date
Initial release	December 2024

Reference Architecture Guide

Use this reference architecture guide to implement SAP HANA in a scale-up configuration for Hitachi Solution for the SAP HANA platform on Eviden BullSequana SHx0 (SH20 / SH40 / SH80) series and different sizes of BullSequana SH160 servers using Intel 4th Gen Xeon Scalable Processors. This document covers the following deployments:

- SAP HANA tailored data center integration (TDI) — With a SAP HANA TDI deployment, each installation is customized by assembling the hardware, operating system, and hypervisor (optional) from SAP-certified components. SAP HANA Tailored Data Center Integration — Overview has the details about SAP HANA TDI Phase 5 and the TDI overview.

When it comes to deploying SAP HANA on-premises, customers often require a robust and scalable storage solution that can handle the high-performance demands of this in-memory database. That's where Hitachi Virtual Storage Platform (VSP) comes into play.

Hitachi VSP is an ideal choice for SAP HANA TDI (Tailored Datacenter Integration) solutions due to its exceptional performance, scalability, and reliability features. Here are some key reasons why:

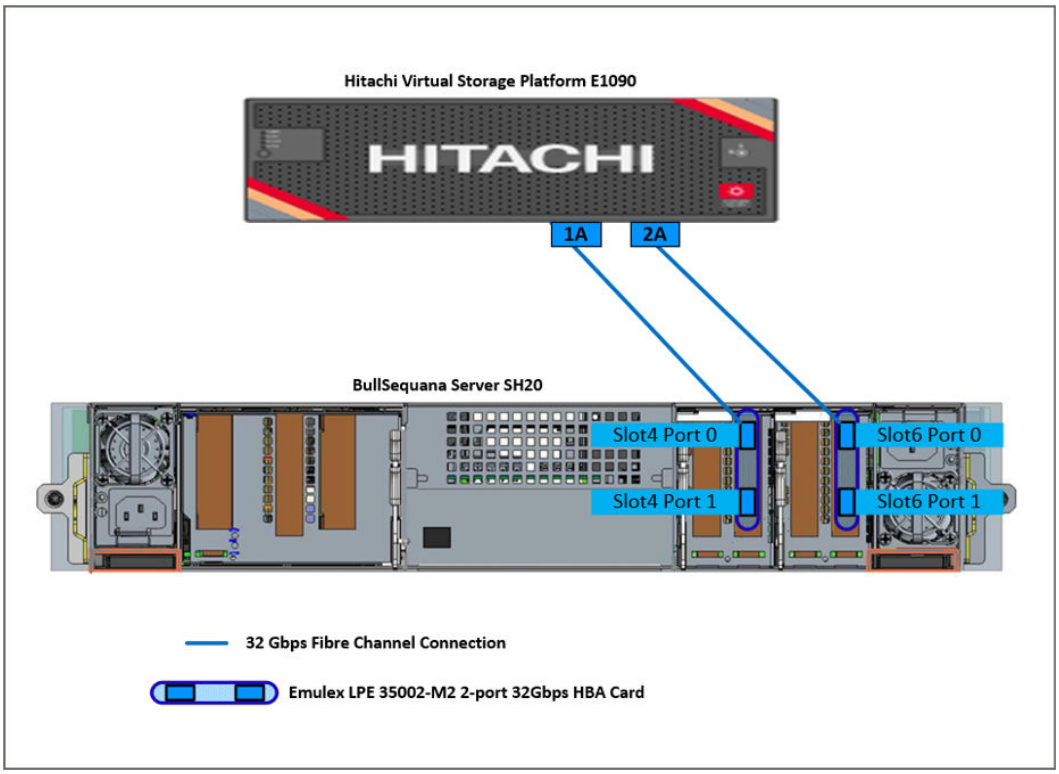
- High-Performance: Hitachi VSP provides ultra-low latency and high throughput, making it an excellent match for SAP HANA's demanding workloads. Its advanced flash-based architecture ensures rapid data access and minimizes I/O bottlenecks.
- Scalability: As your SAP HANA environment grows, Hitachi VSP scales seamlessly to meet increasing demands. Its modular design allows you to add or remove nodes as needed, ensuring efficient resource utilization and minimizing downtime.
- Reliability: With Hitachi VSP, you can rely on enterprise-grade availability and redundancy features, such as dual controllers, hot-swappable components, and advanced RAID configurations. This ensures minimal risk of data loss and system downtime.
- SAP-Certified: Hitachi VSP has been certified by SAP for use with SAP HANA, providing customers with confidence in the compatibility and performance of the solution.
- Integration: Hitachi VSP integrates smoothly with SAP HANA, allowing for streamlined management and monitoring through tools like SAP Solution Manager and Hitachi Command Suite.
- Data Protection: Hitachi VSP offers advanced data protection features, including snapshots, replication, and encryption, to ensure business continuity and protect against data loss.
- Flexibility: Hitachi VSP supports various deployment models, including all-flash arrays, hybrid arrays, and software-defined storage, giving customers flexibility in choosing the best fit for their specific needs.

By selecting Hitachi VSP for your SAP HANA TDI solution, you'll benefit from a highly performant, scalable, and reliable storage platform that meets the demands of your mission-critical applications.

These solutions use the following components:

- Hardware
  - One BullSequana SHx0 series (SH20 / SH40 / SH80), or one BullSequana SH160
  - External subsystem Hitachi Virtual Storage Platform enterprise storage (for example, VSP E1090)
- Software
  - Linux OS (SUSE Linux Enterprise Server / RedHat Enterprise Linux)with SAP HANA The validation of this environment with external storage using Hitachi Virtual Storage Platform E1090 (VSP E1090) with SHx0 servers using 4th generation Intel Xeon Scalable Processors. Contact your account representative for details and implementation services whenever you require external storage.

The following figure shows the topology of this reference solution for SH20 as an example using external drives on a Hitachi VSP E1090 storage system.



Hitachi Vantara offers a comprehensive solution for deploying SAP HANA on your infrastructure using the TDI approach. This solution leverages best-in-class server and storage components that integrate seamlessly with your existing environment to deliver optimal performance for your SAP HANA workloads.

This technical paper assumes that you have familiarity with the following:

- Storage area network (SAN)-based storage systems
- General storage concepts

- Common IT storage practices
- SAP HANA

Note: Testing of this configuration was in a lab environment. Many factors 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.

Memory configurations SHx0 series

Memory configurations BullSequana SH series models SH20, SH40, and SH80

BullSequana SH series models SH20, SH40, and SH80 offer memory capacities ranging from 512 GB to 16 TB per node. This section details the memory configurations available for systems equipped with Intel 4th generation Xeon Scalable Processors.

This system supports the configurations listed in the following table.

Number of Sockets	Memory Size	Storage
▪ CPU – Intel 4th Gen Xeon Scalable Processor with one of the following: • 2 Intel Xeon Platinum 8490H Processor 60-core, 1.9GHz, 350W • 2 Intel Xeon Platinum 8468H Processor 48-core, 1.9GHz, 350W • 2 Intel Xeon Platinum 8460H Processor 40-core, 1.9GHz, 350W • 2 Intel Xeon Platinum 8444H Processor 16-core, 1.9GHz, 350W • 2 Intel Xeon Platinum 8454H Processor 32-core, 1.9GHz, 350W	▪ 512 GB with 16 × 32 GB RDIMM ▪ 1024 GB with 32 × 32 GB RDIMM ▪ 1024 GB with 16 × 64 GB RDIMM ▪ 1536 GB with 16 × 96 GB RDIMM ▪ 2048 GB with 32 × 64 GB RDIMM ▪ 2048 GB with 16 × 128 GB RDIMM ▪ 3072 GB with 32 × 96 GB RDIMM ▪ 4096 GB with 32 × 128 GB RDIMM	Hitachi Virtual Storage Platform E1090

Number of Sockets	Memory Size	Storage
▪ CPU – Intel 4th Gen Xeon Scalable Processor with one of the following: • 4 Intel Xeon Platinum 8490H Processor 60-core, 1.9GHz, 350W • 4 Intel Xeon Platinum 8468H Processor 48-core, 1.9GHz, 350W • 4 Intel Xeon Platinum 8460H Processor 40-core, 1.9GHz, 350W • 4 Intel Xeon Platinum 8444H Processor 16-core, 1.9GHz, 350W • 4 Intel Xeon Platinum 8454H Processor 32-core, 1.9GHz, 350W	▪ 1024 GB with 32 × 32 GB RDIMM ▪ 2048 GB with 64 × 32 GB RDIMM ▪ 2048 GB with 32 × 64 GB RDIMM ▪ 3072 GB with 32 × 96 GB RDIMM ▪ 4096 GB with 64 × 64 GB RDIMM ▪ 4096 GB with 32 × 128 GB RDIMM ▪ 6144 GB with 64 × 96 GB RDIMM ▪ 8192 GB with 64 × 128 GB RDIMM	
▪ CPU – Intel 4th Gen Xeon Scalable Processor with one of the following: • 8 Intel Xeon Platinum 8490H Processor 60-core, 1.9GHz, 350W • 8 Intel Xeon Platinum 8468H Processor 48-core, 1.9GHz, 350W • 8 Intel Xeon Platinum 8460H Processor 40-core, 1.9GHz, 350W • 8 Intel Xeon Platinum 8444H Processor 16-core, 1.9GHz, 350W • 8 Intel Xeon Platinum 8454H Processor 32-core, 1.9GHz, 350W	▪ 2048 GB with 64 × 32 GB RDIMM ▪ 4096 GB with 128 × 32 GB RDIMM ▪ 4096 GB with 64 × 64 GB RDIMM ▪ 6144 GB with 64 × 96 GB RDIMM ▪ 8192 GB with 128 × 64 GB RDIMM ▪ 8192 GB with 64 × 128 GB RDIMM ▪ 12288 GB with 128 × 96 GB RDIMM ▪ 16384 GB with 128 × 128 GB RDIMM	
Notes for Mixed DIMM support: ▪ Only a homogenous population of the same DIMM technology (RDIMM, LRDIMM, 3DS) can be used. ▪ Only a combination of n-1 DIMM capacity can be used (that is, 32 GB DIMM and 64 GB DIMM; 64 GB DIMM and 128 GB DIMM; but not 32 GB DIMM and 128 GB DIMM).		

SHx0 (including 2S/4S/8S) SAP HANA scale-up supports the T-shirt size configurations listed in the following table.

BW/S4H	*#Sockets*	*Scale-up Memory (GB)*	*DIMM*			
			32 GB	64 GB	96 GB	128 GB
	2	512	2 × 8 × 32	NA	NA	NA
BW/S4H		1024	2 × 16 × 32	2 × 8 × 64	NA	NA
		1536	NA	NA	2 × 8 × 96	NA
		2048	NA	2 × 16 × 64	NA	2 × 8 × 128
		3072	NA	NA	2 × 16 × 96	NA
S4H		4096	NA	NA	NA	2 × 16 × 128
BW/S4H	4	1024	4 × 8 × 32	NA	NA	NA
		2048	4 × 16 × 32	4 × 8 × 64	NA	NA
		3072	NA	NA	4 × 8 × 96	NA
		4096	NA	4 × 16 × 64	NA	4 × 8 × 128
		6144	NA	NA	4 × 16 × 96	NA
S4H		8192	NA	NA	NA	4 × 16 × 128
BW/S4H	8	2048	8 × 8 × 32	NA	NA	NA
		4096	8 × 16 × 32	8 × 8 × 64	NA	NA
		6144	NA	NA	8 × 8 × 96	NA
		8192	NA	8 × 16 × 64	NA	8 × 8 × 128
		12288	NA	NA	8 × 16 × 96	NA
S4H		16384	NA	NA	NA	8 × 16 × 128
Half Slotting		Full Slotting				
Note: SAP supports full or half slotting RDIMM						

Memory configurations BullSequana SH160 servers

BullSequana SH160 servers offer configurations from 8-sockets to 16-sockets per server using 4th generation Intel Scalable Processors and memory sizes up to 32 TB. The following table lists the memory configurations for the different server sizes.

Number of Sockets	RAM Size
8× 4th Gen Intel Xeon Scalable Processor using one of the following: ▪ Intel Xeon Platinum 8490H Processor 60-core, 1.9GHz, 350W ▪ Intel Xeon Platinum 8480+ Processor 56-core, 2.0GHz, 350W	▪ 2048 GB with 64 × 32 GB R-DIMMs ▪ 4096 GB with 128 × 32 GB or 64 × 64 GB R-DIMMs ▪ 6144GB with 64 × 96 GB R-DIMMs ▪ 8192 GB with 128 × 64 GB or 64 × 128 GB R-DIMMs ▪ 12288 GB with 128 × 96 GB R-DIMMs ▪ 16384 GB with 128 × 128 GB -RDIMMs

Number of Sockets	RAM Size
12 × 4th Gen Intel Xeon Scalable Processor using one of the following: ▪ Intel Xeon Platinum 8490H Processor 60-core, 1.9GHz, 350W ▪ Intel Xeon Platinum 8480+ Processor 56-core, 2.0GHz, 350W	▪ 3072 GB with 96 × 32 GB R-DIMMs ▪ 6144 GB with 192 × 32 GB or 96 × 64 GB R-DIMMs ▪ 9216 GB with 96 × 96 GB R-DIMMs ▪ 12288 GB with 192 × 64 GB or 96 × 128 GB R-DIMMs ▪ 18432 GB with 192 × 96 GB R-DIMMs ▪ 24576 GB with 192 × 128 GB R-DIMMs
16 × 4th Gen Intel Xeon Scalable Processor using one of the following: ▪ Intel Xeon Platinum 8490H Processor 60-core, 1.9GHz, 350W ▪ Intel Xeon Platinum 8480+ Processor 56-core, 2.0GHz, 350W	▪ 4096 GB with 128 × 32 GB R-DIMMs ▪ 8192 GB with 256× 32 GB or 128 × 64 GB R-DIMMs ▪ 12288 GB with 128 × 96 GB R-DIMMs ▪ 16384 GB with 256 × 64 GB or 128 × 128 GB R-DIMMs ▪ 24576 GB with 256 × 96 GB R-DIMMs ▪ 32768 GB with 256 × 128 GB R-DIMMs

BullSequana SH160 (including 8S/12S/16S) SAP HANA scale-up supports the T-shirt size configurations listed in the following table.

BW/S4H	#Sockets	Scale-up Memory (GB)	DIMM			
			32GB	64GB	96GB	128GB
	8	512	2 × 8 × 32	NA	NA	NA
BW/S4H		1024	2 × 16 × 32	2 × 8 × 64	NA	NA
		1536	NA	NA	2 × 8 × 96	NA
		2048	NA	2 × 16 × 64	NA	2 × 8 × 128
		3072	NA	NA	2 × 16 × 96	NA
S4H		4096	NA	NA	NA	2 × 16 × 128
BW/S4H	12	1024	4 × 8 × 32	NA	NA	NA
		2048	4 × 16 × 32	4 × 8 × 64	NA	NA
		3072	NA	NA	4 × 8 × 96	NA
		4096	NA	4 × 16 × 64	NA	4 × 8 × 128
		6144	NA	NA	4 × 16 × 96	NA
S4H		8192	NA	NA	NA	4 × 16 × 128
BW/S4H	16	2048	8 × 8 × 32	NA	NA	NA
		4096	8 × 16 × 32	8 × 8 × 64	NA	NA
		6144	NA	NA	8 × 8 × 96	NA
		8192	NA	8 × 16 × 64	NA	8 × 8 × 128
		12288	NA	NA	8 × 16 × 96	NA
S4H		16384	NA	NA	NA	8 x 16 x 128
Half Slotting		Full Slotting				
Note: SAP supports full or half slotting RDIMMs.						

Key solution elements

The following are 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 might require manual configuration of the network and/or using different components.

Hardware elements

This section details the hardware used for this joint solution. You can use your Hitachi VSP storage with Eviden servers in different configurations and sizes for your HANA scale-up solution.

BullSequana Server SHx0 series (2S/4S/8S) uses an external storage subsystem VSP E1090 for lab validation, as indicated in the following table.

Hardware	Quantity	Configuration	Role	Implementation Type
BullSequana SH20	1	CPU – Intel 4th Generation Xeon® Scalable Processors (Any one option): ▪ 2 Intel Xeon Platinum 8490H Processor 60-core, 1.9GHz, 350W ▪ 2 Intel Xeon Platinum 8468H Processor 48-core, 1.9GHz, 350W ▪ 2 Intel Xeon Platinum 8460H Processor 40-core, 1.9GHz, 350W ▪ 2 Intel Xeon Platinum 8444H Processor 16-core, 1.9GHz, 350W ▪ 2 Intel Xeon Platinum 8454H Processor 32-core, 1.9GHz, 350W For the RAM per SAP HANA node, see Memory configurations SHx0 series (on page 5).	SAP HANA server	TDI
PCIe Network cards	2	▪ Mellanox Connectx-6 dual port PCIe card per compute module	For SAP HANA 25 GbE client network and an additional 25 GbE network	All implementations
	2	▪ Cisco SFP+ 3M Twin axial cables		
VSP E1090	1	▪ 1 pair of controllers ▪ 1 pair 4-port 14 Gbps channel blades ▪ 1 expansion DBS drive box ▪ 1024 GB Cache	Block storage when using an external storage sub-system.	TDI

Hardware	Quantity	Configuration	Role	Implementation Type
		▪ 1 pair SAS ports ▪ 1 pair PSUs ▪ 1.92 TB NVMe SSD		
Fibre Channel Dual HBA card	2	▪ Emulex Dual HBA-LPe35002 RBlade 32 Gbps card per compute module ▪ According to the table in Slotting rules for HBA and NIC connections (on page 17).	Connectivity to the external storage sub-system.	TDI
	2	32 Gbps SFP		
Cisco Nexus 92348 switch	1	48 × 1 GbE ports	Optional switch for management network.	All implementations (optional)
Cisco Nexus 93180YC-FX/FX3	2	48 × 25 GbE ports	Optional switches for the client network or additional backup network.	All implementations (optional)
Minkels Global Solutions Rack	1	1 standard rack	Optional rack for mounting servers.	All implementations
PDUs	2	Vertical PDUs	Optional PDUs for the solution.	All implementations

Software elements

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

Purpose	Software
Operating System	SUSE Linux Enterprise Server for SAP Applications Red Hat Enterprise Linux for SAP Solutions
Database	SAP HANA 2.0 SPS 07 or later

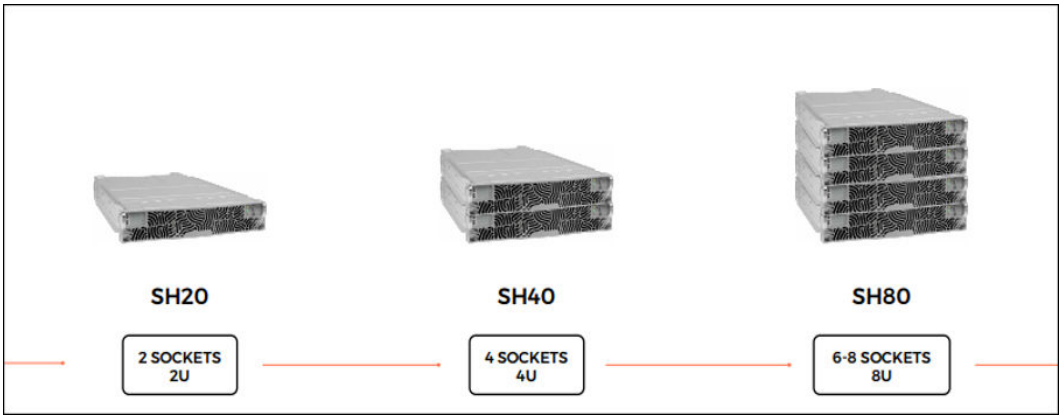
Solution design

The detailed design for this scale-up configuration of Hitachi Solution for the SAP HANA Platform for this reference solution includes the following:

- BullSequana SHx0 series configuration (on page 12)
- Network architecture configuration (on page 14)
- Storage architecture configuration (on page 15)
- Slotting rules for HBA and NIC connections (on page 17)

BullSequana SHx0 series configuration

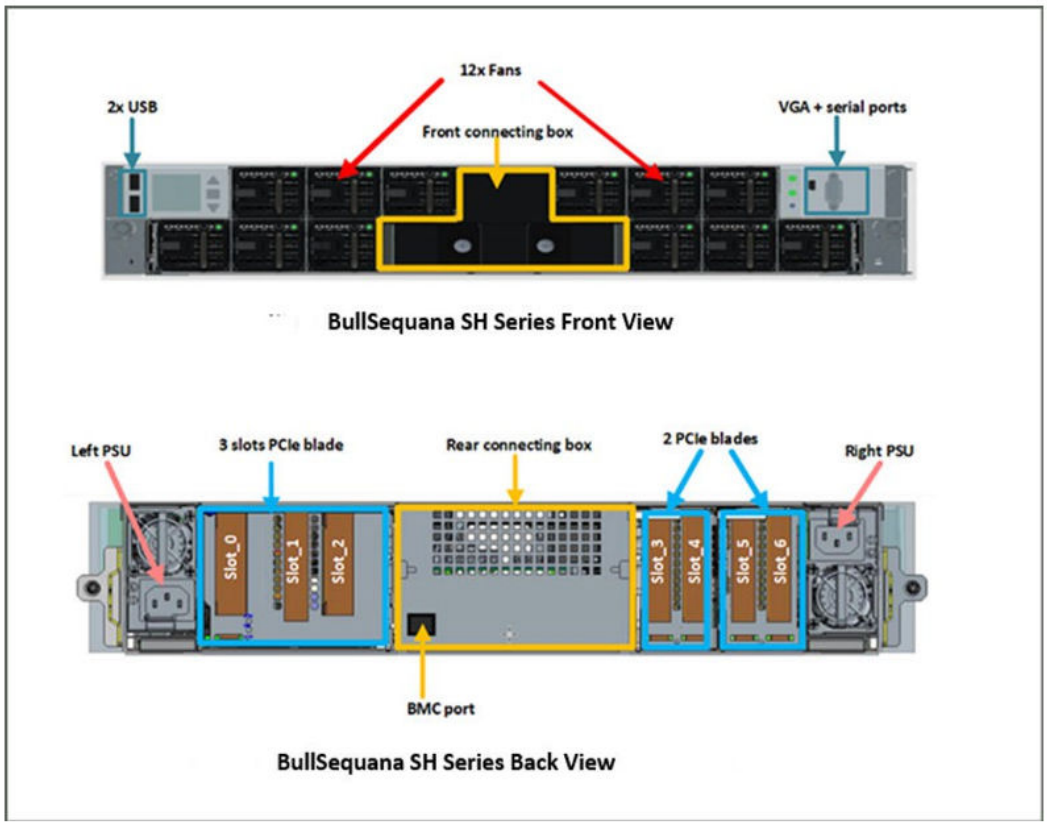
The BullSequana SH series product lineup offers scalability in 2-CPU increments. The following illustration shows models SH20, SH40, and SH80. The SH20 (2U) has 2 sockets, SH40 (4U) has 4 sockets, and SH80 supports 2, 4, and 8 sockets based on its size (8U).



This solution uses one BullSequana SH server with Intel 4th generation Xeon Scalable Processors ranging from 2 sockets to 8 sockets. Follow Slotting rules for HBA and NIC connections (on page 17). Each 2S (2-socket) server, that is, SH20 has the following components:

- For TDI models using external enterprise storage (VSP E1090)
  - 2 × Mellanox Connect-6 DX 2-port 25 GbE Network Adapters
  - 2 × Emulex LPE 35002-M2 32 Gbps PCIe HBA Cards
- The TDI module uses 2 × PCIe Gen5 x8 slots for PCIe 25 Gb Network adapters and 2 × PCIe Gen5 × 8 slots for HBA cards.
- 1 × 1GbE Management port for BMC

This compute module acts as the primary module. Other identical modules can be added as secondary modules to add more resources. The following illustration provides details about the PCIe components with the front and back view of all BullSequana SH series configurations.



BullSequana SH160 configuration

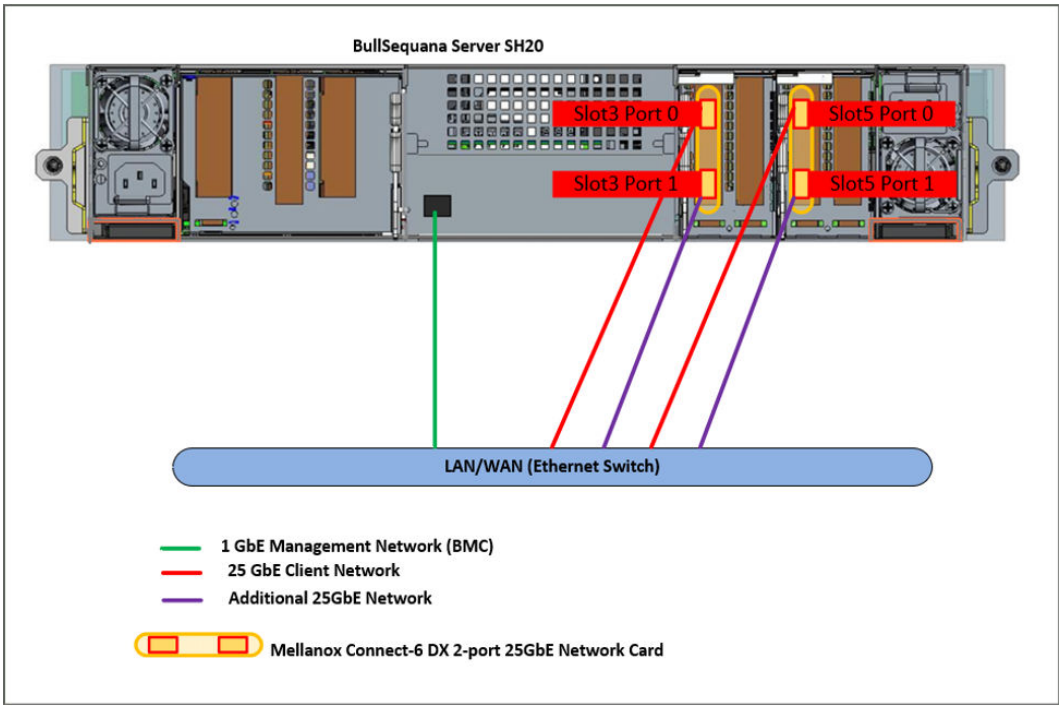
The BullSequana SH160 product lineup offers scalability in 4-CPU increments for SAP HANA. The following illustration shows the front and back of the SH160 server with eight compute modules and the node controller.

The BullSequana SH160 solutions follow the same configuration guidelines as the SHx0 series described previously. However, depending on the workload, you might need to add additional storage paths by connecting the empty ports of the Emulex HBA PCIe cards to the VSP storage.

Network architecture configuration

Connect the 1GbE management port of the BullSequana SH server to a Cisco Nexus 92348 or any other external 1 GbE switch for management connectivity, and the 25 GbE network port to Cisco Nexus 93180YC-FX/FX3 switches for client network connections for 2 sockets as shown in the following figure. For other server configurations such as 4S and 8S see Slotting rules for HBA and NIC connections (on page 17).

Make the following 25 GbE network connections for SAP HANA nodes as shown in the following illustration.



Storage architecture configuration

These are the components you need to implement a scale-up SAP HANA system with the Eviden BullSequana SH series using Hitachi Virtual Storage Platform E1090:

- 2× 2-port Emulex LPE35002-M2 32 Gbps PCIe HBA cards
- 1 × Hitachi Virtual Storage Platform E1090
- Storage drive box trays (DBS)
- Spare drives

Note: You can use a different Hitachi Vantara storage architecture to implement this reference architecture. Hitachi Virtual Storage Platform E1090 was used as external storage for validation testing of this environment. Contact your Hitachi Vantara account representative for details and implementation services to configure an environment using external storage.

The following are mandatory for the external storage option with a direct connection between the Hitachi Virtual Storage Platform and the Emulex 32 Gb HBA on the BullSequana SH series system:

- Enable Host Mode Option 02, Host Mode Option 94, and Host Mode Option 109 for the corresponding storage port connected with the server.

  Host Mode Option 109 — This option fixes a SAN boot issue when the system cannot find the Boot LUN after a restart.

  Host Mode Option 94 — This option is mandatory for direct connection between the Hitachi Virtual Storage Platform and the Emulex 32 Gb HBA. If this mode is not set, then SAN storage cannot be identified from the Emulex 32 Gb HBA.

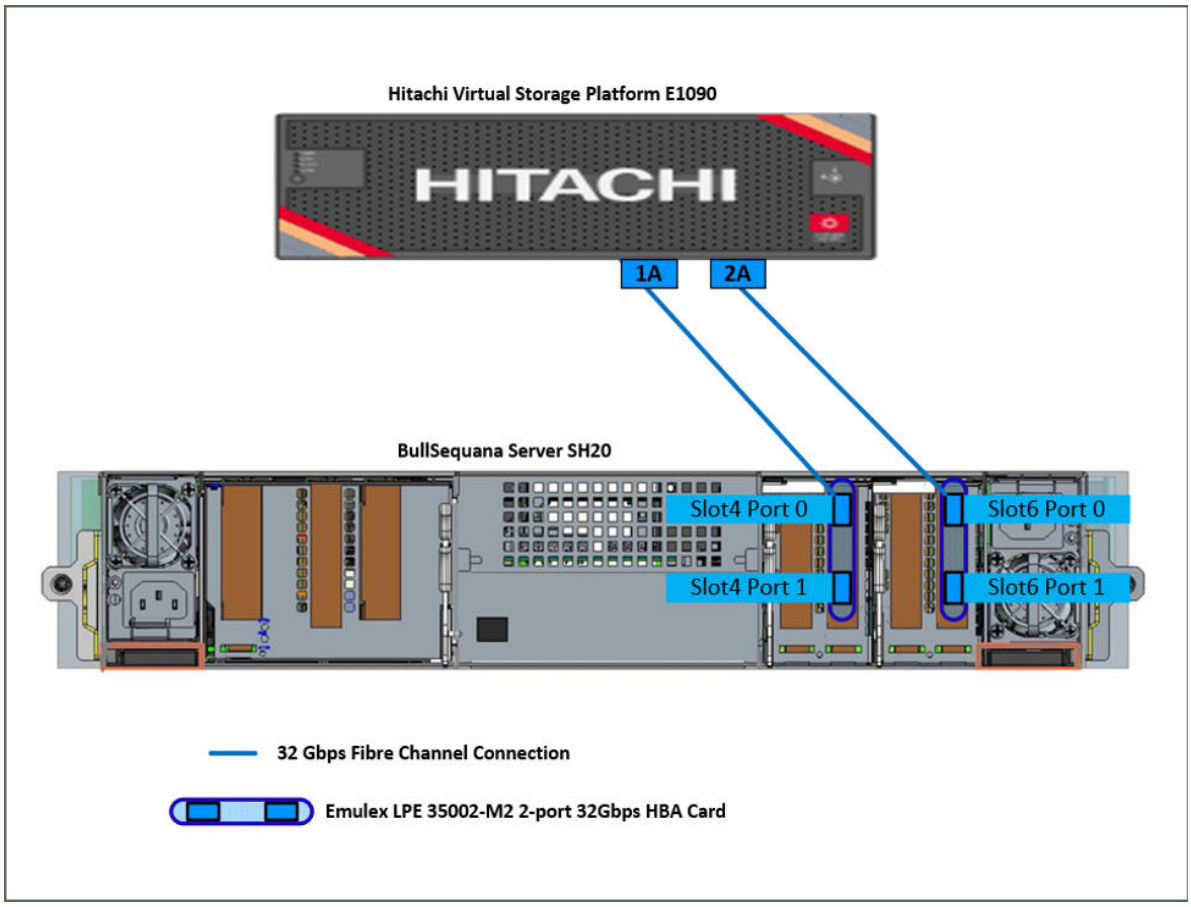
  Host Mode Option 02 (Optional) — This option is recommended when the system uses test-unit-ready (TUR) for `path_checker` in the `/etc/multipath.conf` file. This mode is typically used for fencing technology.

- Host Group ID must be 00 for SAN boot.

Also, use the port properties listed in the following table:

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

An example configuration for port properties with the Hitachi Virtual Storage Platform and the BullSequana SH20 is shown in the following illustration.



The SAP HANA storage configuration includes the following for different sizes:

- Operating system volume (OS)
- SAP HANA shared volume (/hana/shared)
- SAP HANA log volume (/hana/log)
- SAP HANA data volume (/hana/data)

Slotting rules for HBA and NIC connections

Following best practices, use these slotting rules for HBA and NIC cards. The following tables list slotting rules for different server configurations. By adhering to these slotting rules, we can get optimal system performance, reduced troubleshooting efforts, and system stability.

2-socket server (SH20)	Primary	Right1		Right2	
		eth9901	HBA2	eth9902	HBA1
4-socket server (SH40)	Primary	Right1		Right2	
		eth9901	-	-	HBA2
	Secondary1	Right1		Right2	

		eth9902	-	-	HBA1
8-socket server (SH80)	Primary	Right1		Right2	
		eth9901	-	-	-
	Secondary1	Right1		Right2	
		eth9902	-	-	-
	Secondary2	Right1		Right2	
		-	-	-	HBA2
	Secondary3	Right1		Right2	
		-	-	-	HBA1

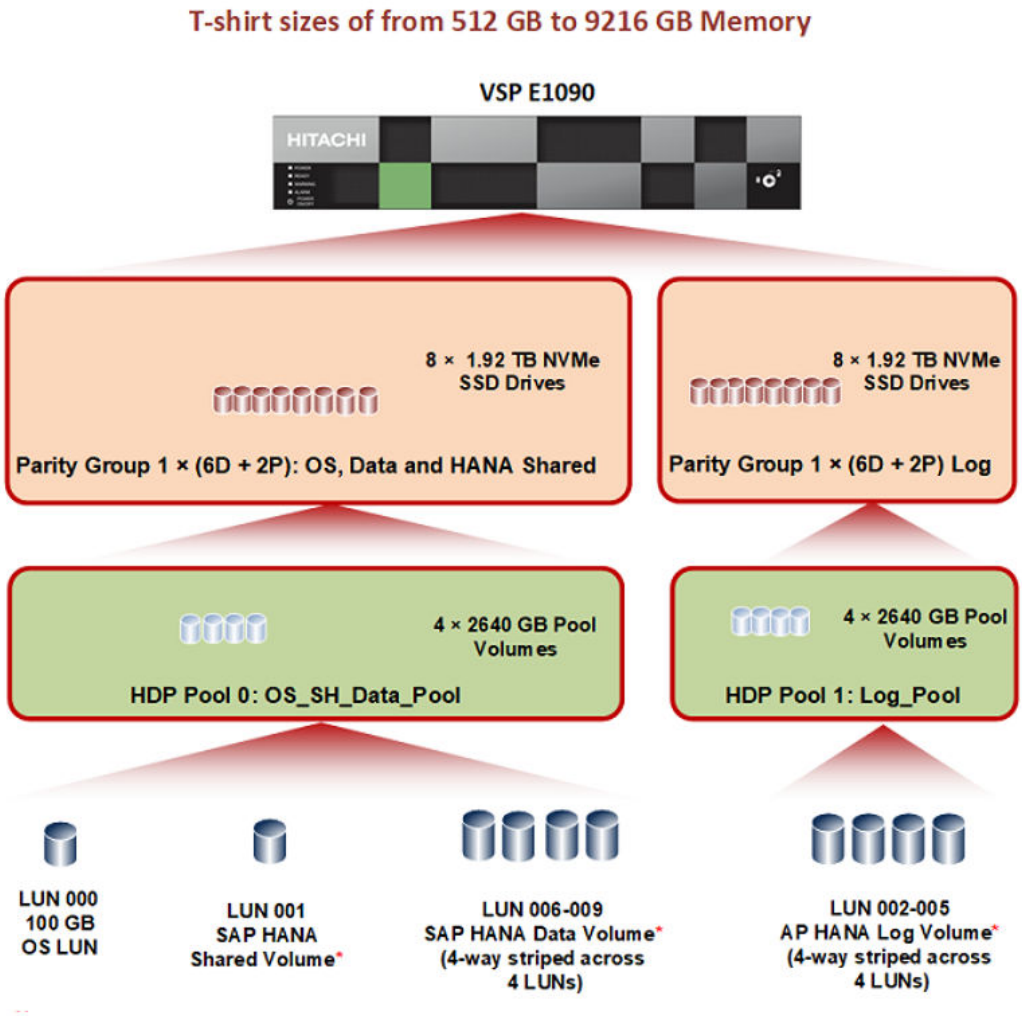
12-socket server (SH160)	Primary	Right1		Right2	
		eth9901	-	-	-
	Secondary1	Right1		Right2	
		eth9902	-	-	-
	Secondary2	Right1		Right2	
		-	-	-	-
	Secondary3	Right1		Right2	
		-	-	-	-
	UBOX				
	Secondary4	Right1		Right2	
		-	-	-	HBA2
	Secondary5	Right1		Right2	
		-	-	-	HBA1

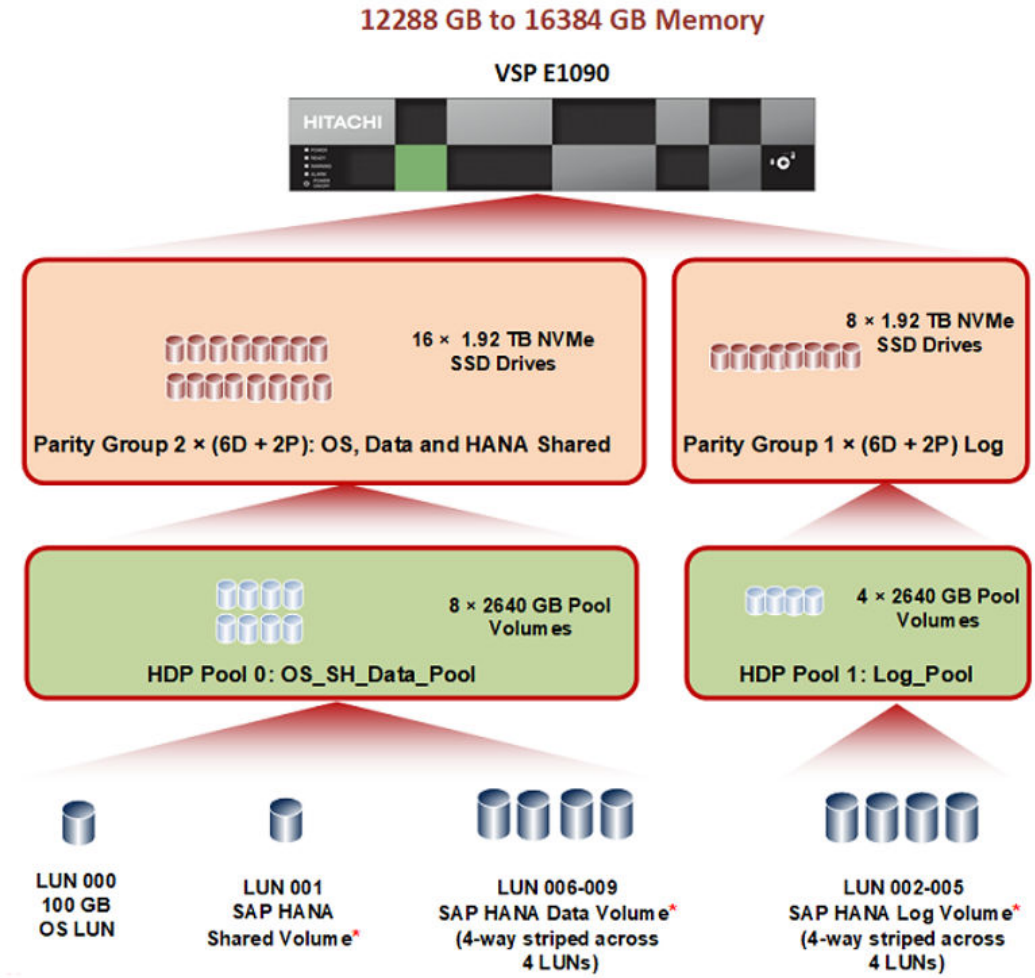
16-socket server (SH160)	Primary	Right1		Right2	
		eth9901	-	-	-
	Secondary1	Right1		Right2	

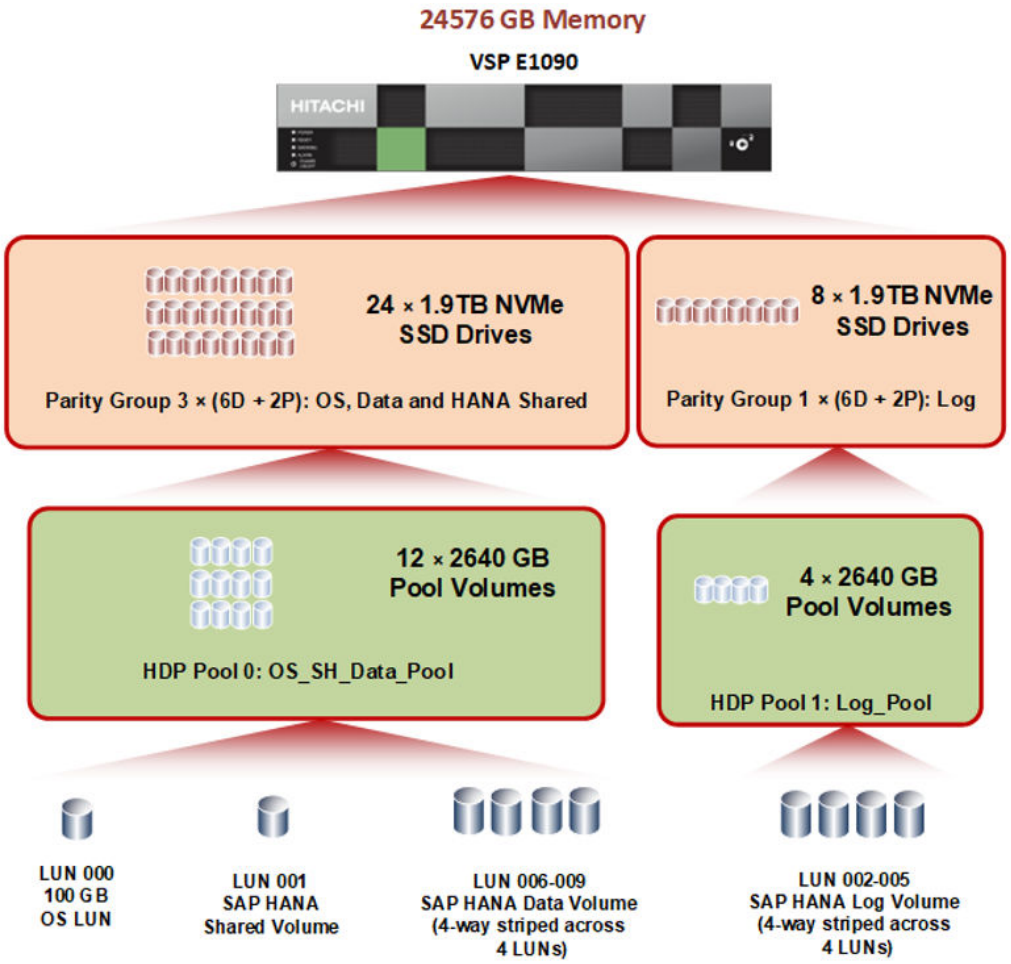
		eth9902	-	-	-
	Secondary2	Right1		Right2	
		-	-	-	-
	Secondary3	Right1		Right2	
		-	-	-	-
	UBOX				
	Secondary4	Right1		Right2	
		-	-	-	-
	Secondary5	Right1		Right2	
		-	-	-	-
	Secondary6	Right1		Right2	
		-	-	-	HBA2
	Secondary7	Right1		Right2	
		-	-	-	HBA1

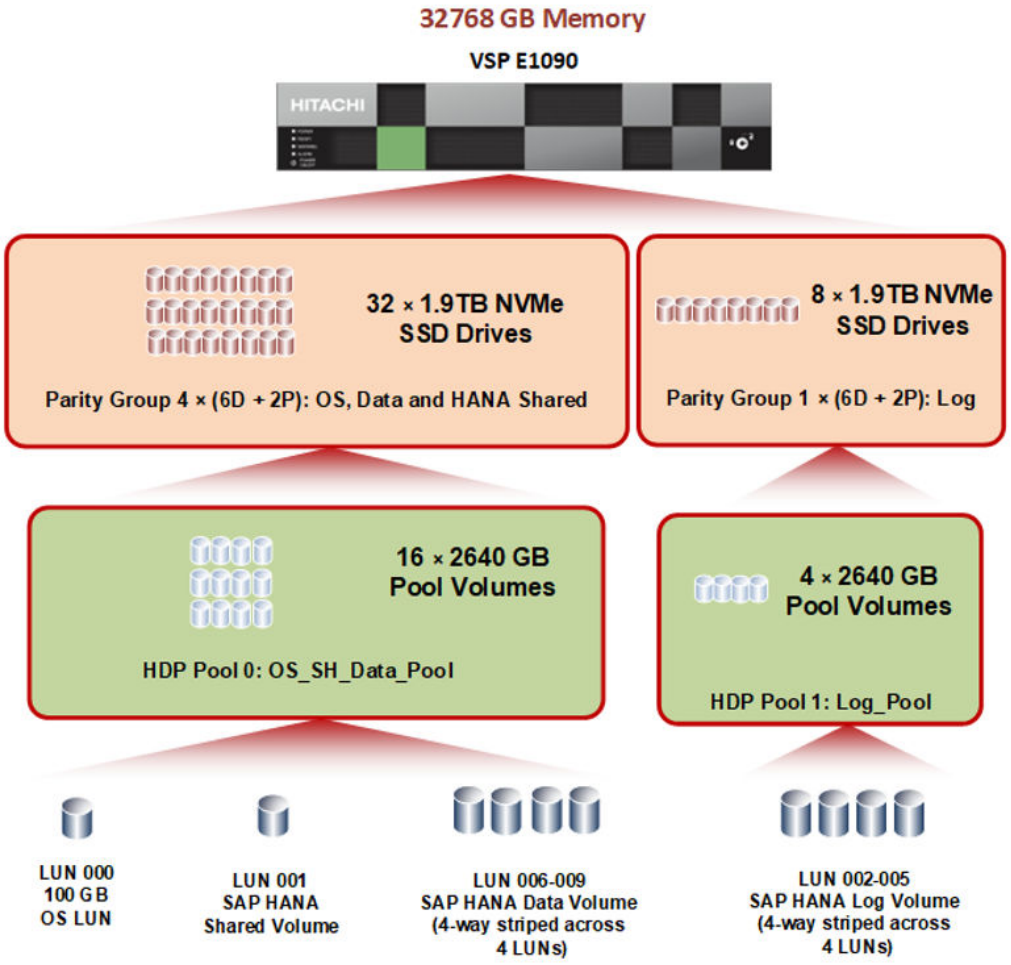
Storage volumes for different memory sizes

The following figures show the minimum storage configuration for different memory sizes.


T-shirt sizes of from 512 GB to 9216 GB Memory
VSP E1090
HITACHI
8 × 1.92 TB NVMe SSD Drives
Parity Group 1 × (6D + 2P): OS, Data and HANA Shared
8 × 1.92 TB NVMe SSD Drives
Parity Group 1 × (6D + 2P) Log
4 × 2640 GB Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 2640 GB Pool Volumes
HDP Pool 1: Log_Pool
LUN 000 100 GB OS LUN
LUN 001 SAP HANA Shared Volume*
LUN 006-009 SAP HANA Data Volume* (4-way striped across 4 LUNs)
LUN 002-005 AP HANA Log Volume* (4-way striped across 4 LUNs)


12288 GB to 16384 GB Memory
VSP E1090
HITACHI
16 × 1.92 TB NVMe SSD Drives
Parity Group 2 × (6D + 2P): OS, Data and HANA Shared
8 × 1.92 TB NVMe SSD Drives
Parity Group 1 × (6D + 2P) Log
8 × 2640 GB Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 2640 GB Pool Volumes
HDP Pool 1: Log_Pool
LUN 000
100 GB
OS LUN
LUN 001
SAP HANA
Shared Volume*
LUN 006-009
SAP HANA Data Volume*
(4-way striped across
4 LUNs)
LUN 002-005
SAP HANA Log Volume*
(4-way striped across
4 LUNs)


24576 GB Memory
VSP E1090
HITACHI
24 × 1.9TB NVMe SSD Drives
Parity Group 3 × (6D + 2P): OS, Data and HANA Shared
8 × 1.9TB NVMe SSD Drives
Parity Group 1 × (6D + 2P): Log
12 × 2640 GB Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 2640 GB Pool Volumes
HDP Pool 1: Log_Pool
LUN 000 100 GB OS LUN
LUN 001 SAP HANA Shared Volume
LUN 006-009 SAP HANA Data Volume (4-way striped across 4 LUNs)
LUN 002-005 SAP HANA Log Volume (4-way striped across 4 LUNs)



Hitachi Dynamic Provisioning (HDP) Pool layout

This solution uses a dynamic provisioning pool design for the storage layout that ensures maximum utilization and optimization at a lower cost. Hitachi Storage Virtualization Operating System RF with Hitachi Dynamic Provisioning uses storage-based virtualization layered on top of RAID technology (RAID on RAID) to enable virtual LUNs (dynamically provisioned volumes) to draw space from multiple pool volumes. This improves storage performance and utilization.

For the storage layout, use two Hitachi Dynamic Provisioning pools (HDP) with the specific parity groups as listed in the following tables.

Dynamic Provisioning Pool Name	Purpose	Parity Group RAID Level and Disks	
		512 GB to 9216 GB	12288 GB to 16348 GB
OS_SH_Data_Pool (Pool 0)	Operating system LUN SAP HANA shared LUN	1 × RAID 6 (6D+2P) on 1.92 TB NVMe SSD drives 8 × 1.92TB SSD	2 × RAID 6 (6D+2P) on 1.92 TB NVMe SSD drives 16 × 1.92 TB SSD

Dynamic Provisioning Pool Name	Purpose	Parity Group RAID Level and Disks	
		512 GB to 9216 GB	12288 GB to 16348 GB
	Data LUNs		
Log_Pool (Pool 1)	Log LUNs	RAID 6 (6D+2P) on 1.92 TB NVMe SSD drives 8 × 1.92 TB SSD	

Dynamic Provisioning Pool Name	Purpose	Parity Group RAID Level and Disks	
		24576 GB	32768 GB
OS_SH_Data_Pool (Pool 0)	Operating system LUN SAP HANA Shared LUN Data LUNs	3 × RAID 6 (6D+2P) on 1.92 TB NVMe SSD drives 24 × 1.92TB SSD	4 × RAID 6 (6D+2P) on 1.92 TB NVMe SSD drives 32 × 1.92 TB SSD
Log_Pool(Pool 1)	Log LUNs	RAID 6 (6D+2P) on 1.92 TB NVMe SSD drives 8× 1.92 TB SSD	

Two pools are enough to provide storage and throughput for all supported storage sizes:

- Pool 0 is used to create virtual volumes (V-Vols) for OS, HANA data and shared binaries. Additional RAID groups and pool volumes can be added to increase the size of Pool 0 to support higher memory configurations.
- Use Pool 1 to create virtual volumes for HANA log.
- Use thin provisioning to leverage benefits of automatic performance optimization and storage space savings across pools of virtual capacity.

The following tables list the minimum storage configuration by following *SAP HANA Tailored Data Center Integration on Hitachi Virtual Storage Platform E990 and VSP E1090 with Hitachi Storage Virtualization Operating System RF Reference Architecture Guide* (https://docs.hitachivantara.com/v/u/en-us/application-optimized-solutions/mk-sl-197) for different memory sizes for BullSequana SH series with VSP E1090 as an example.

Memory Size	From 512 GB to 9216 GB	From 12288 GB to 16348 GB
P-VOLs (for OS/SH/DT)	1 × RAID 6 (6D+2P) 8 × 1.92 TB SSD 4 × 2640 GB PVOL	2 × RAID 6 (6D+2P) 16 × 1.92 TB SSD 8 × 2640 GB PVOL

Memory Size	From 512 GB to 9216 GB	From 12288 GB to 16348 GB
VVOL - OS	OS: (1 × 100 GB)	
VVOL - /hana/shared	/hana/shared 1 × 1024 GB	/hana/shared 1 × 4096 GB
VVOL - /hana/data	/hana/data for 512 GB size: 4 × 128 GB; for 1024 GB size: 4 × 256 GB; for 1536 GB size: 4 × 384 GB; for 2048 GB size: 4 × 512 GB; for 3072 GB size: 4 × 768 GB; for 4096 GB size: 4 × 1024 GB; for 614 GB size: 4 × 1536 GB; for 8192 GB size: 4 × 2048 GB; for 9216 GB size: 4 × 2304 GB	/hana/data for 12288 GB size: 4 × 3072 GB for 16384 GB size: 4 × 4096 GB
P-VOLs (for Log)	1 × RAID 6 (6D+2P) 8 × 1.92 TB SSD 4 × 2640 GB PVOL	
VVOL - /hana/log	/hana/log 512 GB: 4 × 128 GB	

Memory Size	24576 GB	32768 GB
P-VOLs (for	3 × RAID 6 (6D+2P)	4 × RAID 6 (6D+2P)
OS/SH/DT)	24 × 1.92 TB SSD	32 × 1.92 TB SSD
	12 × 2640 GB PVOL	16 × 2640 GB PVOL
VVOL- OS	OS: (1 × 100 GB)	
VVOL- /hana/shared	/hana/shared 1 × 24576 GB	/hana/shared 1 × 32768 GB
VVOL- /hana/data	/hana/data	/hana/data
	4 × 6144GB;	4 × 8192 GB

P-VOLs (for Log)	1 × RAID 6 (6D+2P) 8 × 1.92 TB SSD 4 × 2640 GB PVOL
VVOL- /hana/log	/hana/log 512 GB: 4 × 128 GB

The following table lists the LUN path assignment used when validating the SAP HANA environment.

Dynamic Provisioning Pool	LUN ID	LDEV ID	LDEV Name
OS_SH_Data_Pool	0000	00:02:00	HANA_OS
	0001	00:02:01	HANA_SH
Log_Pool	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
OS_SH_Data_Pool	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

This section describes how to configure SAP HANA for this solution.

File system

These volumes use the following file systems for implementation of this solution either with an external storage subsystem:

- Operating system volume
  - BTRFS Filesystem (only for SLES/XFS Filesystem)
- SAP HANA Shared volume
- SAP HANA Data volume
- SAP HANA Log volume

Device-Mapper Multipath

This solution uses Device-Mapper Multipath to combine the multiple connections coming from external storage subsystems.

SAP HANA software installation

After you configure the file systems for the SAP HANA data volume and log volume, install the latest SAP HANA 2.0 SPS stack on the server.

Install the following SAP HANA software components on the server:

- SAP HANA Database Server
- SAP HANA Client
- SAP Host Agent

Engineering validation

The test methodology for validating the TDI configuration using BullSequana SH server running with TS45.02 firmware and an enterprise storage configuration with Hitachi Virtual Storage Platform E1090 used the following:

- SAP HANA Hardware and Cloud Measurement Tools (HCMT-079_0) was tested on these volumes for SLES 15 SP5:
  - Data volume
  - Log volume
  - Shared volume

For optimal use of SAP HANA database, use the parameters listed in the corresponding appendix for your operating system release. Follow SAP Note 2399079 to set up these parameters defined in global.ini for SAP HANA 2.0.

Sample global.ini file

SUSE Enterprise Linux Server for SAP Applications

This is a sample `global.ini` file that was configured and used for validating the TDI solution with SUSE Linux Enterprise Server for SAP Applications 15 SP5.

```
tcp_backlog = 2048

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

```
async_write_submit_active[data] = on
async_write_submit_blocks[data] = all
min_submit_batch_size[data] = 16
max_submit_batch_size[data] = 64
max_parallel_io_requests[data] = 64
size_kernel_io_queue[data] = 512

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

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

Product descriptions

The following information describes the hardware and software components used in this reference architecture.

Eviden BullSequana SH series

To take advantage of the latest developments in artificial intelligence (AI), data analytics and machine learning, you require an infrastructure with high reliability, extreme performance, and agile scalability. BullSequana SH series servers deliver this with a unique modular architecture.

Your server can be configured and scaled to meet the needs of a wide variety of application workloads. This can be used from in-memory data analytics processing to virtualization and hybrid cloud.

The BullSequana SH series has several complementary models, each based on the 4th Gen Intel Xeon Scalable Processor. You can upgrade a model to the next model, preserving your hardware and software investment as your business grows.

Hitachi Virtual Storage Platform E1090

The Hitachi Virtual Storage Platform E1090 (VSP E1090) storage system is a high-performance, large-capacity data storage system. The VSP E1090 all-flash arrays (AFAs) support NVMe and SAS solid-state drives (SSDs). The VSP E1090H hybrid models can be configured with both SSDs and hard disk drives (HDDs).

- The NVMe flash architecture delivers consistent, low-microsecond latency, which reduces the transaction costs of latency-critical applications and delivers predictable performance to optimize storage resources.
- The hybrid architecture allows for greater scalability and provides data-in-place migration support.

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.

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

As an 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 guide for basic concepts and for planning.

- SAP HANA Server Installation and Update Guide

  This guide provides an overview of how to install and update an SAP HANA system with the SAP HANA lifecycle management tools.

- SAP HANA Administration Guide

  This guide explains how to configure, manage, maintain, and optimize your SAP HANA installation using SAP HANA administration tools.

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)

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

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