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Hitachi Solution for the SAP HANA Platform in a Scale-up Configuration using Hitachi Advanced Server DS7000

Reference Architecture Guide

MK-SL-147-11
May 2024

Feedback

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Revision history

Revision	Changes	Date
MK-SL-147-11	Add support for RHEL 9.2.	May 2024
MK-SL-147-10	Add support for SLES 15 SP5 and RHEL 8.8.	January 2024
MK-SL-147-09	Add support for SLES 15 SP4 and RHEL 8.6 for Hitachi Advanced Server DS7000 series servers.	March 2023

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 Hitachi Advanced Server DS7000 series using Intel Xeon Scalable Processors. This document covers following deployments:

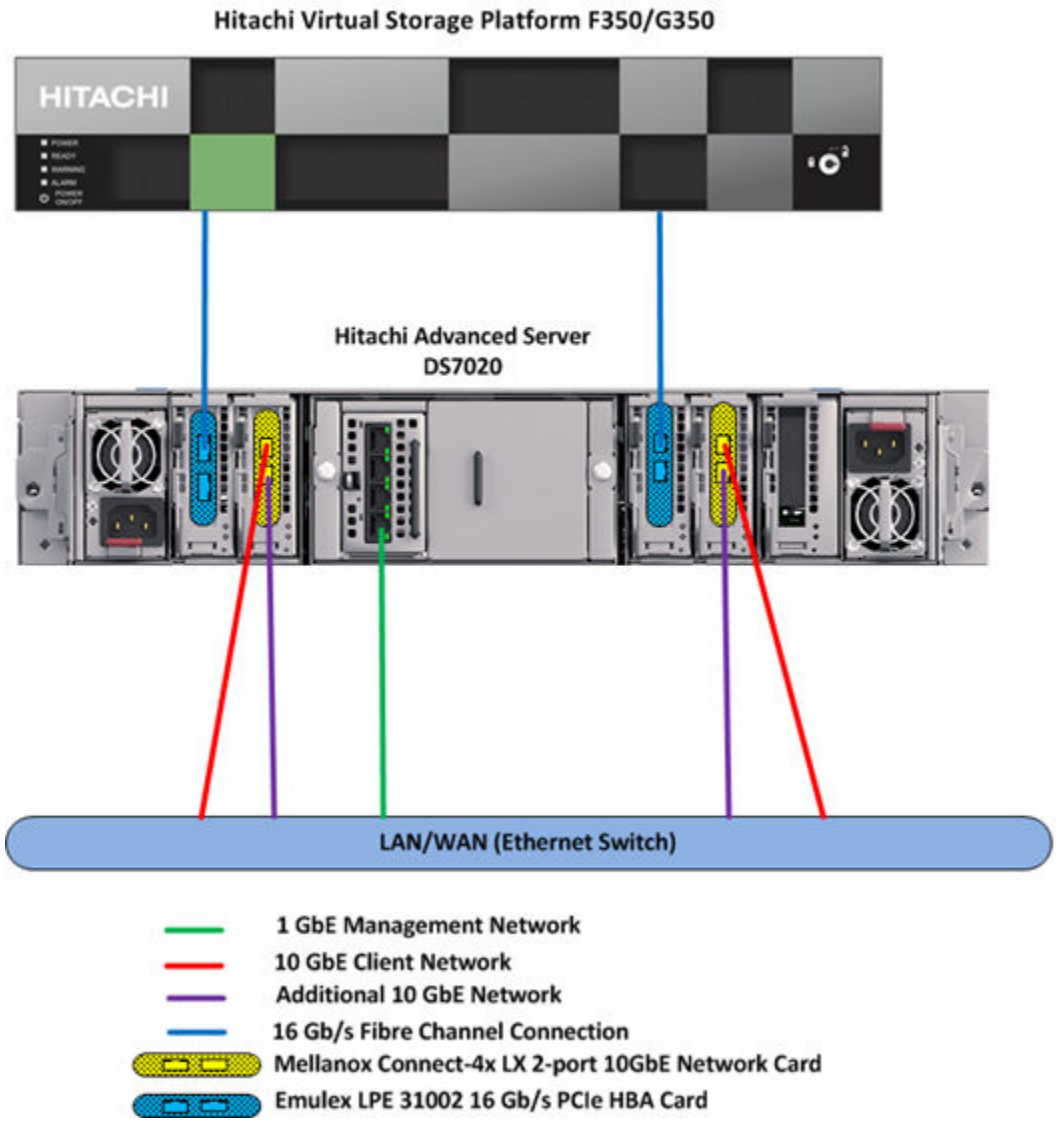
- SAP HANA appliance — With a SAP HANA appliance deployment, the hardware vendor pre-assembles, pre-installs, and pre-configures the hardware and software, with the complete package certified by SAP.
- SAP HANA tailored data center integration (TDI) — With a SAP HANA TDI deployment, each installation is customized by assembling 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.

These solutions use the following components:

- Hardware
  - One Hitachi Advanced Server DS7000 series
  - External subsystem storage Hitachi Virtual Storage Platform G200 (VSP G200)
  - External subsystem storage Hitachi Virtual Storage Platform F350 (VSP F350) or VSP G350
- Software
  - Preconfigured with SAP HANA to provide a converged solution for applications using SAP HANA Platform

The validation of this environment with external storage uses Hitachi Virtual Storage Platform F350 or VSP G350 and VSP G200 with DS7000 servers using first generation Intel Xeon Scalable Processors. Your needs may require other storage options and fall under a Tailored Datacenter Integration (TDI) solution. Contact your account representative for details and implementation services whenever you require using external storage.

The following figure shows the topology of this reference solution using external drives on a Hitachi Virtual Storage Platform F350 or VSP G350 storage subsystem.



This Hitachi Solution for SAP HANA is a preconfigured converged system for any business workload running on SAP HANA Platform. It is ready to plug into your network to host business data, deliver data-driven insights throughout your business, and predict real-time outcomes.

The solution included by Intel Select Solutions for SAP HANA, supports the configurations of both with and without Intel Optane DC Persistent Memory. Intel Optane DC Persistent Memory is a new class of memory and architected specifically for data center requirements. It delivers an unprecedented combination of high-capacity, affordability, and persistence. By moving and maintaining larger amounts of data closer to the processor, workloads and services can optimized to reduce latencies and enhance overall performance.

Note: Hitachi Advanced Server DS7080 in a 6-socket configuration uses a "Compute Box for a 4 × 2 socket server." The bottom compute unit is missing, being replaced by a 2U dummy for compute box. The sockets are numbered from 0 to 5, from top to bottom.

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 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.

Memory configurations

This section shows the available memory configurations for systems with first- or second-generation Intel Xeon Scalable Processors, including the use of Intel Optane DC persistent memory for systems with second generation processors.

Memory configurations with first generation Intel Xeon scalable processors

This system supports the configurations listed in the following table.

Number of Sockets	RAM Size	Storage
2 × Intel Xeon Platinum 8176/8176M/8180/8180M processors using Hitachi Advanced Server DS7020	▪ 384 GB with 12 × 32 GB LRDIMMs ▪ 768 GB with 24 × 32 GB LRDIMMs ▪ 768 GB with 12 × 64 GB LRDIMMs ▪ 1152 GB with 12 × 32 GB and 12 × 64 GB LRDIMMs ▪ 1536 GB with 24 × 64 GB LRDIMMs	Hitachi Virtual Storage Platform F350, VSP G350, or VSP G200
2 × Intel Xeon Platinum 8176M/8180M processors using Hitachi Advanced Server DS7020	▪ 1536 GB with 12 × 128 GB RDIMMs 3DS ▪ 2304 GB with 12 × 64 GB and 12 × 128 GB RDIMMs 3DS ▪ 3072 GB with 24 × 128 GB RDIMMs 3DS	
4 × Intel Xeon Platinum 8176/8176M/8180/8180M processors using Hitachi Advanced Server DS7040	▪ 2304 GB with 24 × 32 GB and 24 × 64 GB LRDIMMs ▪ 3072 GB with 48 × 64 GB LRDIMMs	

Number of Sockets	RAM Size	Storage
4 × Intel Xeon Platinum 8176M/8180M processors using Hitachi Advanced Server DS7040	▪ 3072 GB with 24 × 128 GB RDIMMs 3DS ▪ 4608 GB with 24 × 64 GB and 24 × 128 GB RDIMMs 3DS ▪ 6144 GB with 48 × 128 GB RDIMMs 3DS	
6 × Intel Xeon Platinum 8176/8176M/8180/8180M processors using Hitachi Advanced Server DS7080	▪ 3456 GB with 36 × 32 GB and 36 × 64 GB LRDIMMs ▪ 4608 GB with 72 × 64 GB LRDIMMs	
6 × Intel Xeon Platinum 8176M/8180M processors using Hitachi Advanced Server DS7080	▪ 4608 GB with 36 × 128 GB RDIMMs 3DS ▪ 6912 GB with 36 × 64 GB and 36 × 128 GB RDIMMs 3DS ▪ 9216 GB with 72 × 128 GB RDIMMs 3DS	
8 × Intel Xeon Platinum 8176/8176M/8180/8180M processors using Hitachi Advanced Server DS7080	▪ 4608 GB with 48 × 32 GB and 48 × 64 GB LRDIMMs ▪ 6144 GB with 96 × 64 GB LRDIMMs	
8 × Intel Xeon Platinum 8176M/8180M processors using Hitachi Advanced Server DS7080	▪ 6144 GB with 48 × 128 GB RDIMMs 3DS ▪ 9216 GB with 48 × 64 GB and 48 × 128 GB RDIMMs 3DS ▪ 12288 GB with 96 × 128 GB RDIMMs 3DS	

Memory slotting is shown in the tables in the next section.

Memory configurations with second generation Intel Xeon scalable processors

Memory configurations without Intel Optane DC persistent memory are listed in the following table, with memory slots shown accordingly in the next table.

Number of Sockets	RAM Size
2 × Intel Xeon Platinum 8276*/8276M**/8276L, or 8280*/8280M**/8280L processors using Hitachi Advanced Server DS7020	▪ 384 GB with 12 × 32 GB 2933 RDIMM-DR ▪ 768 GB with 24 × 32 GB 2933 RDIMM-DR ▪ 768 GB with 12 × 64 GB 2933 RDIMM-DR

Number of Sockets	RAM Size
	▪ 1152 GB with 12 × 32 GB and 12 × 64 GB 2933 RDIMM-DR ▪ 1536 GB with 24 × 64 GB 2933 RDIMM-DR
2 × Intel Xeon Platinum 8276M**/8276L, or 8280M**/8280L processors using Hitachi Advanced Server DS7020	▪ 1536 GB with 12 × 128 GB 2933 LRDIMM-QR ▪ 2304 GB with 12 × 64 GB and 12 × 128 GB 2933 LRDIMM-QR ▪ 3072 GB with 24 × 128 GB 2933 LRDIMM-QR
4 × Intel Xeon Platinum 8276*/8276M**/8276L, or 8280*/8280M**/8280L processors using Hitachi Advanced Server DS7040	▪ 1536 GB with 48 × 32 GB 2933 RDIMM-DR ▪ 1536 GB with 24 × 64 GB 2933 RDIMM-DR ▪ 2304 GB with 24 × 32 GB and 24 × 64 GB 2933 RDIMM-DR ▪ 3072 GB with 48 × 64 GB 2933 RDIMM-DR
4 × Intel Xeon Platinum 8276M**/8276L, or 8280M**/8280L processors using Hitachi Advanced Server DS7040	▪ 3072 GB with 24 × 128 GB 2933 LRDIMM-QR ▪ 4608 GB with 24 × 64 GB and 24 × 128 GB 2933 LRDIMM-QR ▪ 6144 GB with 48 × 128 GB 2933 LRDIMM-QR
6 × Intel Xeon Platinum 8276*/8276M**/8276L, or 8280*/8280M**/8280L processors using Hitachi Advanced Server DS7080	▪ 3456 GB with 36 × 32 GB and 36 × 64 GB 2933 RDIMM-DR ▪ 4608 GB with 72 × 64 GB 2933 RDIMM-DR
6 × Intel Xeon Platinum 8276M**/8276L, or 8280M**/8280L processors using Hitachi Advanced Server DS7080	▪ 4608 GB with 36 × 128 GB 2933 LRDIMM-QR ▪ 6912 GB with 36 × 64 GB and 36 × 128 GB 2933 LRDIMM-QR ▪ 9216 GB with 72 × 128 GB 2933 LRDIMM-QR
8 × Intel Xeon Platinum 8276*/8276M**/8276L, or 8280*/8280M**/8280L processors using Hitachi Advanced Server DS7080	▪ 4608 GB with 48 × 32 GB and 48 × 64 GB 2933 RDIMM-DR ▪ 6144 GB with 96 × 64 GB 2933 RDIMM-DR
8 × Intel Xeon Platinum 8276M**/8276L, or 8280M**/8280L processors using Hitachi Advanced Server DS7080	▪ 6144 GB with 48 × 128 GB 2933 LRDIMM-QR ▪ 9216 GB with 48 × 64 GB and 48 × 128 GB 2933 LRDIMM-QR ▪ 12288 GB with 96 × 128 GB 2933 LRDIMM-QR

Number of Sockets	RAM Size
*Not covered by Intel Select Solutions **According to the *Intel PCN 117365-00*, the discontinuance of the M series began on January 15, 2020. **Note:** M and L type processors are required for 128 GB DIMM use.	

The lower DIMM slot number in the table below is closer to the CPU.

Controller Number	0						1						Capacity (GB) per 2 CPUs
Channel Number	0		1		2		3		4		5		
DIMM Slot Number	1	2	3	4	5	6	7	8	9	10	11	12	
1DPC 32 GB DIMM	32		32		32		32		32		32		384
2DPC 32 GB DIMM	32	32	32	32	32	32	32	32	32	32	32	32	768
1DPC 64 GB DIMM*	64		64		64		64		64		64		768
2DPC 32 or 64 GB Mixed DIMM*	64	32	64	32	64	32	64	32	64	32	64	32	1152
2DPC 64 GB DIMM*	64	64	64	64	64	64	64	64	64	64	64	64	1536
1DPC 128 GB DIMM*	128		128		128		128		128		128		1536
2DPC 64 GB or 128 GB mixed DIMM*	128	64	128	64	128	64	128	64	128	64	128	64	2304

2DPC 128 GB DIMM*	128	128	128	128	128	128	128	128	128	128	128	128	3072
* Covered by Intel Select Solutions for SAP HANA.													

Memory configurations with Intel Optane DC Persistent Memory are listed in the following table, with the DIMM slots shown accordingly in the next table.

Number of Sockets	RAM Size (Intel Optane DC Persistent Memory + DRAM)
2 × Intel Xeon Platinum 8276*/ 8276M**/8276L, or 8280*/ 8280M**/8280L processors using Hitachi Advanced Server DS7020	▪ 1920 GB (12 × 128 GB + 12 × 32 GB 2933 RDIMM-DR) ▪ 2304 GB (12 × 128 GB + 12 × 64 GB 2933 RDIMM-DR) ▪ 3840 GB (12 × 256 GB + 12 × 64 GB 2933 RDIMM-DR)
2 × Intel Xeon Platinum 8276M**/8276L, or 8280M**/ 8280L processors using Hitachi Advanced Server DS7020	▪ 3072 GB (12 × 128 GB + 12 × 128 GB 2933 LRDIMM-QR) ▪ 4608 GB (12 × 256 GB + 12 × 128 GB 2933 LRDIMM-QR) ▪ 7680 GB (12 × 512 GB + 12 × 128 GB 2933 LRDIMM-QR)
4 × Intel Xeon Platinum 8276*/ 8276M**/8276L, or 8280*/ 8280M**/8280L processors using Hitachi Advanced Server DS7040	▪ 3840 GB (24 × 128 GB + 24 × 32 GB 2933 RDIMM-DR) ▪ 4608 GB (24 × 128 GB + 24 × 64 GB 2933 RDIMM-DR) ▪ 7680 GB (24 × 256 GB + 24 × 64 GB 2933 RDIMM-DR)
4 × Intel Xeon Platinum 8276M**/8276L, or 8280M**/ 8280L processors using Hitachi Advanced Server DS7040	▪ 6144 GB (24 × 128 GB + 24 × 128 GB 2933 LRDIMM-QR) ▪ 9216 GB (24 × 256 GB + 24 × 128 GB 2933 LRDIMM-QR) ▪ 15360 GB (24 × 512 GB + 24 × 128 GB 2933 LRDIMM-QR)

Number of Sockets	RAM Size (Intel Optane DC Persistent Memory + DRAM)
6 × Intel Xeon Platinum 8276*/ 8276M**/8276L, or 8280*/ 8280M**/8280L processors using Hitachi Advanced Server DS7080	▪ 5760 GB (36 × 128 GB + 36 × 32 GB 2933 RDIMM-DR) ▪ 6912 GB (36 × 128 GB+ 36 × 64 GB 2933 RDIMM-DR) ▪ 11520 GB (36 × 256 GB DCPMM + 36 × 64 GB 2933 RDIMM-DR)
6 × Intel Xeon Platinum 8276M**/8276L, or 8280M**/ 8280L processors using Hitachi Advanced Server DS7080	▪ 9216 GB (36 × 128 GB + 36 × 128 GB 2933 LRDIMM-QR) ▪ 13824 GB (36 × 256 GB + 36 × 128 GB 2933 LRDIMM-QR) ▪ 23040 GB (36 × 512 GB + 36 × 128 GB 2933 LRDIMM-QR)
8 × Intel Xeon Platinum 8276*/ 8276M**/8276L, or 8280*/ 8280M**/8280L processors using Hitachi Advanced Server DS7080	▪ 7680 GB (48 × 128 GB + 48 × 32 GB 2933 RDIMM-DR) ▪ 9216 GB (48 × 128 GB + 48 × 64 GB 2933 RDIMM-DR) ▪ 15360 GB (48 × 256 GB + 48 × 64 GB 2933 RDIMM-DR)
8 × Intel Xeon Platinum 8276M**/8276L, or 8280M**/ 8280L processors using Hitachi Advanced Server DS7080	▪ 12288 GB (48 × 128 GB + 48 × 128 GB 2933 LRDIMM-QR) ▪ 18432 GB (48 × 256 GB + 48 × 128 GB 2933 LRDIMM-QR)
* Not covered by Intel Select Solutions. ** According to the Intel PCN 117365-00, the discontinuance of the M series began on January 15, 2020.	

Again, the lower DIMM slot number is closer to the CPU.

controller #	0						1						Capacity (GB) per 2 CPUs
channel #	0		1		2		3		4		5		
DIMM slot #*	1	2	3	4	5	6	7	8	9	10	11	12	

2DPC 128 GB + 32 GB DRAM**	128	32	128	32	128	32	128	32	128	32	128	32	1920
2DPC 128 GB + 64 GB DRAM	128	64	128	64	128	64	128	64	128	64	128	64	2304
2DPC 128 GB + 128 GB DRAM	128	128	128	128	128	128	128	128	128	128	128	128	3072
2DPC 256 GB + 64 GB DRAM	256	64	256	64	256	64	256	64	256	64	256	64	3840
2DPC 256 GB + 128 GB DRAM	256	128	256	128	256	128	256	128	256	128	256	128	4608
2DPC 512 GB + 128 GB DRAM	512	128	512	128	512	128	512	128	512	128	512	128	7680
* Odd numbered slots are for Intel Optane DC Persistent Memory; Even numbered slots are for DRAM. ** Not covered by Intel Select Solutions.													

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 can require manual configuration of the network and/or using different components.

Hardware elements

This section details the hardware used to deploy this specific scale-up configuration of Hitachi Solution for SAP HANA for the different sized solutions.

Hitachi Advanced Server DS7000 series uses an external storage subsystem, as indicated in the following table.

Hardware	Quantity	Configuration	Role
Hitachi Advanced Server DS7020	1	CPUs per SAP HANA node: ▪ One of the following: • 2 Intel Xeon Platinum 8176/8176M Processor 28-core, 2.1GHz, 165W • 2 Intel Xeon Platinum 8180/8180M Processor 28-core, 2.5GHz, 205W • 2 Intel Xeon Platinum 8276*/8276M**/8276L processors, 28-core, 2.20 GHz, 152 W • 2 Intel Xeon Platinum 8280*/8280M**/8280L processors, 28-core, 2.70 GHz, 205 W ▪ 2 heat sinks CPU 0/1 ▪ For the RAM per SAP HANA node, see the previous section	SAP HANA server
Mellanox Technologies MT27710 Family [ConnectX-4 Lx]	2	▪ Mellanox Connectx4 dual port PCIe card per compute module	For SAP HANA 10 GbE client network and additional 10 GbE network
	2	▪ Cisco SFP+ 3M Twinaxial cables	
Hitachi Virtual Storage Platform F350 or VSP G350 or VSP G200	1	▪ 1 pair of controllers ▪ 1 pair 4-port 14 Gb/s channel blades ▪ 1 expansion DBS drive box ▪ 128 GB Cache ▪ 1 pair SAS ports ▪ 1 pair PSUs ▪ 1.92 TB SSD or 600 GB/1200 GB SAS drives (on VSP G200)	Block storage

Hardware	Quantity	Configuration	Role
		(The number of drives varies for different memory sizes)	
16 Gb/s Fibre Channel Dual HBA LPe31002 M6 Blade	2	▪ 2-port LPE31002-M6 16 Gb/s card per compute module	Connectivity to the external storage subsystem
	4	▪ 16 Gb/s SFP	
Cisco Nexus 92348 switch	1	▪ 48 × 1 GbE ports	Optional switch for management network
Cisco Nexus 93180YC-FX switch	2	▪ 48 × 10 GbE ports	Optional switches for client network or additional backup network
Minkels V2 Rack 600 × 1200 × 2010 mm (W × D × H) 42U with brake	1	▪ 1 standard rack	Optional rack for mounting server
PDUs	6	▪ Vertical PDUs	Optional PDUs for solution
*Not covered by Intel Select Solutions. Also refer to the supported configurations with and without Intel Optane DC Persistent Memory described above for 4 socket, 6 socket, and 8 socket CPU information that is covered by Intel Select Solutions. **According to the *Intel PCN 117365-00*, the discontinuance of the M series began on January 15, 2020.			

Software elements

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

Purpose	Software
Operating system (Choose one)	▪ SUSE Linux Enterprise Server for SAP Applications ▪ Red Hat Enterprise Linux Server for SAP Applications When using Intel Optane DC Persistent Memory, the minimum supported operating system can be found at https://compatibility.hitachivantara.com/products/sap-hana?sap_hana_solution_type=778.

Purpose	Software
Database	SAP HANA ▪ When using Intel Optane DC Persistent Memory, this solution supports SAP HANA 2.0 SPS04 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:

- Hitachi Advanced Server DS7000 series Configuration
- Network Architecture
- Storage Architecture Configuration
- SAP HANA Configuration

Hitachi Advanced Server DS7000 series configuration

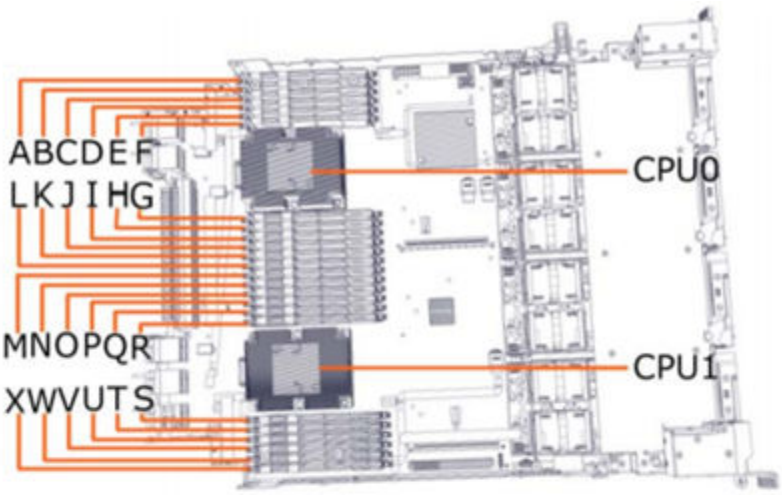
The basic building blocks for Hitachi Advanced Server DS7000 series compute model comprise the following:

- 2 Intel Xeon Platinum processors, using one of the following 28-core models:
  - 8176, or 8176M
  - 8180, or 8180M
  - 8276, or 8276M**, or 8276L
  - 8280, 8280M**, or 8280L
- 12 memory DIMMs per CPU, 24 per compute module
- 5 I/O blades for PCIe adapters
- 4 native 1 GbE Ethernet ports

This compute module acts as the master module. Other identical modules can be added as subordinate modules to add more resources. The following figure provides details about the PCIe components of all Advanced Server DS7000 series configurations:

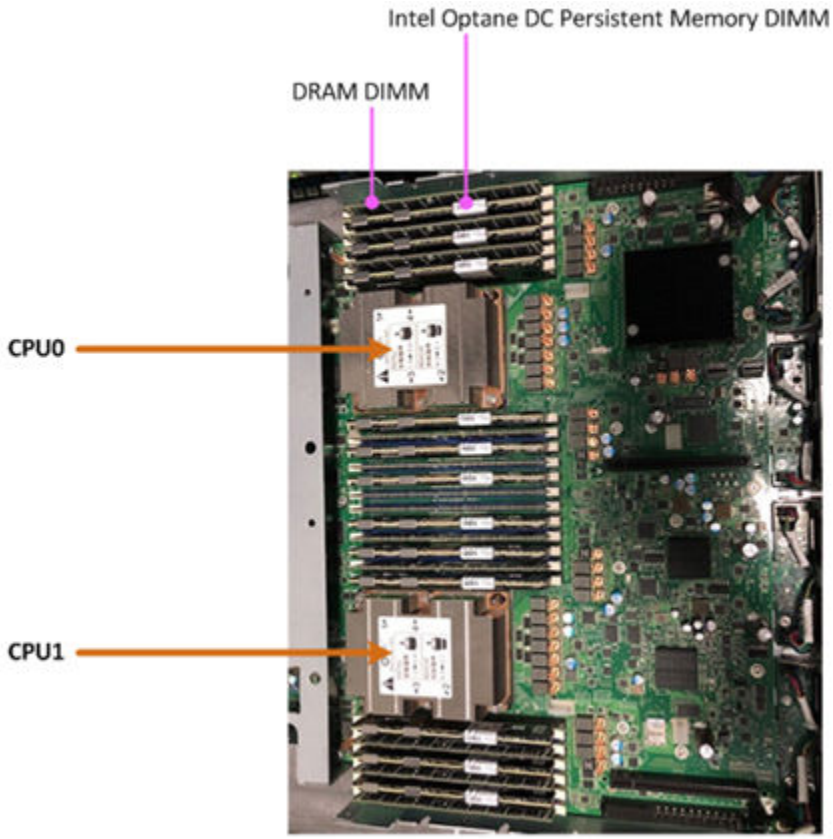
	Hitachi Advanced DS7000 Server				
Master	CPU 0		CPU 1		
	0	1	2	3	4
	RP8	RP8	RP8	RP8	RP85
	HBA 2	ETH 1	HBA 1	ETH 2	RAID SAS
Default Guide	Storage	10 / 1 GbE Network	Storage	10 / 1 GbE Network	RAID / SAS

The following figure shows the locations of the memory modules. Only insert the Intel Optane DC Persistent Memory DIMMs in the slots with slot name CH-<X>1. For example, use the CH-C1 slot. The numbers of DCPMM DIMMs must match with number of DRAM DIMMs.

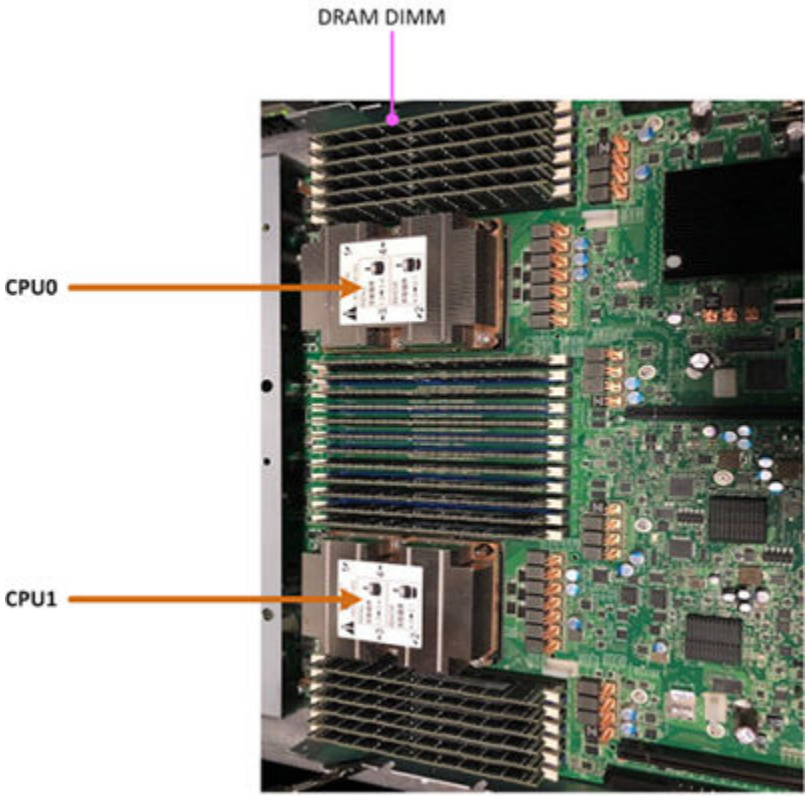


Mark	Slot name on board	CPU	iMC	Channel	DIMM	Locator on board
A	CH-C0	0	0	2	0	J5C3
B	CH-C1	0	0	2	1	J5C4
C	CH-B0	0	0	1	0	J5C5
D	CH-B1	0	0	1	1	J6C1
E	CH-A0	0	0	0	0	J6C2
F	CH-A1	0	0	0	1	J6C3
G	CH-D1	0	1	3	1	J8C1
H	CH-D0	0	1	3	0	J8C2
I	CH-E1	0	1	4	1	J8C3
J	CH-E0	0	1	4	0	J8C4
K	CH-F1	0	1	5	1	J9C7
L	CH-F0	0	1	5	0	J9C8
M	CH-J0	1	0	2	0	J1C1
N	CH-J1	1	0	2	1	J1C2
O	CH-H0	1	0	1	0	J1C3
P	CH-H1	1	0	1	1	J2C1
Q	CH-G0	1	0	0	0	J2C2
R	CH-G1	1	0	0	1	J2C3
S	CH-K1	1	1	3	1	J4C1
T	CH-K0	1	1	3	0	J4C2
U	CH-L1	1	1	4	1	J4C3
V	CH-L0	1	1	4	0	J4C4
W	CH-M1	1	1	5	1	J5C1
X	CH-M0	1	1	5	0	J5C2

The following figure is an example for mix-and-match DRAM and Intel Optane DC Persistent Memory DIMMs on an Advanced Server DS7000 series 2S module:



The following figure is an example of DRAM DIMMs without Intel Optane DC Persistent Memory DIMMs on an Advanced Server DS7000 series 2S module:



Hitachi Advanced Server DS7000 series systems scale from 2 sockets to 8 sockets. See the following figure for the locations of the network and HBA cards.

Hitachi Advanced Server DS7020 (Front)

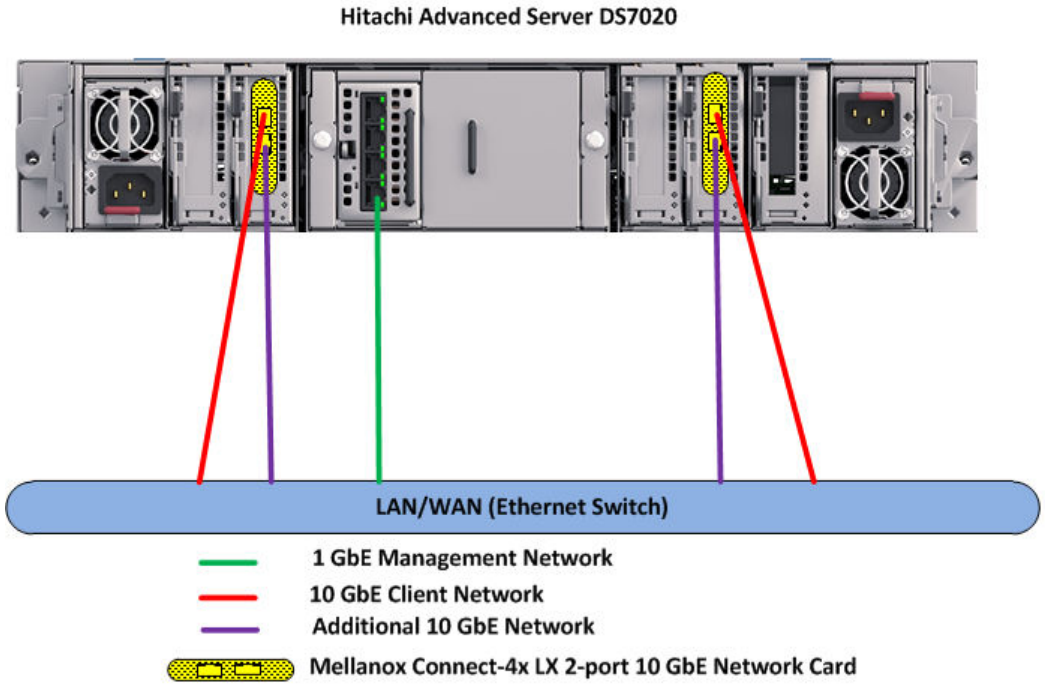
Hitachi Advanced Server DS7020 with external Storage (Back)

Mellanox Connect-4x LX 2-port 10GbE Network Card

Emulex LPE 31002 16 G/s PCIe HBA Card

Network architecture configuration

Connect the 1 GbE management port of Hitachi Advanced Server DS7000 series to a Cisco Nexus 92348 or 3048 switch or to any other external 1 GbE switch for management connectivity, as shown in the following figure.



Make the following 10 GbE network connections for SAP HANA nodes as shown in the table .

- Connect the following to Cisco Nexus 93180YC-FX or 93180YC-EX switches, or to any other external switches:
  - Port 0 of 10 GbE Mellanox Connect-4x LX PCIe card to two different Cisco Nexus 93180YC-FX or 93180YC-EX switches.
  - Bond the corresponding two ports, eth9901 and eth9902, as bond0 at the operating system level using active-active network bond mode with the following options:

    mode= 802.3ad miimon=100 xmit_hash_policy=2 updelay=5000 lacp_rate=fast

    This acts as the client network for the SAP HANA node.
- If additional 10 GbE network connections are required, connect Port 1 of both 10 GbE Mellanox Connect-4x LX PCIe cards to the Cisco Nexus 93180YC-FX or 93180YC-EX switches or to any other external switches.
- For all sizes, PCIe Slots 1 and 3 of the master module (see above) are used to create a bond. All other slots and ports can be used at the customer's discretion.

Network Card	Port	Network Description
PCIe_Slot_1 of Master Module	0	Client network for the SAP HANA node (eth9902)
	1	Free for use as additional 10 GbE network for backup, SAP HANA system replication, or other purposes
PCIe_Slot_3 of Master Module	0	Client network for the SAP HANA node (eth9901)
	1	Free for use as additional 10 GbE network for backup, SAP HANA system replication, or other purposes

Note: The management network and client network can be on the same network switch or a separate network switch, depending on the network environment.

Storage architecture configuration

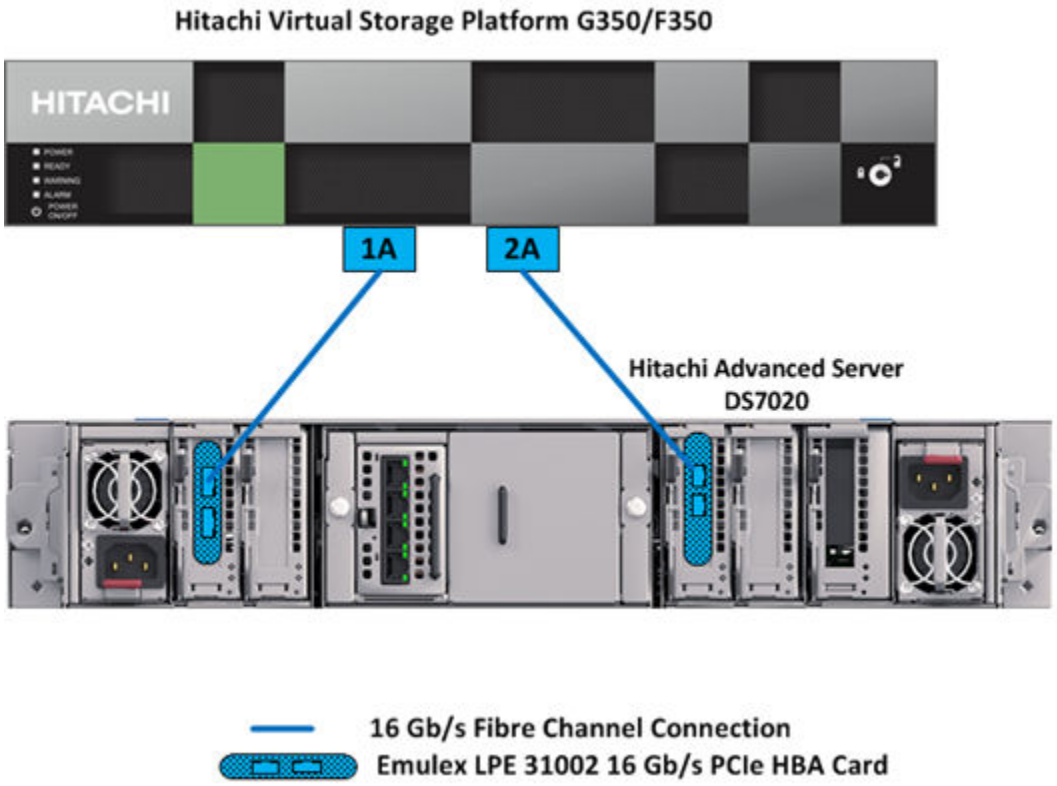
These are the components you need to implement a scale-up SAP HANA system with Hitachi Advanced Server DS7000 series using Hitachi Virtual Storage Platform F350, VSP G350 or VSP G200:

- 2 × 2-port Emulex LPE31002-M6 16 Gb/s PCIe HBA cards
- 1 Hitachi Virtual Storage Platform F350, VSP G350, or VSP G200
- Storage drive box trays (DBS)
- Spare drives

For a direct connection between Hitachi Virtual Storage Platform F350, VSP G350, or VSP G200 and the Emulex HBA on Advanced Server DS7000 series, use System Mode 847 on the storage to enable the following host mode options (HMO) for the corresponding storage port connected to the server:

- HMO 94— Mandatory for direct connection between Hitachi Virtual Storage Platform and the Emulex Lpe31002 HBA to work. Without setting up Host Mode Option 94, SAN storage cannot be identified from the Emulex HBA.
- HMO109— Fixes the SAN boot issue where sometimes the system cannot find the boot LUN after a reboot. Host Group ID must be 00 for SAN Boot.

The following figure shows the connections between the storage and the Hitachi Advanced Server DS7000 series system.



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

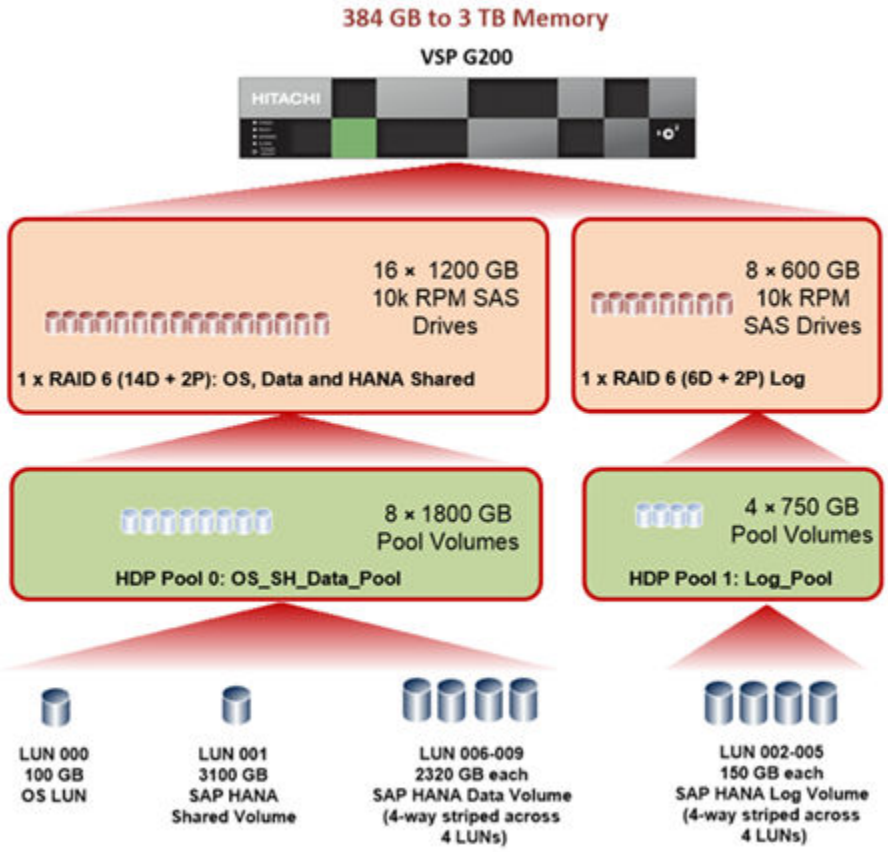
For this setting	Use this value
Port Security	Disabled
Port Speed	16 Gbps
Fabric	OFF
Connection Type	P-to-P

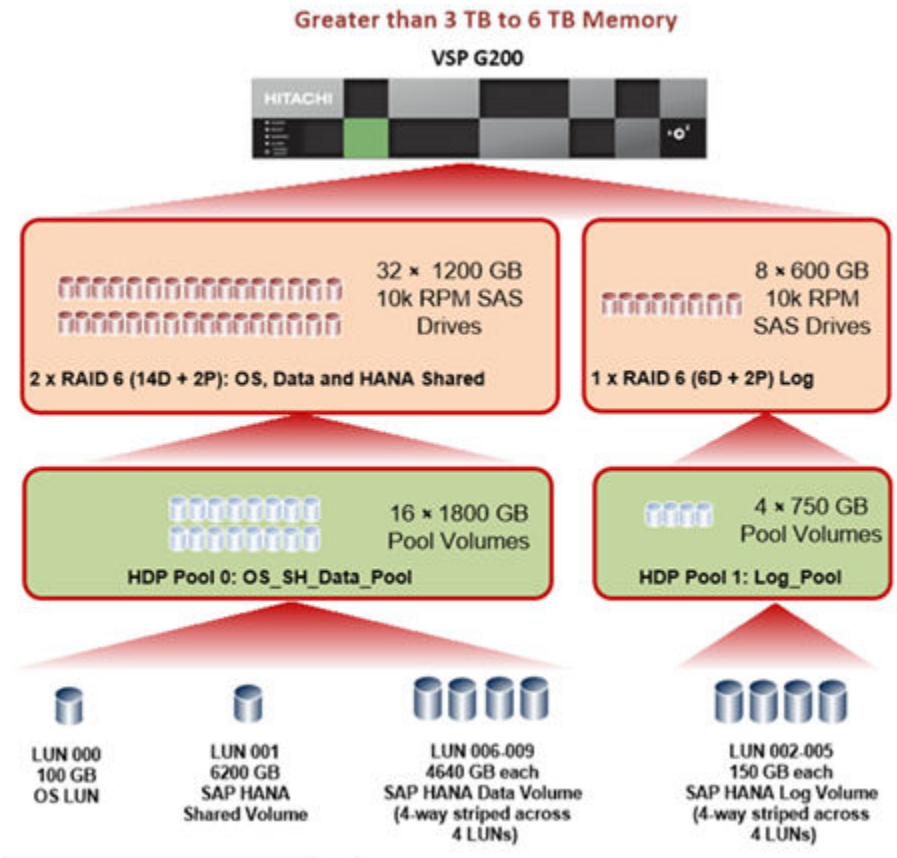
The storage configuration includes the following for different sizes:

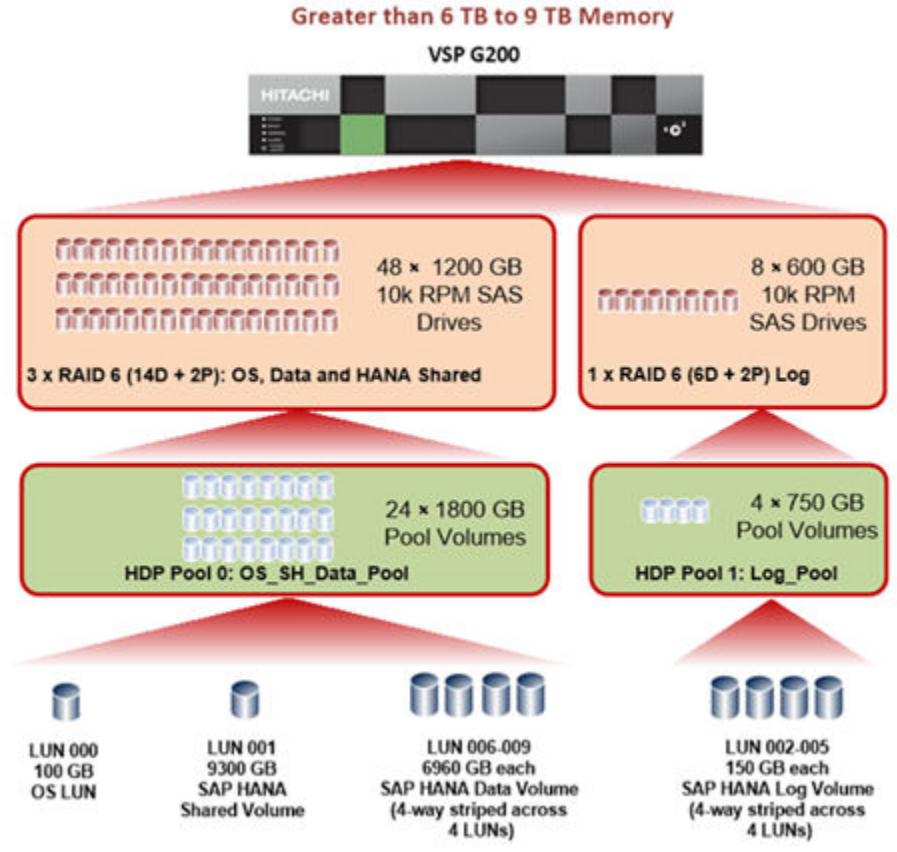
- Operating system volume (OS)
- SAP HANA shared volume (/hana/shared)
- SAP HANA log volume (/hana/log)
- SAP HANA data volume (/hana/data)

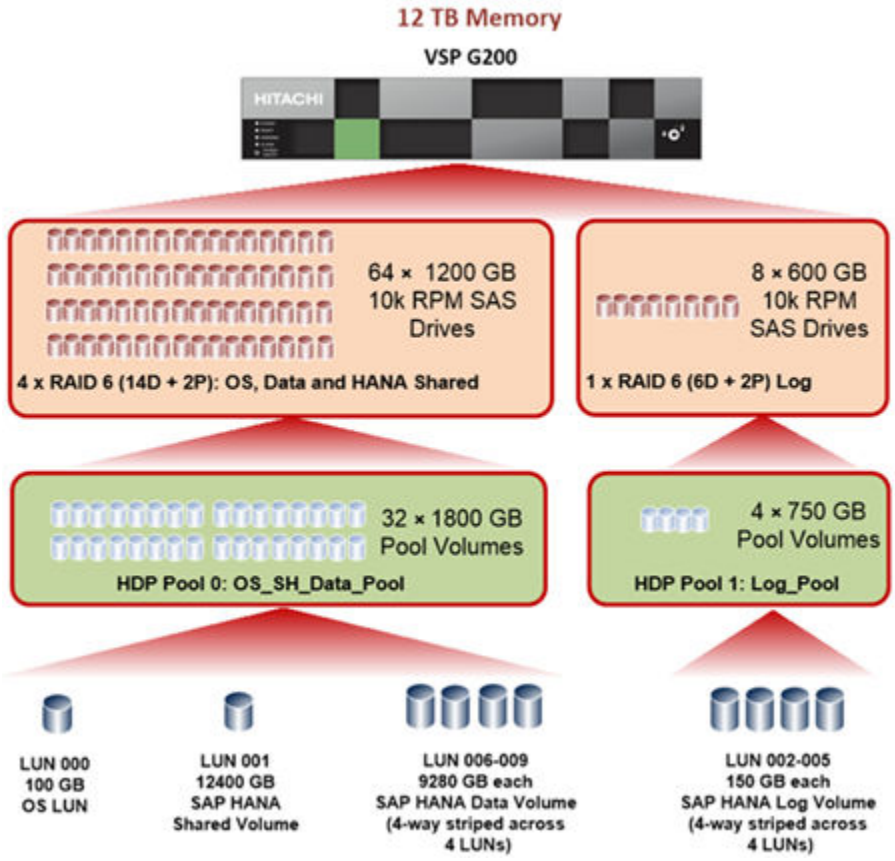
The following figures show the storage configuration for different memory sizes.

Memory sizes and figures using VSP G200

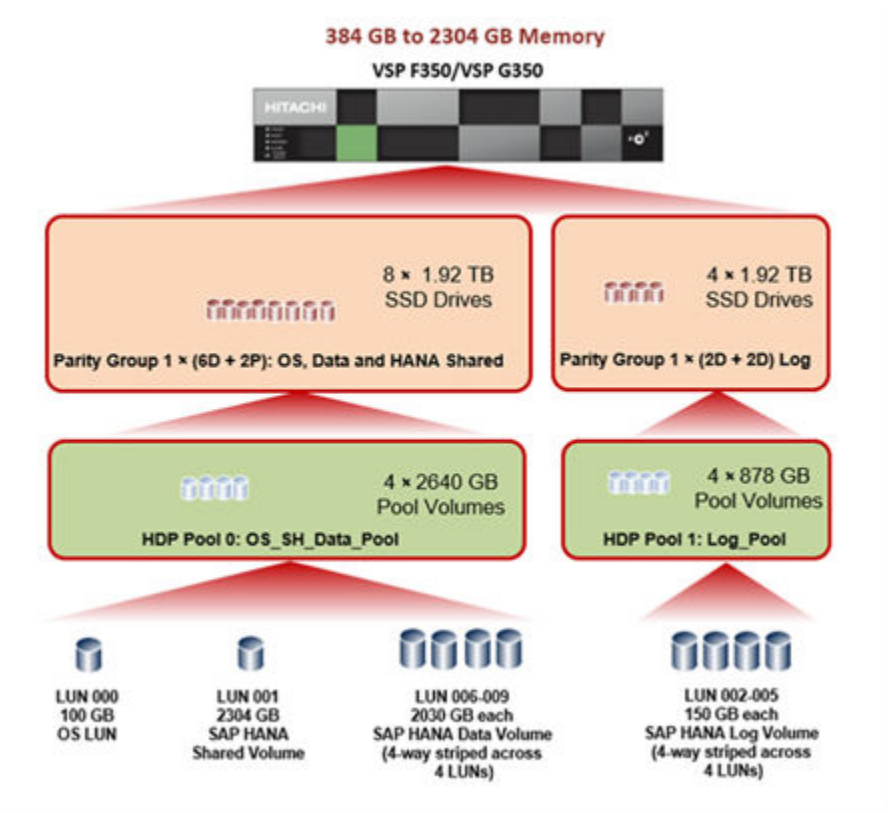


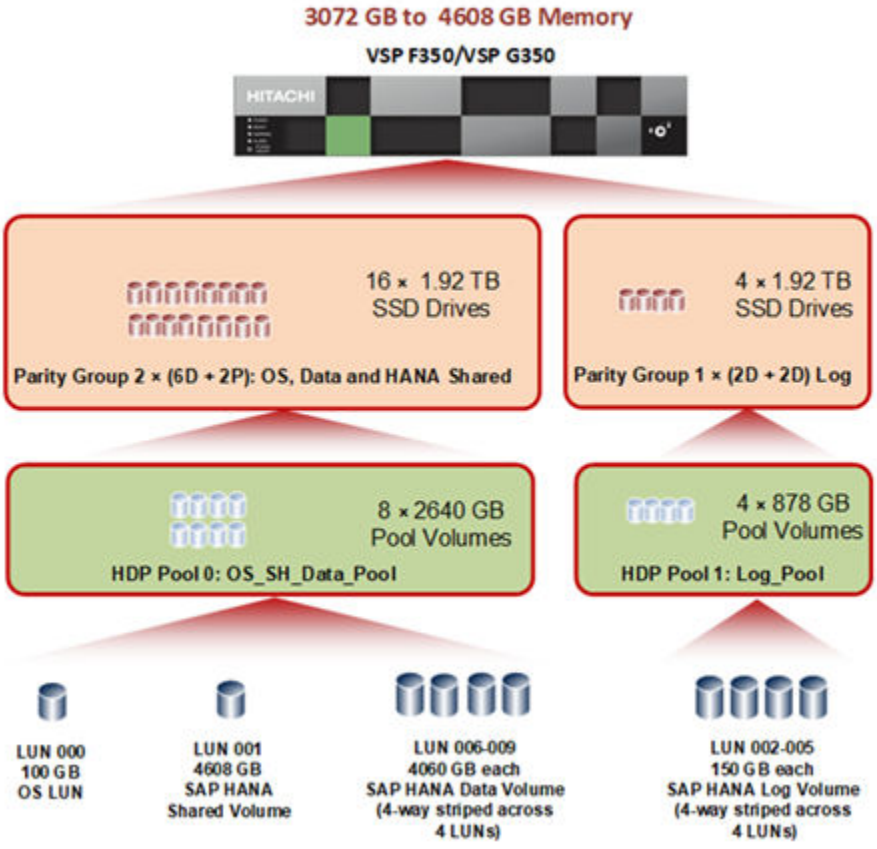

Greater than 3 TB to 6 TB Memory
VSP G200
HITACHI
32 × 1200 GB 10k RPM SAS Drives
2 x RAID 6 (14D + 2P): OS, Data and HANA Shared
8 × 600 GB 10k RPM SAS Drives
1 x RAID 6 (6D + 2P) Log
16 × 1800 GB Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 750 GB Pool Volumes
HDP Pool 1: Log_Pool
LUN 000 100 GB OS LUN
LUN 001 6200 GB SAP HANA Shared Volume
LUN 006-009 4640 GB each SAP HANA Data Volume (4-way striped across 4 LUNs)
LUN 002-005 150 GB each SAP HANA Log Volume (4-way striped across 4 LUNs)

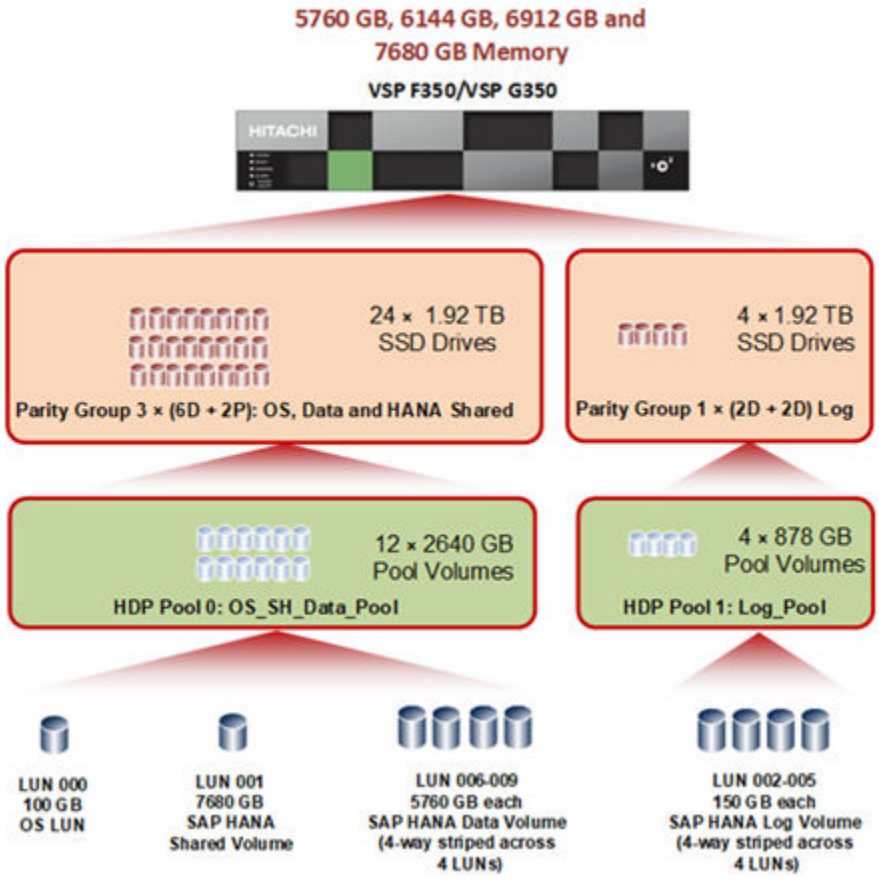

Greater than 6 TB to 9 TB Memory
VSP G200
HITACHI
48 × 1200 GB 10k RPM SAS Drives
3 x RAID 6 (14D + 2P): OS, Data and HANA Shared
8 × 600 GB 10k RPM SAS Drives
1 x RAID 6 (6D + 2P) Log
24 × 1800 GB Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 750 GB Pool Volumes
HDP Pool 1: Log_Pool
LUN 000 100 GB OS LUN
LUN 001 9300 GB SAP HANA Shared Volume
LUN 006-009 6960 GB each SAP HANA Data Volume (4-way striped across 4 LUNs)
LUN 002-005 150 GB each SAP HANA Log Volume (4-way striped across 4 LUNs)

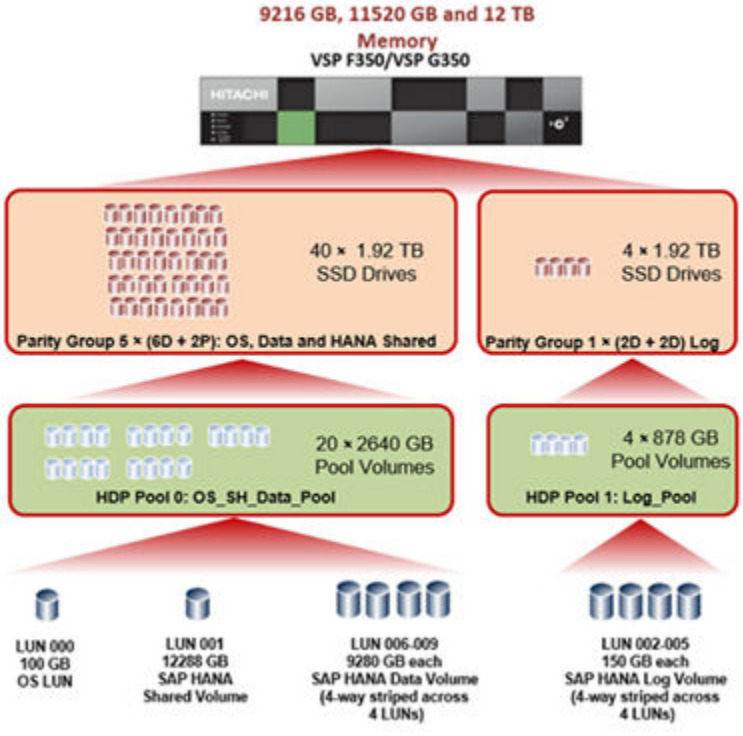

12 TB Memory
VSP G200
HITACHI
64 × 1200 GB
10k RPM SAS
Drives
4 x RAID 6 (14D + 2P): OS, Data and HANA Shared
8 × 600 GB
10k RPM
SAS Drives
1 x RAID 6 (6D + 2P) Log
32 × 1800 GB
Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 750 GB
Pool Volumes
HDP Pool 1: Log_Pool
LUN 000
100 GB
OS LUN
LUN 001
12400 GB
SAP HANA
Shared Volume
LUN 006-009
9280 GB each
SAP HANA Data Volume
(4-way striped across
4 LUNs)
LUN 002-005
150 GB each
SAP HANA Log Volume
(4-way striped across
4 LUNs)

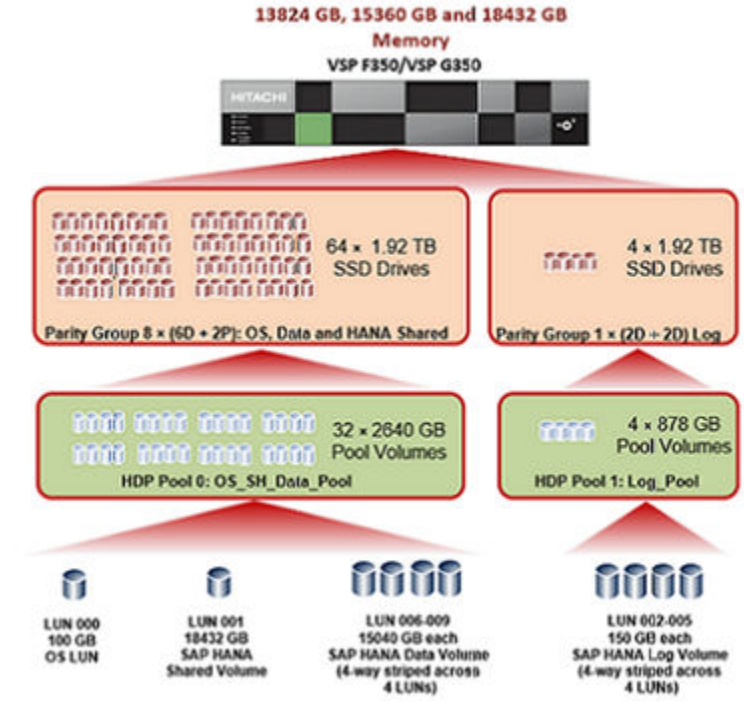
Memory sizes and figures using VSP F350/VSP G350

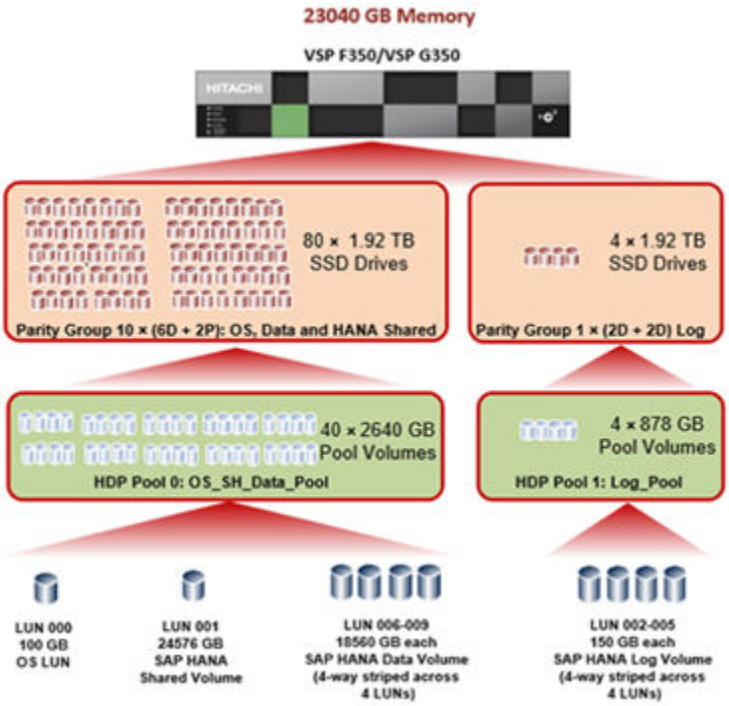





5760 GB, 6144 GB, 6912 GB and
7680 GB Memory
VSP F350/VSP G350
24 × 1.92 TB
SSD Drives
Parity Group 3 × (6D + 2P): OS, Data and HANA Shared
4 × 1.92 TB
SSD Drives
Parity Group 1 × (2D + 2D) Log
12 × 2640 GB
Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 878 GB
Pool Volumes
HDP Pool 1: Log_Pool
LUN 000
100 GB
OS LUN
LUN 001
7680 GB
SAP HANA
Shared Volume
LUN 006-009
5760 GB each
SAP HANA Data Volume
(4-way striped across
4 LUNs)
LUN 002-005
150 GB each
SAP HANA Log Volume
(4-way striped across
4 LUNs)


9216 GB, 11520 GB and 12 TB
Memory
VSP F350/VSP G350
40 × 1.92 TB
SSD Drives
Parity Group 5 × (6D + 2P): OS, Data and HANA Shared
4 × 1.92 TB
SSD Drives
Parity Group 1 × (2D + 2D) Log
20 × 2640 GB
Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 878 GB
Pool Volumes
HDP Pool 1: Log_Pool
LUN 000
100 GB
OS LUN
LUN 001
12288 GB
SAP HANA
Shared Volume
LUN 006-009
9280 GB each
SAP HANA Data Volume
(4-way striped across
4 LUNs)
LUN 002-005
150 GB each
SAP HANA Log Volume
(4-way striped across
4 LUNs)


13824 GB, 15360 GB and 18432 GB Memory
VSP F350/VSP G350
64 × 1.92 TB SSD Drives
Parity Group 8 × (6D + 2P): OS, Data and HANA Shared
4 × 1.92 TB SSD Drives
Parity Group 1 × (2D + 2D) Log
32 × 2640 GB Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 878 GB Pool Volumes
HDP Pool 1: Log_Pool
LUN 000 100 GB OS LUN
LUN 001 18432 GB SAP HANA Shared Volume
LUN 006-009 15040 GB each SAP HANA Data Volume (4-way striped across 4 LUNs)
LUN 002-005 150 GB each SAP HANA Log Volume (4-way striped across 4 LUNs)


23040 GB Memory
VSP F350/VSP G350
80 × 1.92 TB SSD Drives
Parity Group 10 × (6D + 2P): OS, Data and HANA Shared
4 × 1.92 TB SSD Drives
Parity Group 1 × (2D + 2D) Log
40 × 2640 GB Pool Volumes
HDP Pool 0: OS_SH_Data_Pool
4 × 878 GB Pool Volumes
HDP Pool 1: Log_Pool
LUN 000 100 GB OS LUN
LUN 001 24576 GB SAP HANA Shared Volume
LUN 006-009 18560 GB each SAP HANA Data Volume (4-way striped across 4 LUNs)
LUN 002-005 150 GB each SAP HANA Log Volume (4-way striped across 4 LUNs)

Hitachi Dynamic Provisioning Pool layout

This solution utilizes 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 the storage utilization.

Two pools are enough to provide storage and throughput for all supported storage sizes, as listed in the table.

- Use Pool 0 to create virtual volumes (vVols) for the operating system, data, and shared binaries. You can add additional parity groups and pool volumes to increase the size of Pool 0 to support larger memory configurations.
- Use Pool 1 to create virtual volumes for log.

Dynamic Provisioning Pool Name	Purpose	Parity Group RAID Level and Disks
OS_SH_Data_Pool	Operating system LUN SAP HANA shared LUN Data LUN	For VSP F350 or VSP G350: RAID-6 (6D+2P) on 1.92 TB, SSD drives For VSP G200: RAID-6 (14D+2P) on 1200 GB, SAS drives
Log_Pool	Log LUN	For VSP G350 or VSP G350: RAID-10 (2D+2D) on 1.92 TB, SSD drives For VSP G200: RAID-6 (6D+2P) on 600 GB, SAS drives

The example used for SAP HANA certification is minimal storage configuration on Hitachi Virtual Storage Platform F350 or VSP G350 in a scale-up appliance solution for SAP HANA with sizes ranging from 384 GB to 2304 GB memory, as follows:

- Logical devices layout
- Virtual volume for SAP HANA node
- LUN path assignment

The following table shows the logical devices layout.

Dynamic Provisioning Pool	Parity Group ID	Parity Group RAID Level and Disks	LDEV ID	LDEV Name	LDEV Size (GB)	MPU Assign-ment
OS_SH_Data_Pool	1	RAID-6 (6D+2P) on 1.92 TB SSD drives	00:00:01	OS_SH_DA_Pool_1	2640	MPU-10
			00:00:02	OS_SH_DA_Pool_2	2640	MPU-20
			00:00:03	OS_SH_DA_Pool_3	2640	MPU-10
			00:00:04	OS_SH_DA_Pool_4	2640	MPU-20
Log_Pool	2	RAID-10 (2D+2D) on 1.92 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

The following table shows the virtual volume information for SAP HANA nodes.

Dynamic Provisioning Pool	Virtual Volume ID	Virtual Volume Name	Virtual Volume Size	MPU Assign-ment
OS_SH_Data_Pool	00:02:00	HANA_OS	100 GB	MPU-10
	00:02:01	HANA_SH	2304 GB	MPU-20
Log_Pool	00:02:02	HANA_LOG_1	150 GB	MPU-10
	00:02:03	HANA_LOG_2	150 GB	MPU-20
	00:02:04	HANA_LOG_3	150 GB	MPU-10
	00:02:05	HANA_LOG_4	150 GB	MPU-20
OS_SH_Data_Pool	00:02:06	HANA_DATA_1	2030 GB	MPU-10
	00:02:07	HANA_DATA_2	2030 GB	MPU-20
	00:02:08	HANA_DATA_3	2030 GB	MPU-10
	00:02:09	HANA_DATA_4	2030 GB	MPU-20

The following table shows the LUN path assignments.

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

This describes how to configure SAP HANA in this solution for the following:

- DRAM with Intel Optane DC Persistent Memory
- DRAM only

File system

The implementation of this solution uses an external storage subsystem:

- BTRFS Filesystem
  - Operating system volume
- XFS Filesystem
  - For DRAM with Intel Optane DC Persistent Memory
    - SAP HANA shared volume
    - Data volume
    - Log volume
    - Persistent memory volume

    Note: Intel Optane DC Persistent Memory in this solution is considered as a persistent memory and mounted under Linux as a regular disk using "Direct Access" (DAX) for device mount option.
  - For DRAM only
    - SAP HANA shared volume
    - Data volume
    - Log volume

Device-mapper multipath

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

SAP HANA software installation

After configuring the file system 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:

- Database
- Client

Engineering validation using Intel Skylake CPUs

The test methodology for validating the appliance configuration using Hitachi Advanced Server DS7000 series on enterprise storage configuration with Hitachi Virtual Storage Platform F350, VSP G350, and VSP G200 used the following:

- SAP HANA Hardware Configuration Check Took (HWCCT) using FSPERF revision hwcct-212_5 was tested on these volumes for SLES 12 SP3, SLES 12 SP4, RHEL 7.4, and RHEL 7.6:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-046_0) was tested on these volumes for SLES 15 SP1:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-055_0) was tested on these volumes for RHEL 8.2:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-060_0) was tested on these volumes for SLES 15 SP3 and RHEL 8.4:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-065_0) was tested on these volumes for SLES 15 SP4 and RHEL 8.6:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-074_0) was tested on these volumes for SLES 15 SP5 and RHEL 8.8:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-077_0) was tested on these volumes for SLES 15 SP5 and RHEL 9.2:
  - Data volume
  - Log 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.

Engineering validation using Intel Cascade Lake CPUs

The test methodology for validating the appliance configuration using Hitachi Advanced Server DS7000 series with DRAMs on enterprise storage configuration with Hitachi Virtual Storage Platform F350 or VSP G350 used the following:

- SAP HANA Hardware Configuration Check Tool (HWCCT) using FSPERF revision hwcct-212_5 was tested on these volumes for SUSE Linux Enterprise Server 12 SP4, SUSE Linux Enterprise Server 15 SP1, and Red Hat Enterprise Linux 7.6:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-047_0) was tested on these volumes for Red Hat Enterprise Linux 8.1:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-055_0) was tested on these volumes for SLES 15 SP2 and RHEL 8.2:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-060_0) was tested on these volumes for SLES 15 SP3 and RHEL 8.4:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-065_0) was tested on these volumes for SLES 15 SP4 and RHEL 8.6:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-074_0) was tested on these volumes for SLES 15 SP5 and RHEL 8.8:
  - Data volume
  - Log volume
- SAP HANA Hardware and Cloud Measurement Tools (HCMT-077_0) was tested on these volumes for SLES 15 SP5 and RHEL 9.2:
  - Data volume
  - Log 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 SUSE Linux Enterprise Server global.ini file

The following is a sample *global.ini* file configured and used for validation on the listed SLES releases.

Using first generation Intel Xeon scalable processors

The following is a sample *global.ini* file configured and used for validation of a system using first generation Intel Xeon scalable processors.

SLES 12 SP3, SLES 12 SP4, SLES 15 SP1, SLES 15 SP2, SLES 15 SP3, SLES 15 SP4, and SLES 15 SP5

```
[communication] tcp_backlog = 2048
[fileio] max_parallel_io_requests[data] = 64
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] = 64
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
```

Using second generation Intel Xeon scalable processors

The following is a sample *global.ini* file configured and used for validation of a system using second generation Intel Xeon scalable processors.

SLES 15 SP4 and SLES 15 SP5

```
[communication] tcp_backlog = 2048

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

```
min_submit_batch_size[log] = 16
async_write_submit_blocks[log] = all
async_write_submit_active[log] = on async_read_submit[log] = on

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

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

SLES 15 SP3

```
[communication] tcp_backlog = 2048

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

async_write_submit_active[log] = on async_read_submit[log] = on

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

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

SLES 12 SP4, SLES 15 SP1, and SLES 15 SP2

```
[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] = on
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] = on

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

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

Sample RedHat Enterprise Linux Server global.ini file

The following is a sample *global.ini* file configured and used for validation on the listed RHEL releases:

Using first generation Intel Xeon scalable processors

The following is a sample *global.ini* file configured and used for validation of a system using first generation Intel Xeon scalable processors.

RHEL 7.4 and RHEL 7.6

```
[communication]
tcp_backlog = 2048

[fileio]
max_parallel_io_requests[data] = 64
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] = 64
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
```

RHEL 8.2, 8.4, and 8.6

```
[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] = on
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] = on

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

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

RHEL 8.8 and RHEL 9.2

```
[communication]
tcp_backlog = 2048
sslMinProtocolVersion=tls12

[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] = 128
```

```
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] = 128
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

[system_replication_communication]
enable_ssl=off

[ldap]
sslMinProtocolVersion=tls12
```

Using second generation Intel Xeon scalable processors

The following is a sample *global.ini* file configured and used for validation of a system using second generation Intel Xeon scalable processors.

RHEL 7.6 and RHEL 8.1

```
[communication]
tcp_backlog = 2048

[fileio]
max_parallel_io_requests[data] = 64
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] = 64
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
```

RHEL 8.2, 8.4, and 8.6

```
[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] = on
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] = on

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

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

RHEL 8.8 and RHEL 9.2

```
[communication]
tcp_backlog = 2048
sslMinProtocolVersion=tls12

[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] = 128
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] = 128
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

[system_replication_communication]
enable_ssl=off

[ldap]
sslMinProtocolVersion=tls12
```

Product descriptions

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

Hitachi Advanced Server DS7000 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. Hitachi Advanced Server DS7000 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 Advanced Server DS7000 series has several complementary models, each based on the 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 F Series family

Use Hitachi Virtual Storage Platform F series family storage for a flash-powered cloud platform for your mission critical applications. This storage meets demanding performance and uptime business needs. Extremely scalable, its 4.8 million random read IOPS allows you to consolidate more applications for more cost savings.

Hitachi Virtual Storage Platform F series family delivers superior all-flash performance for business-critical applications, with continuous data availability.

Hitachi Virtual Storage Platform G series family

The Hitachi Virtual Storage Platform G series family enables the seamless automation of the data center. It has a broad range of efficiency technologies that deliver maximum value while making ongoing costs more predictable. You can focus on strategic projects and consolidating more workloads while using a wide range of media choices.

The benefits start with Hitachi Storage Virtualization Operating System RF. This includes an all new enhanced software stack that offers up to three times greater performance than our previous midrange models, even as data scales to petabytes.

Hitachi Virtual Storage Platform G series offers support for containers to accelerate cloud-native application development. Provision storage in seconds, and provide persistent data availability, all the while being orchestrated by industry leading container platforms. Move these workloads into an enterprise production environment seamlessly, saving money while reducing support and management costs.

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 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) 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.

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