Hitachi Solution for the SAP HANA Platform using Intel Xeon Scalable Processors and VMware vSphere

Reference Architecture Guide

Feedback

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Revision history

Revision	Changes	Date
MK-SL-112-03	Update to include ESXi 7.0U2a	June 25, 2021
MK-SL-112-02	Updated Table 5	March 3, 2021
MK-SL-112-01	Update for CLX processors	July 6, 2020

Reference Architecture Guide

Use this reference architecture guide to design your implementation of Hitachi Solution for the SAP HANA platform using a converged solution for VMware vSphere . This scalable, converged infrastructure uses Hitachi Advanced Server DS 7000 series with a Hitachi storage system certified as SAP HANA enterprise storage. You will see Hitachi Virtual Storage Platform G700 (VSP G700) and VSP F700 in this guide, but you can use other certified storage from Hitachi.

SAP HANA tailored datacenter integration (TDI) offers great flexibility for SAP business solutions in production and non-production environments. This can be in bare metal or virtualized environments.

Hitachi Solution for SAP HANA with Intel Xeon scalable processors running on VMware vSphere 6.5, 6.7u3, and 7.0u2a follows the SAP HANA TDI guidelines. The supported VMWare ESXi version for SAP HANA can be found in SAP Note 2652670 (SAP user credentials required). It offers the power of SAP HANA while benefitting from the flexibility of a virtualized environment. It is ready to plug into your network to provide real-time access to operational data inside SAP HANA in your software-defined data center.

> 📄 **Note:** Testing of this configuration was in a lab environment. Many things affect production environments beyond prediction or duplication in a lab environment. Follow the recommended practice of conducting proof-of-concept testing for acceptable results in a non-production, isolated test environment that otherwise matches your production environment before your production implementation of this solution.

Solution overview

This solution uses the Hitachi Advanced Server DS 7000 series in a 2, 4, 6, or 8-socket configuration directly attached Hitachi Virtual Storage Platform G700 or other SAP-certified storage from Hitachi.

Implement and configure VMware ESXi 6.5, VMware ESXi 6.7u3, and VMware ESXi 7.0u2a following VMware and SAP best practices to guarantee best performance for SAP HANA running in a single or multiple virtual machine deployment.

Advanced Server DS 7000 series is certified as a scale-up appliance in various configurations running SUSE Linux Enterprise Server for SAP Applications 12 SP4 (or later) or Red Hat Enterprise Linux 7.6 (or later). For more details, see the Certified and Supported SAP HANA Hardware Directory.

VMware has certified vSphere 6.5, 6.7, and 7.0 on Intel Skylake SP and Intel Cascade Lake SP processors for virtualized SAP HANA deployments. See SAP Note 2393917.

Hitachi Virtual Storage Platform G700

Hitachi Advanced Server DS7000

LAN/WAN (Ethernet Switch)

——— 1 GbE Management Network
——— 10 GbE Client Network
——— Additional 10 GbE Network
——— 16 Gb/s Fibre Channel Connection
⬭ Mellanox Connect-4x LX 2-port 10GbE Network Card
⬭ Emulex LPE 31002 16 Gb/s PCIe HBA Card
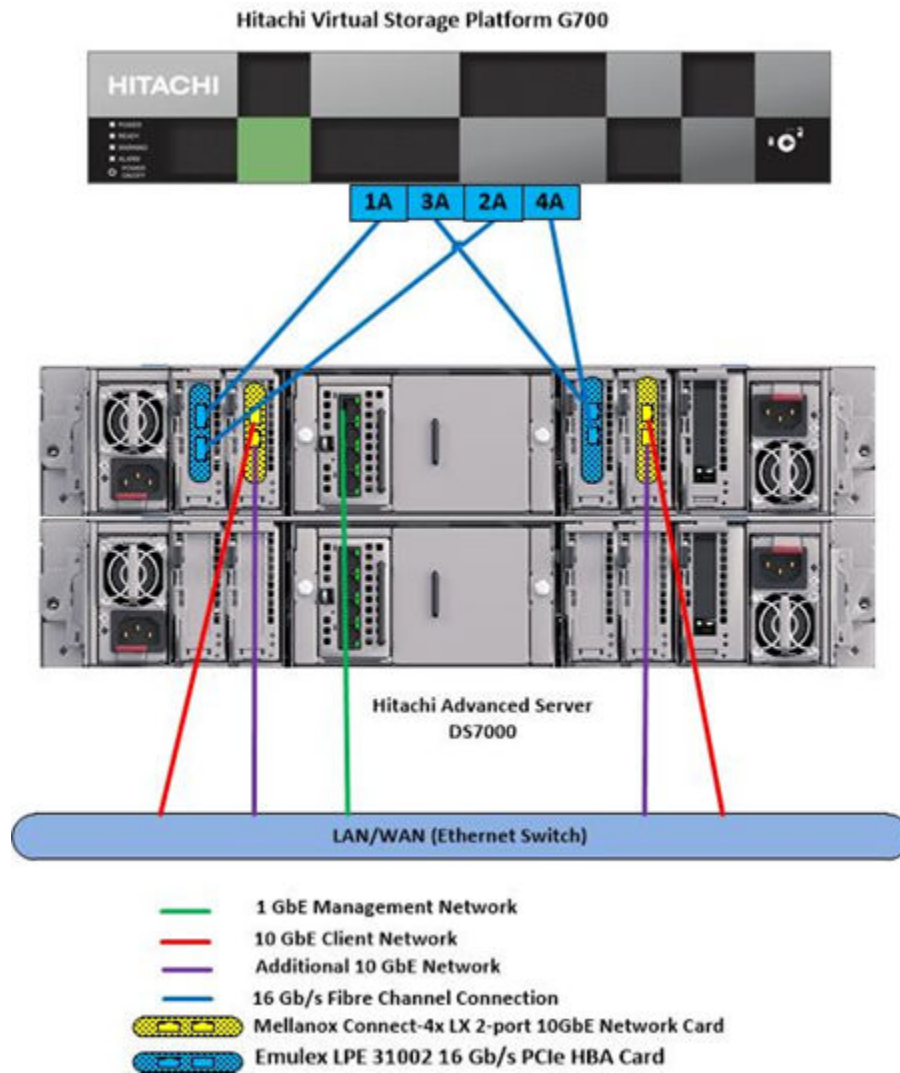
Key solution components

The key hardware and software elements of this virtualized SAP HANA solution are described in this chapter.

Hardware components

The converged infrastructure stack of Hitachi Advanced Server for SAP HANA follows the rules of SAP HANA TDI for virtualized environments. Leverage the flexibility of SAP HANA TDI for setups with multiple servers in a single environment using one SAP HANA-certified Hitachi enterprise storage system. This enables consolidated landscapes that guarantee equal performance and reliability as in bare metal appliances.

This reference architecture guide uses Hitachi Advanced Server DS 7000 series for running VMware vSphere to host SAP HANA. It also uses Hitachi Virtual Storage Platform G700 as persistent storage, although you can substitute other members of the Virtual Storage Platform G or the Virtual Storage Platform F series family if you have different needs.

Software components

This solution uses VMware ESXi 6.7u3/7.0U2a as a hypervisor but other supported versions are usable. Red Hat Enterprise Linux and SUSE Linux Enterprise Server for SAP Applications are available as guest operating systems within the VMs for running SAP HANA. For more information, see the software compatibility guide.

Solution design

The detailed design for this scale-up configuration of Hitachi Solution for SAP HANA in this reference architecture guide includes the following:

- Hitachi Advanced Server DS 7000 series Configuration

- Network Architecture

- Storage Architecture

- VMware vSphere Configuration

- Guest Operating System Configuration

- SAP HANA Installation and Configuration

Hitachi Advanced Server DS 7000 series configuration

Hitachi Advanced Server DS 7000 series basic building block comprises the following:

- 2 processors with either of the following:
  - Intel Skylake SP
    - 28-core 8176, 8176M, or 8176L
    - 28-core 8180, 8176M, or 8176L
  - Intel Cascade Lake SP
    - 28-core 8276, 8276M, or 8276L
    - 28-core 8280, 8280M, or 8280L
- 12 memory DIMMs per CPU, 24 per compute module
- 5 IO server blades for PCIe adapters
- 4 native 1 GbE Ethernet ports

This compute module acts as master module. Other identical modules can be added as subordinate modules to add more resources.

Advanced Server DS 7000 series scales from 2 sockets to 8 sockets. See the following figure for the location of network and HBA cards.

Hitachi Advanced Server DS7000 (Front)

Hitachi Advanced Server DS7000 with external Storage (Back)

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

 Emulex LPE 31002 16 Gb/s PCIe HBA Card

Possible memory configurations

For bare metal and virtualized environments, the memory configurations listed in the following table are supported on Hitachi Advanced Server DS 7000 series when running SAP HANA. Mixed DIMM configurations are also marked.

Controller	0						1						Total RAM per 2-socket Module (GB)
Channel	0		1		2		0		1		2		
DIMM slot													
DIMM size	1	2	3	4	5	6	7	8	9	10	11	12	
32 GB	32		32		32		32		32		32		384
32 GB	32	32	32	32	32	32	32	32	32	32	32	32	768
64 GB	64		64		64		64		64		64		768
32/64 GB (Mixed DIMM)	64	32	64	32	64	32	64	32	64	32	64	32	1152
64 GB	64	64	64	64	64	64	64	64	64	64	64	64	1536
128 GB	128		128		128		128		128		128		1536
64/128 GB (Mixed DIMM)	128	64	128	64	128	64	128	64	128	64	128	64	2304
128 GB	128	128	128	128	128	128	128	128	128	128	128	128	3072

Memory DIMM population rules apply for all servers with Intel Xeon Scalable CPUs:

- Homogeneous population of the same DIMM type (LR DIMMs, RDIMMs, 3DS)

- DIMM sizes are according to the previous table for Advanced Server DS 7000 series

- DIMMs validated by Hitachi according to Intel's memory validation matrix

Network architecture configuration

Connect the 1 GbE management port of the Hitachi Advanced Server DS 7000 series server to a Cisco Nexus 3048 switch or to any other external 1 GbE switch for management connectivity, as shown in the following figure. This reference architecture guide uses Cisco Nexus switches.
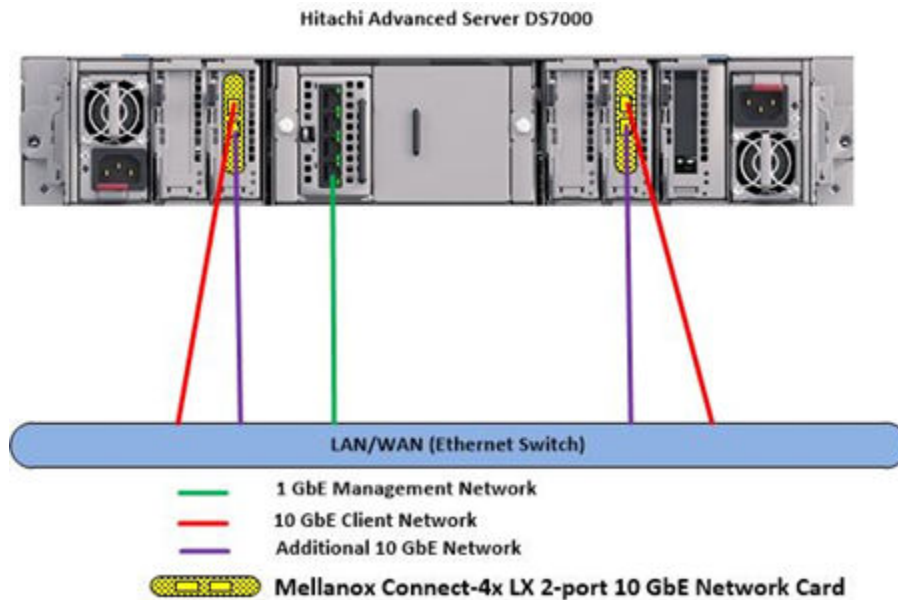
Make the following 10 GbE network connections for the Hitachi Advanced Server DS 7000 series server:

- Connect the following to Cisco Nexus 93180YC-EX switches or to any other external switches:

  - Connect Port 0 of both 10 GbE Mellanox Connect-4x LX PCIe cards to two different Cisco Nexus 93180YC-EX switches.

  - Configure the corresponding two ports at the VMware ESXi level as uplinks in the virtual standard switch (VSS). Configure both vmnics as active. Use these two ports as the management network for the ESXi node as well as the network for the guest operating system. This acts as the client network for the SAP HANA node.

  - At installation, the field engineer from Hitachi Vantara works with your VMware vCenter administrator to convert, merge, and migrate the VSS to your existing or new virtual distributed switch.

    Optional— At this point, to speed up detecting corrupted connections, configure external switch ports with a port channel set to active/active as well as setting the LACP timeout value to short. On VDS, use vLAGs instead of uplinks.

- If you require additional 10 GbE network connections, connect Port 1 of both 10 GbE Mellanox Connect-4x LX PCIe cards to the Cisco Nexus 93180YC-EX switches or to any other external switches.

- For all sizes, use PCIE Slot 1 and Slot 3 of the master module as uplinks in the VSS. All other slots and ports can be used as you want, such as the following examples:

  - Extra management kernel ports

  - Extra virtual machine traffic

  - VMware vSphere vMotion

  - Backup

  - SAP HANA System Replication

Network Card	Port	Network Description
PCIe_Slot_1 of Master Module	0	VMware ESXi kernel and virtual machine traffic
	1	Free for use
PCIe_Slot_3 of Master Module	0	VMware ESXi kernel and virtual machine traffic
	1	Free for use
Optional 10 GbE Mellanox Connect-4x LX PCIe cards of subordinate modules	0 and 1	Free for use

📄 **Note:** The ESXi kernel network and virtual machine traffic can be on the same network switch or on separate network switches. It depends on the network environment.

In case of high load network requirements, optional 10 GbE cards can be added to free PCIe slots of the subordinate modules on Hitachi Advanced Server DS 7000 series.

Storage architecture

This is the storage architecture and configuration for this solution:

- Hitachi Virtual Storage Platform G700 Setup and Configuration
- Parity Group, RAID, and LUN Configuration

Hitachi Virtual Storage Platform G/VSP F series family setup and configuration

These are the storage components you need to implement a scale-up SAP HANA system with the Hitachi Advanced Server DS 7000 series server using any Hitachi Virtual Storage Platform G/VSP F series family system, such as Virtual Storage Platform G700:

- 2 × 2-port Emulex LPE31002-M6 16 Gb/s PCIe HBA cards
- 1 Hitachi Virtual Storage Platform G series family system, such as Virtual Storage Platform G700
- Storage drive box trays (DBS)
- Spare drives

The following are mandatory for direct connection between the Virtual Storage Platform system and the Emulex HBA on Advanced Server DS 7000 series, as shown in the following figure:

- Use System Mode 847 on the storage system.
- Enable Host Mode Option 94 for the corresponding storage port connected to the server.
- Host Group ID must be 00 for SAN boot.

Hitachi Virtual Storage Platform G700

Hitachi Advanced Server DS7000

─── 16 Gb/s Fibre Channel Connection
Emulex LPE 31002 16 Gb/s PCIe HBA Card
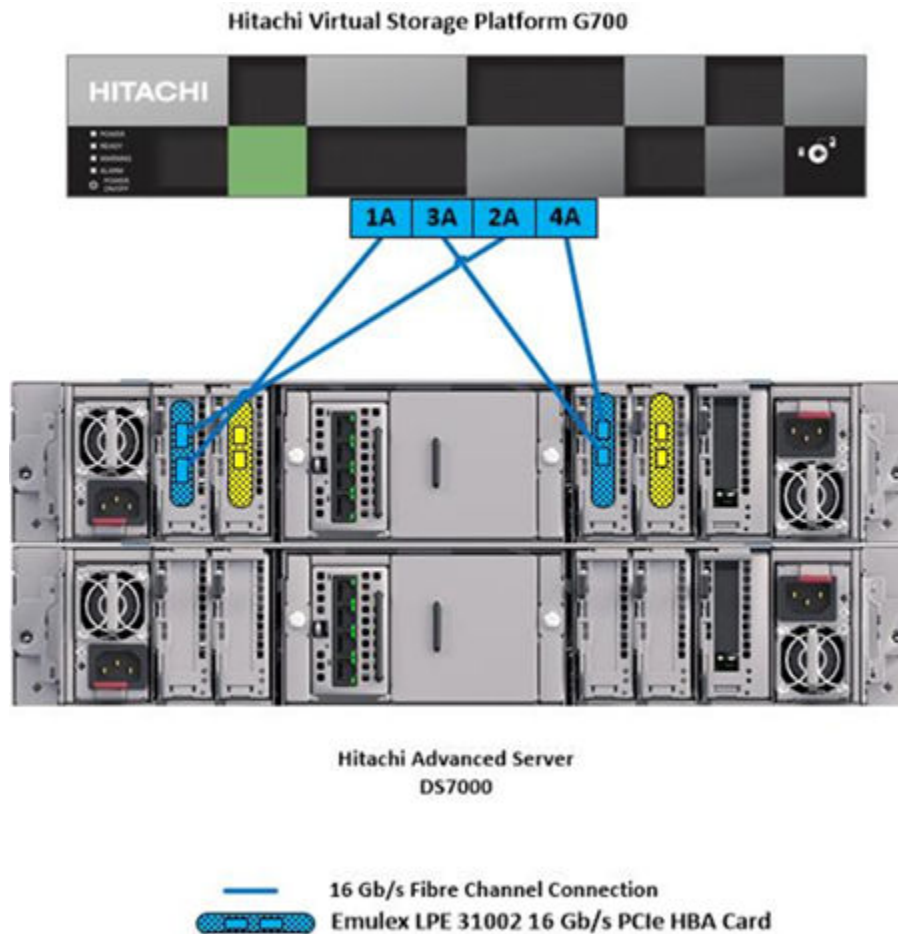
Without setting up this option, SAN storage cannot be identified from the Emulex HBA. Also, make sure to use the port properties listed in the following table.

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

Parity group, RAID, and Lun configuration

This reference architecture utilizes a dynamic provisioning pool design for the storage layout that ensures maximum utilization and optimization at a lower cost for Hitachi Solution for SAP HANA using VMware vSphere.

This is the configuration of parity groups, RAID level, and LUNs. Use two dynamic provisioning pools with the specific parity groups and LDEV assignment listed in the following table for the storage layout.

Parity Group	RAID Level and Disks	LDEV ID	LDEV Size	MPU ID	Description
1	RAID-6 (6D+2P) on 1.92 TB, SSD drives	0:00:00	2.6 TB	MPU10	Used for OS_SH_DATA Pool
		0:00:01	2.6 TB	MPU10	
		0:00:02	2.6 TB	MPU20	
		0:00:03	2.6 TB	MPU20	
2	RAID-10 (2D+2P) on 1.92 TB, SSD drives	0:00:04	1.5 TB	MPU10	Used for LOG Pool
		0:00:05	1.5 TB	MPU 20	

The example layout uses the dynamic provisioning pool layout on Virtual Storage Platform G700 for a DS7000 server with up to 3 TB RAM. On these dynamic provisioning pools, create DP-VOLs with the assignment as shown in the following table.

For sizes larger than 3 TB or for hosting more virtual machines, add additional RAID groups to increase the size of the pools. Use and expand the same DP-VOLs with the additional RAID groups.

Dynamic Provisioning Pool	DP-VOL ID	DP-VOL Name	DP-VOL Size	MPU ID
OS_SH_DATA Pool	0:00:06	ESXi_host	256 GB	MPU10
	0:00:07	HANA_OS_VMFS	400 GB	MPU11
	0:00:08	HANA_SHARED_VMFS	3 TB	MPU20
	0:00:09	HANA_DATA_VMFS1	1.5 TB	MPU10
	0:00:10	HANA_DATA_VMFS2	1.5 TB	MPU11
	0:00:11	HANA_DATA_VMFS3	1.5 TB	MPU20
	0:00:12	HANA_DATA_VMFS4	1.5 TB	MPU21
LOG Pool	0:00:13	HANA_LOG_VMFS1	768 GB	MPU10
	0:00:14	HANA_LOG_VMFS2	768 GB	MPU11
	0:00:15	HANA_LOG_VMFS3	768 GB	MPU20
	0:00:16	HANA_LOG_VMFS4	768 GB	MPU21

For the DP-VOL assignment, use the host IDs defined in the following table to configure host groups on the Hitachi Virtual Storage Platform G/VSP F series family system. To support high availability, each LUN has multiple paths from the host to multiple ports on Virtual Storage Platform.

Connect all ports of the Emulex LPE31002-M6 16 Gb/s PCIe HBA cards to the storage unit, as shown in the following table.

HBA Card	Port	VSP G Series Family Port
PCIe_Slot_2 of Master Module	0	1A
PCIe_Slot_2 of Master Module	1	2A
PCIe_Slot_4 of Master Module	0	3A
PCIe_Slot_4 of Master Module	1	4A

In multi-virtual machine environments, you may require additional HBA cards to guarantee storage performance for all virtual machines. Add these to the PCIe slots of the subordinate modules of Hitachi Advanced Server DS 7000 series and direct attached to free ports on the Virtual Storage Platform G/VSP F series family storage.

VMware vSphere configuration

This covers configuration of the VMware ESXi server, SAP's requirements, and possible virtual machine configurations.

VMware provides a patch that affects the sizing of the virtual machines discussed later in this reference architecture guide.

- Mitigating the Sequential-Context attack vector by patching and updating VMware vSphere does not have a significant impact of performance.

- The ESXi Side-Channel-Aware Scheduler patch does not allow the usage of more than one thread per physical CPU core. This limits the number of vCPUs available on a system. It can impact performance on existing systems and sizing of new systems.

Enabling the patch with the ESXi Side-Channel-Aware Scheduler affects the sizing of virtual machines. When activated, it can successfully mitigate this vulnerability, however, at the cost of not using hyperthreads and thus impacting performance. VMware has summarized the performance impact of enabling the patches in KB55767.

For the SAP HANA workload in the virtual machines, SAP does not allow overcommitting CPU resources. Consider this when sizing virtual machines and determining the required compute hardware resources.

The following table lists the minimum and maximum sizes for virtual machines running an SAP HANA workload.

Configuration	Size
Minimum virtual machine size	0.5-socket with at least 8 physical cores (16 vCPUs with HT) and 128 GB RAM
Maximum virtual machine size	128v CPUs on 4-socket virtual machine size and 6 TB RAM with vSphere 6.5/6.7/6.7u1/7u2a 224 vCPUs* on 4-socket virtual machine size and 6 TB RAM with vSphere 6.7u3/7u2a
Sub-socket virtual machine sizes	0.5-socket No support for virtual machines with 1.5 sockets, 2.5 sockets, and so forth.
Full-socket virtual machine sizes	1-, 2-, 3-, and 4-socket
Maximum number of virtual machines	4 virtual machines per 2-socket server 16 virtual machines per 8-socket server

These are the SAP general sizing guidelines for virtualized environments, with respect to storage, CPU, and memory requirements of SAP HANA.

In addition to the general guidelines, the 0.5-socket virtual machines and OLAP workload on SAP HANA, require an additional 14% more CPU resources to provide additional headroom for high load situations on both virtual machines sharing the CPU socket.

When creating single or multi-virtual machine environments on a VMware ESXi server, some memory must be reserved for the ESXi server itself. Do not assign all available physical memory to the virtual machines. According to VMware's guidance, this memory overhead can be between 0.5% and a more conservative 3%. For example, on a Hitachi Advanced Server DS7000 with 4096 GB of RAM, assign up to 4080 GB to virtual machines.

SAN Operating system boot configuration

This solution configuration requires SAN boot. It uses one 256 GB LUN from the Hitachi Virtual Storage Platform G-series family systems as the operating system volume to host the hypervisor.

The Emulex LPE31002-M6 16 Gb/s PCIe HBA cards have the 256 GB ESXi LUN configured as the primary boot device. Install VMware vSphere ESXi on this LUN.

Activate round robin multipathing policy

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

Use the round robin multipathing policy for the following I/O paths:

- ESXi operating system LUN

- SAP HANA server operating system LUN

- SAP HANA data volume LUN

- SAP HANA log volume LUN

- SAP HANA shared volume LUN

Virtual machine configuration parameters

VMware releases best practices for configuring the VMware ESXi server when running an SAP HANA workload that results from the certification together with SAP to ensure that all performance requirements for SAP HANA are met.

When provisioning virtual machines for SAP HANA, make sure to use hyperthreads on fewer NUMA nodes instead of only physical CPU cores spread over multiple NUMA nodes.

Also, add or change the parameters on the virtual machines as listed in the following table.

For This	Use This
monitor.halt_in_monitor	TRUE
monitor.idleLoopSpinBeforeHalt	TRUE
tools.guestlib.enableHostinfo	TRUE
numa.nodeAffinity	i.e.: 0,1
disk.EnableUUID	TRUE

Multiple virtual machine configurations

When running this solution in a single-virtual machine configuration, a Hitachi Advanced Server DS 7000 series with 4 CPUs provides enough resources to run a virtual machine with the maximum possible 224 vCPUs.

A setup with multiple virtual machines may soon require a server with more CPU and memory resources likeAdvanced Server DS 7000 series with either 6 CPUs or 8 CPUs.

Depending on the number of virtual machines as well as the requirements of the SAP HANA installation inside these virtual machines, further storage resources can become necessary. Contact your Hitachi Vantara account team to size storage for all SAP HANA-certified enterprise storage units.

Sizing is available for SAS drives, SSD drives, and Hitachi Accelerated Flash devices for the maximum number of SAP HANA nodes in the SAP HANA Certified Hardware Directory. For virtualized environments, one virtual machine counts as one SAP HANA node, according to SAP requirements.

In a single server environment, the maximum number of virtual machines is 16 when using only 0.5-socket virtual machines on an 8-socket server. However, this sizing is also valid for running multiple ESXi servers connected to one Hitachi storage system.

SAP HANA Tailored Data Center Integration on Hitachi Virtual Storage Platform G Series and VSP F Series with Hitachi Storage Virtualization Operating System Reference Architecture Guide (PDF) provides insight in best practices for Hitachi storage in SAP HANA TDI environments.

According to SAP Note 2393917, SAP and VMware support a co-deployment of production and non-production virtual machines on the same server. It is also possible to separate the production and non-production SAP HANA virtual machines on different servers but connect both servers to the same storage system.

Non-production virtual machines do not have the same performance requirements as production virtual machines. SAP gives no performance guarantee for non-production SAP HANA installations.

However, in both cases, you must ensure that the production SAP HANA instances and virtual machines are not negatively impacted by the non-production systems running in parallel.

Guest operating system configuration

The following are supported as guest operating systems for the virtual machines in Hitachi Advanced Server DS 7000 series:

▪ SUSE Linux Enterprise Server for SAP Applications 12 SP4 or later

▪ Red Hat Enterprise Linux 7.6 or later

Changing the configuration settings is only supported along the guidelines from SAP and the operating system distributor. Otherwise, changes can 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

▪ 2235581 – SAP HANA: Supported Operating System

The initially delivered configuration of the operating system should persist. Do not make any modifications to the operating system, except as noted or approved by SAP.

SAP HANA installation and configuration

This describes the SAP HANA configuration on the scale-up configuration for Hitachi Solution the SAP HANA on VMware vSphere.

Operating system boot configuration

This virtualized SAP HANA configuration requires SAN boot. Carve out one 100 GB VMDK for the SAP HANA operating system, including the */usr/sap/* directory for files related to the SAP application.

SAP HANA volume configuration

Use the following DP-VOLs for the SAP HANA virtual machine configuration on the Hitachi Virtual Storage Platform G-series family system to configure the following:

- Four 2.6 TB DP-VOLs to create:

  - Four 1.5 TB VMFSs for SAP HANA data volumes

  - One 3 TB VMFS for SAP HANA shared volume

- Four 768 GB DP-VOLs to create four 768 GB VMFSs for SAP HANA log volumes

The logical volume manager (LVM) configures the SAP HANA persistent storage volumes from virtual machines. With four VMDKs for the SAP HANA log, the LVM creates a single 4-way striped volume on which to create the XFS file system to store the SAP HANA log volumes. Similarly, do this for the SAP HANA data volumes.

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

SAP HANA software installation

After configuring the file system for the SAP HANA data volume and log volume, install the latest SAP HANA Datacenter Service Point (DSP) stack on the SAP HANA server, upgraded to the required SAP HANA revision.

Install the following SAP HANA software components on the SAP HANA node for VMware vSphere server:

- SAP HANA database

- SAP HANA client

- SAP Host agent

Configuration file settings (global.ini)

For optimal use of the system with an SAP HANA database, use the parameters listed in one of these global.ini files for your operating system release. Follow SAP Note 2399079 to setup these parameters defined in global.ini for SAP HANA 2.0.

- Red Hat Enterprise Linux 7.6/8.1 operating system

  Use this global.ini configuration file with a solution using Red Hat Enterprise Linux 7.6/8.1 for an operating system.

```
[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/HIQ
basepath_logvolumes = /hana/log/HIQ
```

- SUSE Enterprise Linux 12 SP4 or SUSE Enterprise Linux 15 SP1 operating system

  Use this global.ini configuration file with a solution using SUSE Enterprise Linux 12 SP4 or SUSE Enterprise Linux 15 SP1 operating system for an operating system.

```
[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/HIQ
basepath_logvolumes = /hana/log/HIQ
```

Engineering validation

The test methodology validated the appliance configuration of Hitachi Advanced Server DS 7000 series with an enterprise storage configuration on Hitachi Virtual Storage Platform G700 used SAP HANA Hardware Cloud Measurement Tool (HCMT) with revision 055 tested on the following:

- Data volume
- Log volume

Product descriptions

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

Hitachi Advanced Server DS 7000 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 DS 7000 series 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 DS 7000 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.

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 <u>download more information</u>, 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.

<u>SAP HANA hardware directory</u> provides information about SAP HANA appliances certified by SAP hardware partners.

SAP HANA Tailored Data Center Integration

SAP increases flexibility and provides an alternative to SAP HANA Appliances with SAP HANA tailored data center integration (TDI) in currently 5 phases. This includes many kinds of virtualization technology. Understanding the possibilities and requirements of an SAP HANA TDI environment is crucial. One of these requirements is that all virtualized environments for SAP HANA are considered as SAP HANA TDI by SAP. SAP provides documentation around SAP HANA TDI environments that explain the 5 phases of SAP HANA TDI as well as hardware and software requirements for the whole stack:

▪ <u>SAP Help Portal: SAP HANA Platform</u> (frequently asked questions)

▪ <u>SAP HANA Storage Requirements</u>

▪ <u>SAP HANA Network Requirements</u>

Taking all this into account, Hitachi offers a solution for the whole SAP HANA TDI stack from hardware infrastructure to software deployment.

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 <u>SUSE Linux Enterprise Server</u> 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 <u>Red Hat Enterprise Linux for SAP HANA</u>, 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:

▪ <u>1944799 - SAP HANA Guidelines for SLES Operating System Installation</u>

▪ <u>2009879 - SAP HANA Guidelines for Red Hat Enterprise Linux (RHEL) Operating System</u>

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

VMware vSphere

<u>VMware vSphere</u> is a virtualization platform that provides a datacenter infrastructure. It helps you get the best performance, availability, and efficiency from your infrastructure and applications. Virtualize applications with confidence using consistent management.

VMware vSphere has the following components:

- VMware vSphere ESXi

  This hypervisor loads directly on a physical server. ESXi provides a robust, high-performance virtualization layer that abstracts server hardware resources and makes them shareable by multiple virtual machines.

- VMware vCenter Server

  This management software provides a centralized platform for managing your VMware vSphere environments so you can automate and deliver a virtual infrastructure with confidence:

  - VMware vSphere vMotion
  - VMware vSphere Storage vMotion
  - VMware vSphere Distributed Resource Scheduler
  - VMware vSphere High Availability
  - VMware vSphere Fault Tolerance

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