Hewlett Packard Enterprise

Best Practices Guide

SAP HANA on Hyperconverged Infrastructure with HPE ProLiant DL380 Gen11 server on VMware vSAN

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EXECUTIVE SUMMARY

SAP HANA® is a modern technology that offers an in-memory database, enables a radically different application architecture, and provides a new philosophy about data model simplicity. SAP HANA can be installed on bare-metal or virtual environments. For virtualization, SAP HANA-based applications require dynamic, reliable, and highly available architectures. VMware vSAN® is a software-defined storage solution, certified for SAP HANA, and offers the flexibility to build and operate application-driven storage configurations.

The HPE ProLiant DL380 Gen11 server is a scalable 2U 2P solution that delivers exceptional compute performance, memory density with scalability and high-speed data transfer rate to run your most demanding applications. The HPE ProLiant DL380 Gen11 server is engineered to optimize IT with a cloud operating experience, built-in security, and optimized performance for workloads to drive your business forward.

HPE ProLiant DL380 Gen11 server with VMware vSAN offers customers the flexibility to operate their SAP HANA landscape.

This document provides best practice guidelines for planning, preparing, and deploying SAP HANA on HPE ProLiant DL380 Gen11 server with VMware vSAN.

Target audience: This guide is intended for SAP administrators and architects, who design mission-critical SAP HANA systems to be deployed on HPE ProLiant DL380 Gen11 server with VMware vSAN. This document assumes the reader has a basic understanding of HPE ProLiant, VMware ESXi® and vSAN, and SAP HANA.

Document purpose: The purpose of this document is to describe the setup of HPE ProLiant DL380 Gen11 servers for running SAP HANA in a hyperconverged environment with VMware vSAN.

This Best Practices Guide describes solution testing and certification performed in June 2024.

OVERVIEW

HPE ProLiant DL380 Gen11 servers are engineered for your hybrid world. HPE ProLiant DL380 Gen11 servers simplify the way you control your business's compute—from edge to cloud—with a cloud operating experience.

The server, powered by 4th and 5th Gen Intel® Xeon® Scalable Processors, adds hardware and software-assisted security features, which secure the server hardware foundation on which critical apps run and better protect data in memory.

HPE ProLiant Gen11 servers continuously protect healthy landscape by providing rapid detection of security-compromised servers, even to the point of not allowing them to boot if it identifies and contains malicious code.

HPE ProLiant servers provide automated recovery from a security event, including restoration of validated firmware, and facilitating recovery of operating system, applications and data connections, providing the fastest path to bring a server back online and into normal operations.

Representative configuration

For a productive SAP HANA instance in a hyper-converged infrastructure (HCI) landscape, a minimum of three nodes is required (four nodes are recommended and up to 64 nodes are supported with ESXi 8.0 U2 and 8.0 U3), while one node is reserved for high availability. In addition, a management server for VMware vCenter Server is required. In this example, an external management server has been used.

For each compute node, a minimum of one disk group should be configured. More disk groups could be beneficial to improve the storage performance as the workload can be distributed across several disks. With vSAN, a maximum of five disk groups can be allocated per compute node.

One disk group consists of one caching disk and at least one capacity disk. The disks are directly located in the compute node.

This testing and certification have been done with VMware vSAN 8.0 with Original Storage Architecture (OSA).

NOTE
VMware vSAN with Express Storage Architecture (ESA) currently is not certified for HPE ProLiant DL380 Gen11 with SAP HANA HCI.

For details on VMware recommendations for vSAN configuration, see Create a Disk Group or Storage Pool in vSAN Cluster.

For a listing of the components included in the solution, see Appendix A: Bill of materials.

FIGURE 1 shows a HPE ProLiant DL380 Gen11 server. For an SAP HCI system, a minimum of three servers are required.



FIGURE 1. HPE ProLiant DL380 Gen11 server

HPE ProLiant DL380 Gen11 server requirements for SAP HANA HCI

HPE ProLiant DL380 Gen11 server with VMware vSAN is certified for SAP HANA HCI with the minimum hardware configuration and setup described in this document.

A minimum of three HCI-certified nodes are required for an SAP HANA HCI scenario.

Table 1 highlights the major components for HPE DL380 Gen11 Compute Modules.

TABLE 1. Components for HPE ProLiant DL380 Gen11 server

Components	Description
Processor	Intel® Xeon® Scalable processor (Sapphire Rapids) Platinum, Gold, and Silver
Memory per socket	Up to 2 TB
Network Card	Mellanox MCX631102AS-ADAT Ethernet 10/25Gb 2-port SFP28 Adapter for HPE[1]
Storage Configuration	Several disk groups use each one disk as caching disk with a minimum of one capacity disks
Disk type	NVMe only[2]
VMware ESXi version	8.0 U2c (ff), 8.0 U3(ff)
VMware vSAN version	8.0 U2c (ff), 8.0 U3(ff)
VMware vCenter® version	8.x
VM operating systems	• SUSE Linux® Enterprise Server • Red Hat® Enterprise Linux

[1] The above-mentioned network card was used for the SAP HCI certification. Network cards with higher bandwidth may also be used.
[2] Other disks than the one used for this certification may be used. However, similar or higher IOPs must be met. For a detailed BOM see Appendix A: Bill of materials

Table 1 shows the major components for HPE ProLiant DL380 Gen11 server.

A BOM with order numbers used for the SAP HANA HCI certification is listed in Appendix A: Bill of Materials.

SAP sizing recommendation

SAP workloads are unique and the best configuration and sizing for SAP HANA can be different for each TDI scenario. To determine the SAP HANA requirements, you have these options:

- Use SAP tools like the SAP Quick Sizer.
- SAP sizing reports for existing systems, (e.g. the reports described in SAP Note 1872170 - ABAP on HANA sizing report and SAP Note 2296290 - New Sizing Report for SAP BW/4HANA).
- Contact your local HPE Representative.

NOTE
A specific SAP user is required to read SAP notes.

HPE DL380 GEN11 PRACTICES FOR SAP HANA HCI

Configuration for vSAN on HPE ProLiant DL380 Gen11 server

The remainder of this document assumes HPE ProLiant DL380 Gen11 servers are cabled. A firmware baseline compliant with the VMware hardware compatibility list (HCL) should be applied to all servers to meet the compatibility requirements.

Additionally, administrators may wish to obtain VMware ESXi Image for HPE Servers.

The basic process for configuring vSAN is as follows:

1. Configure the HPE ProLiant DL380 Gen11 server environment:
   a. Define IP ranges for the HPE ProLiant DL380 Gen11 servers, the vCenter Server management VM (if it is not already existing), and the SAP HANA VMs.
   b. Determine capacity and performance requirements.
   c. Acquire vSAN, ESXi and vCenter licenses if necessary.
   d. Install latest SPP packages to the HPE ProLiant DL380 Gen11 servers.
2. Create and configure network:

   On the network switch configure the redundant networks that will be attached to the ESXi hosts, using VLAN IDs. These networks will be used to configure the necessary VMware networks in a later step in the vCenter configuration.

   NOTE
   The vSAN network should have a minimum of 10Gb bandwidth, higher bandwidth guarantees better performance.

3. Set up VMware vCenter Server 8.x on a separate management system with connectivity to the networks. In the scenario described in this best practice guide, vCenter is located on an already existing ESXi management host.

HPE ProLiant DL380 Gen11 server BIOS configuration

1. Boot into **BIOS** settings.
2. Configure the Workload Profile:
3. Navigate to **System Configuration > BIOS/Platform Configuration (RBSU)** and set the **Workload Profile** to **Virtualization – Max Performance** to enable the **Virtualization – Max Performance BIOS** settings.



4. Configure the Server Asset Tag with the SAP HANA HCI identifier:
   a. Navigate to **System Configuration > BIOS/Platform Configuration (RBSU) > System Options > Server Asset Information > Server Information**.
   b. Configure the Server Asset Tag with the SAP HCI identifier string **HPE ProLiant DL380 Gen11 for HCI** and change the Asset Tag Protection to **Locked**, as shown in Figure 2. The Server Asset Tag is mandatory for SAP to identify the SAP HCI solution in a support case.

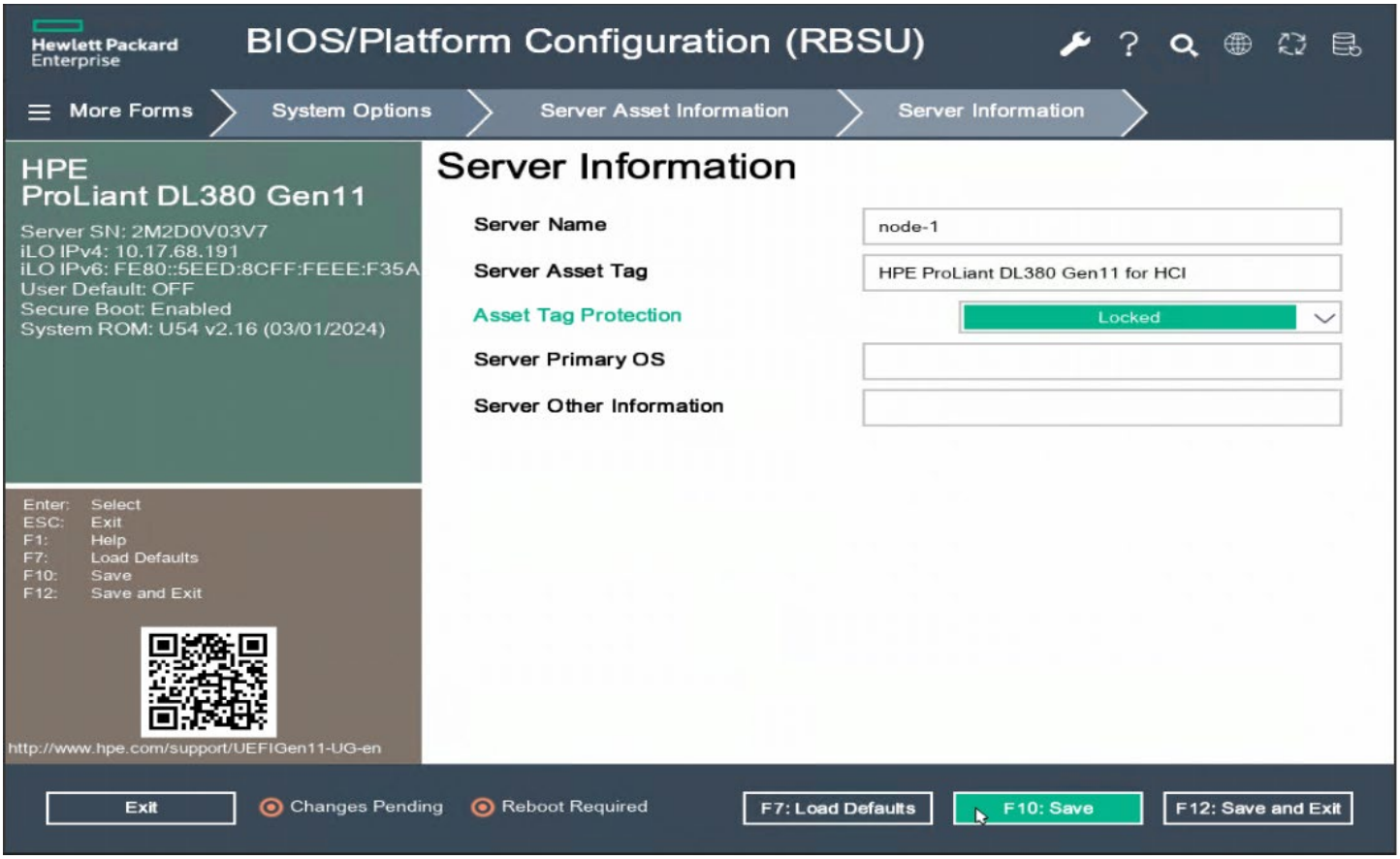

FIGURE 2. Server Asset Tag

Installation and configuration of ESXi and vSAN

VMware ESXi can be installed via standard iLO mounted virtual media or through a customer's PXE deployment service.

1. Boot the nodes and install ESXi through the HPE iLO mount of ISO media.
2. After installation is completed, select the management networks in setup and configure applicable IP, DNS, Gateway, and FQDN.
3. If there is no data center created yet in vCenter, create a new data center as well as a new cluster (vSAN Cluster). Provide your required settings for VMware vSphere High Availability, VMware vSphere Distributed Resource Scheduler™, and others. Add the ESXi hosts to this cluster.
4. Check for available VMware updates and install them on the new ESXi host.
5. In VMware vCenter, create a virtual distributed switch (vDS). Configure the vDS for as many uplinks as required.
   a. Uncheck **Create a default port group**.
   b. If you want to change the uplink names, right-click the created vDS and choose **Settings**, and then **Edit Settings**.

On the **General** section, choose **Edit Uplink Names** and edit the uplink names. This will help eliminate confusion when hosts are added to the vSwitch.

6. Select **Advanced**, then set MTU at 9000, and change the discovery protocol to **Link Layer Discovery Protocol**.
7. Create four Distributed Port Groups for Management, vMotion, vSAN, and Production networks and accept all defaults.
8. Right-click the vDS and choose **Add and Manage Hosts**. Choose the **Add Host** option and select each host you want to add. Choose the **Manage physical adapters** and assign each of the vmnics to the corresponding appropriate vDS uplink. Choose **Apply** to all to apply the physical network adapter assignments to all other hosts.
9. Migrate the default vmk0 VMkernel adapter to the vDS Management port group.
10. After choosing **Finish** in this wizard, all hosts and host adapters will be migrated to the VMware Distributed Switch.
11. Following completion of this wizard, additional Port Groups can be created, vMotion settings configured, and so on.
12. For vSAN and vMotion Distributed Port Groups, create VMkernel adapters. Tag them with the right usage types and provide new IPv4 settings.
13. Next, right-click on each Distributed Port Group and edit them in the **Teaming and failover** section to leverage only those uplinks that are carrying that port group's traffic (for example, the vSAN network port group should be bound only to the vSAN uplinks). Make sure that the port group for vSAN uses the active and standby uplinks inversely to the other port groups.
14. Go to the vSAN Cluster tab and select **Configure** in the right frame.
    a. On the left, select the **Quickstart** Configuration submenu and click **Configure** under **Configure hosts** on the right to open the configuration wizard.
    b. In the claim disks section choose your correct cache and capacity disks for the disk groups. The wizard will tell you whether the disk configuration is correct or not.
    c. After the configuration wizard is completed, VMware will import the drives and place them in the disk groups to be available for use within the cluster.



Create a VM storage policy for vSAN

For the persistent devices of SAP HANA, it is required to define a storage policy. The settings for the vSAN storage policy are shown in **FIGURE 3**.

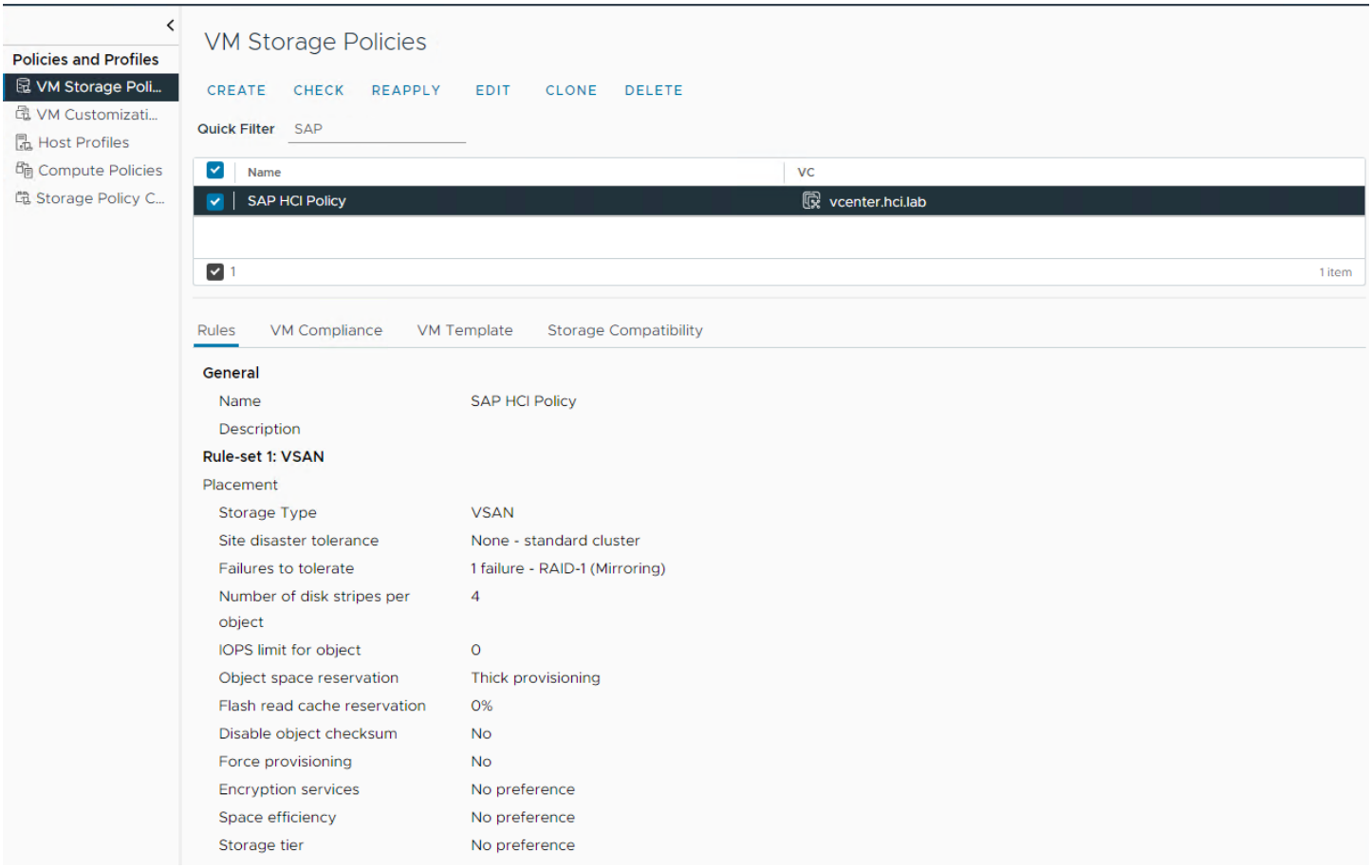

FIGURE 3 VMware Storage Policy

Apply the storage policy to the vSAN datastore as the default storage policy.

SAP HANA with vSphere Cluster Services (vCLS) VMs

As per SAP Note 3372365, it's not allowed to deploy an SAP HANA VM with non-SAP HANA VM on the same NUMA node. For more information and how to configure a vCLS VM anti-affinity policy, check the guidelines for deploying vCLS in a cluster with SAP HANA VMs.

Configure virtual machines

CPU and memory consideration

Use the CPU and memory sizing guidelines from SAP and VMware for SAP HANA in virtualized environments: SAP HANA on VMware vSphere Best Practices and Reference Architecture Guide.

- Only full socket VMs are currently allowed for running SAP HANA on VMware vSAN 8 with Sapphire Rapids CPU architecture. Consequently, a maximum of two SAP HANA VMs can be deployed on a two-socket HPE ProLiant DL380 Gen11 server. See SAP note 3372365 - SAP HANA on VMware vSphere 8 and SAP note 3406060 - SAP HANA on VMware vSphere 8 and vSAN 8.
- The minimum requirement is to have a full socket CPU configuration with at least eight physical cores and a minimum of 128 GB of RAM allocation.
- The maximum supported configuration is a two-socket SAP HANA VM with up to 240 vCPUs and 4 TB of RAM.

In case, a dedicated socket shall be used for an SAP HANA VM, this can be defined using the VM configuration parameter numa.nodeAffinity as shown in **FIGURE 4**.

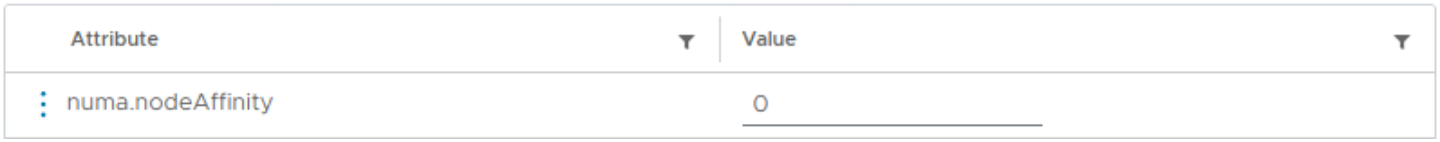

FIGURE 4 Setting of numa.nodeAffinity

NOTE
NUMA-node sharing is not allowed between productive HANA VMs and Non-HANA VMs.

SAP system monitoring

To ensure SAP support in an SAP HANA VM environment, it's mandatory to set up the enhanced SAP system monitoring as described in SAP note 1409604.

1. On each vSphere ESXi host, enable the SAP monitoring by navigating to Configure > System > Advanced System Settings and set the parameter Misc.GuestLibAllowHostInfo = 1, as shown in **FIGURE 5**.

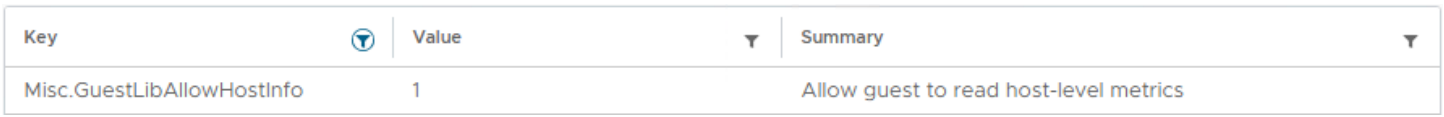

FIGURE 5.ESXI host setting of Misc:GuestLibAllowHostinfo

2. In addition, the mandatory VMware SAP HANA on vSAN Health Check Vib and Installation Script has to be downloaded and deployed on each ESXi host. This script detects if the SAP HANA VMs are running on vSAN and sets additional VM parameters like the Asset Tag to reflect the setup into each VM. This is also required for the SAP Support collection script sapsysinfo.sh.
3. Enable SAP monitoring on each SAP HANA VM via Edit settings > Advanced Parameters, enter parameter tools.guestlib.enableHostInfo and set it to TRUE as shown in **FIGURE 6**.

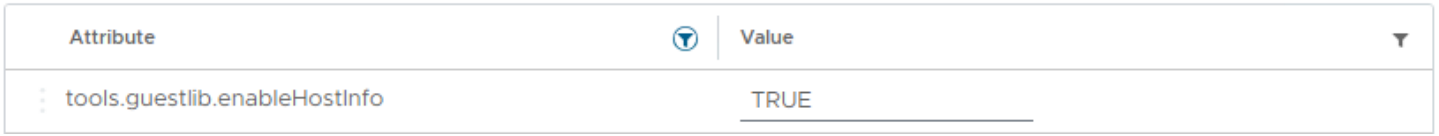

FIGURE 6 VM setting tools.guestlib.enableHostInfo

4. Make sure that the latest VMware Guest Tools are installed on each SAP HANA VM.

Disk consideration

Use a dedicated NVME controller for the different SAP HANA volumes to ensure high IO bandwidth and low latency. To parallelize the unit workloads, create several VM disks for the HANA system. For best performance, we recommend one for the OS, one for usr/sap, one for hana/shared, four for SAP HANA log, and four for SAP HANA data. Use the SAP Quick Sizer for the right sizes of the SAP HANA data and log devices. The disk sizes listed in **Table 2** are examples and can be adapted according to the results of the SAP Quick Sizer.

TABLE 2. Example of SAP TDI disk size recommendation

Mountpoint	Disk size used for best practice guide	SAP disk size recommendation	Provisioning	Controller
/ (root)	60 GB	min 10 GB	Thin	NVME controller 0
/usr/sap	50 GB	min 50 GB	Thin	NVME controller 0
/hana/shared	256 GB	min 1 x RAM up to 1 TB	Thick	NVME controller 0
/hana/data	4 * 128 GB	min 1 x RAM in total	Thick	NVME controller 1
/hana/log	4 * 64 GB	min 0.5 - 1 x RAM in total, up to 512 GB	Thick	NVME controller 2

Create a Linux LVM layout for a virtual machine

For each SAP HANA VM, configure Logical Volume Manager (LVM) and directory structure for filesystem mount. Create separate volume groups and logical volumes for `/usr/sap`, `/hana/shared`, `/hana/data`, and `/hana/log` using their dedicated VM disks.

1. Identify and check that the disks are available with the command:

```
fdisk -l
```

2. Partition the disks, for example `/dev/nvme1n2` and repeat the command for all other devices:

```
sgdisk -n 1:2048:0 -t 1:8e00 /dev/nvme1n2
```

3. Add the disk partitions as physical volumes to LVM.

```
pvcreate /dev/nvme1n2p1 - for /usr/sap
pvcreate /dev/nvme1n3p1 - for /hana/shared
pvcreate /dev/nvme2n1p1 /dev/nvme2n2p1 /dev/nvme2n3p1 /dev/nvme2n4p1- for /hana/data
pvcreate /dev/nvme0n1p1 /dev/nvme0n2p1 /dev/nvme0n3p1 /dev/nvme0n4p1 - for /hana/log
```

4. Create separate volume groups for `/usr/sap`, `/hana/shared`, `/hana/data`, and `/hana/log` using all of their dedicated VM disks.

```
vgcreate hana-usrsap /dev/nvme1n2p1
vgcreate hana-shared /dev/nvme1n3p1
vgcreate hana-data /dev/nvme2n1p1 /dev/nvme2n2p1 /dev/nvme2n3p1 /dev/nvme2n4p1
vgcreate hana-log /dev/nvme0n1p1 /dev/nvme0n2p1 /dev/nvme0n3p1 /dev/nvme0n4p1
```

5. Create the LVM logical volumes for each volume group. For the --stripes parameter, use the number of disk devices.

```
lvcreate --name usrsap --extents 100%VG hana-usrsap
lvcreate --name shared --extents 100%VG hana-shared
lvcreate --name data --extents 100%VG --stripes 4 --stripesize 64 hana-data
lvcreate --name log --extents 100%VG --stripes 4 --stripesize 64 hana-log
```

6. Use xfs as filesystem to format the previously created logical volumes.

```
mkfs.xfs /dev/mapper/hana--usrsap-usrsap
mkfs.xfs /dev/mapper/hana--shared-shared
mkfs.xfs /dev/mapper/hana--data-data
mkfs.xfs /dev/mapper/hana--log-log
```

7. Create the respective directories and mount the logical volumes.

```
mkdir -p /usr/sap /hana/shared /hana/data /hana/log

mount /dev/mapper/hana--usrsap-usrsap /usr/sap
mount /dev/mapper/hana--shared-shared /hana/shared
```

```
mount /dev/mapper/hana--data-data /hana/data
mount /dev/mapper/hana--log-log /hana/log
```

8. Create an entry in `/etc/fstab` for each device.

```
/dev/mapper/hana--usrsap-usrsap  /usr/sap      xfs  defaults  0 0
/dev/mapper/hana--shared-shared  /hana/shared  xfs  defaults  0 0
/dev/mapper/hana--data-data      /hana/data    xfs  defaults  0 0
/dev/mapper/hana--log-log        /hana/log     xfs  defaults  0 0
```

Linux settings

1. Apply the recommended SUSE Linux Enterprise Server or Red Hat Enterprise Linux OS settings for SAP HANA, such as saptune or tuned. Details can be found in the following resources:
   - SAP HANA on VMware vSphere
   - SAP HANA based Applications on VMware vSAN (SAP HANA HCI)
   - Optimizing the Network Configuration on HANA- and OS-Level
2. Add the following kernel boot arguments to the default grub config located at `/etc/default/grub`.
   a. numa_balancing=disable
   b. transparent_hugepage=never
   c. intel_idle.max_cstate=1
   d. processor.max_cstate=1
3. Change the maximum disk I/O size.

   Create the file 99-block-max-sectors.rules in `/etc/udev/rules.d` directory with the following input.

```
ACTION==add|change, SUBSYSTEM==block, RUN+=/bin/sh -c '/bin/echo 512 > /sys%p/queue/max_sectors_kb'
```

Configuration considerations for high availability with VMware HA

In case an SAP HANA VM is being relocated or a VM is being restarted, the SAP HANA database needs to be started again. To reduce the downtime, it is recommended to enable the autostart option in SAP HANA by setting the db parameter **autostart** to 1.

SUMMARY

To set up an SAP HANA landscape on HPE ProLiant DL380 Gen11 server with VMware vSAN, several things have to be considered. Each SAP HANA system requires a different sizing. Define the sizing according to the SAP Sizing recommendation and add the right number of disks for the planned amount of disk groups.

The network bandwidth must be sufficient for SAP HANA on vSAN. The BIOS settings should be set to a reasonable configuration like Virtualization Max Performance.

In VMware vSphere, the networks for vSAN need to be set correctly. Make sure that the port group for vSAN uses the active and standby uplinks inversely to the other port groups.

Ensure that the settings for the SAP system monitoring are set correctly, as described in SAP system monitoring.

Configure the LVM layout with the right striping parameters as described in Create Linux LVM layout for a virtual machine.

Set up and configure the operating system according to SAP requirements as described in Linux settings.



APPENDIX A: BILL OF MATERIALS

NOTE

Part numbers are at time of publication/testing and subject to change. The bill of materials does not include consulting, installation and support services or other rack and power requirements. Please consult with your Hewlett Packard Enterprise Reseller or Hewlett Packard Enterprise Sales Representative for more details. hpe.com/us/en/services/consulting.html

TABLE A1. Bill of materials

Part number	Quantity	Description
S0V50A	3	HPE ProLiant DL380 Gen11 for Data Solutions Server
P49614-B21	6	Intel Xeon-Gold 6430 2.1GHz 32-core 270W Processor for HPE
S1F59A	96	HPE 64GB 2RX4 PC5-4800B-R Smart Kit
P48814-B21	6	HPE DL380 Gen11 8SFF U.3 Prem Kit
P50233-B21	48	HPE 6.4TB NVMe Gen4 High Performance Mixed Use SFF BC U.3 PM1735a SSD
P48802-B21	3	HPE DL380 G11 2U x8/x16/x8 Sec Riser Kit
P42044-B21	6	Mellanox MCX631102AS-ADAT Ethernet 10/25Gb 2-port SFP28 Adapter for HPE
P44712-B21	6	HPE 1800W-2200W Flex Slot Titanium Hot Plug Low Halogen Power Supply Kit
P48825-B21	3	HPE ProLiant DL380 Gen11 8SFF CPU1/2 NVMe Cable Kit
P48830-B21	3	HPE ProLiant DL3XX Gen11 CPU2 to OCP2 x8 Enablement Kit
P48820-B21	3	HPE DL380/DL560 G11 2U High Perf Fan Kit
P48922-B21	3	HPE ProLiant DL3XX Gen11 Intrusion Cable Kit
P50400-B21	3	HPE Gen11 2U Bezel Kit
P48183-B21	3	HPE NS204i-u Gen11 NVMe Hot Plug Boot Optimized Storage Device
P48818-B21	6	HPE DL380/DL560 G11 High Perf 2U HS Kit
P52152-B21	3	HPE ProLiant DL380 Gen11 NS204i-u Internal Cable Kit
P52341-B21	3	HPE ProLiant DL3XX Gen11 Easy Install Rail 3 Kit
P53634-B21	3	HPE ProLiant DL380 Gen11 16NVMe Balanced FIO Bundle Kit
S1D80A	3	HPE ProLiant DL380 Gen11 for SAP HANA Solution Tracking

RESOURCES AND ADDITIONAL LINKS

HPE Servers, hpe.com/servers

HPE Networking, hpe.com/networking

HPE SAP HANA solutions, hpe.com/emea_europe/en/solutions/sap-hana.html

VMware ESXi Image for HPE servers, https://www.hpe.com/us/en/servers/hpe-esxi.html

vSAN 8.0 Administration Guide, https://docs.vmware.com/en/VMware-vSphere/8.0/vsan-802-administration-guide.pdf

SAP HANA on VMware vSphere Best Practices and Reference Architecture Guide, https://core.vmware.com/resource/sap-hana-vmware-vsphere-best-practices-and-reference-architecture-guide

Half-Socket VM support for SAP HANA on vSphere 8 and 4th Gen Intel® Xeon® Scalable processors (Sapphire Rapids),

https://blogs.vmware.com/apps/2024/04/half-socket-vm-support-for-sap-hana-on-vsphere-8-and-4th-gen-intel-xeon-scalable-processors-sapphire-rapids.html

SAP Sizing, https://www.sap.com/about/benchmark/sizing.html

SAP note 1872170 - ABAP on HANA sizing report, https://me.sap.com/notes/1872170

SAP note 2296290 - New Sizing Report for SAP BW/4HANA, https://me.sap.com/notes/2296290

SAP note 3372365 - SAP HANA on VMware vSphere 8, https://me.sap.com/notes/3372365

SAP note 3406060 - SAP HANA on VMware vSphere 8 and vSAN 8, https://me.sap.com/notes/3406060

SAP note 2382421 - Optimizing the Network Configuration on HANA- and OS-Level, https://me.sap.com/notes/2382421

SAP HANA on VMware vSphere, https://help.sap.com/docs/SUPPORT_CONTENT/virtualization/3362185751.html

SAP HANA based Applications on VMware vSAN (SAP HANA HCI), https://help.sap.com/docs/SUPPORT_CONTENT/virtualization/3362185811.html

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