Hewlett Packard Enterprise

Technical White Paper

HPE Solution Architecture on HPE ProLiant DL360, DL380 and DL560 Gen11 Servers for SAP Solutions

4th Generation Intel® Xeon® Scalable (Sapphire Rapids) and 5th Generation Intel® Xeon® Scalable (Emerald Rapids) Processors

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EXECUTIVE SUMMARY

Hewlett Packard Enterprise (HPE) is a leading provider for SAP solutions. With an extensive global footprint of solutions deployed at thousands of SAP customer sites, our solutions are ubiquitous across the application and database tier, including scale-up and scale-out configurations for all SAP HANA database workloads. We provide fully integrated Certified SAP HANA Appliances, Tailored Datacenter Integration (TDI), ERP Central Component (ECC), SAP Business Warehouse (BW) and SAP Suite on HANA (S/4 HANA) solutions.

Our infrastructure portfolio for SAP HANA offers a comprehensive solution to a wide spectrum of customer requirements. From small and medium-sized businesses to the largest global enterprises, HPE delivers professional tailored experiences with solutions of all sizes that encompass both the application and database tiers.

Target audience: This document is for Enterprise Solution Architects, Deployment or Implementation Engineers, and others to learn about the implementation of HPE Solutions for SAP HANA using the HPE ProLiant DL360 Gen11 Server, the HPE ProLiant DL380 Gen11 Server and the HPE ProLiant DL560 Gen11 Server.

Document purpose: This provides an architectural and technical overview when using 2 and 4-socket HPE ProLiant servers for in-memory SAP HANA Database deployments. This document describes the SAP infrastructure components of the HPE ProLiant DL360 Gen11 Server, HPE ProLiant DL380 Gen11 Server and HPE ProLiant DL560 Gen11 Server configurations based on 4th and 5th Generation Intel® Xeon® Scalable Processors. These servers, with internal storage, support a wide variety of memory and disk configurations that SAP HANA environments require.

INTRODUCTION

HPE ProLiant Gen11 Server platforms offer customers flexible hardware options and strategies for running SAP in their data centers. With the choice between SAP HANA Certified Appliances and Tailored Datacenter Integration (TDI) deployment, HPE customers are empowered to seamlessly and easily integrate infrastructure that has been tailored to the requirements specific to their business. Read more about SAP HANA Certified Appliances and TDI in the Solution Overview section.

HPE ProLiant DL360 Gen11 server and HPE ProLiant DL380 Gen11 servers are offered with both 4th Generation Intel Xeon Scalable Processors (Sapphire Rapids) and 5th Generation Intel Xeon Scalable Processors (Emerald Rapids).

HPE ProLiant DL560 Gen11 server is offered with 4th Generation Intel® Xeon® Scalable Processors (Sapphire Rapids) only.

HPE ProLiant DL360 Gen11 Server for SAP HANA

The HPE ProLiant DL360 Gen11 Server is a versatile and scalable compute solution tailored for high-performance and transactional application workloads. This rack-mounted 1U server is available in 1 or 2-socket configurations. It is well-suited for bare metal and virtualized SAP Application platforms and addresses a fundamental set of requirements encompassing data scalability, application performance, and infrastructure uptime. With best-in-class application performance, seamless infrastructure integration, and comprehensive service delivery within the IT environment, the HPE ProLiant DL360 Gen11 provides outstanding value in a small footprint for empowering mission-critical landscapes.

The HPE ProLiant DL360 Gen11 server has the following features:

- Choice of 4th or 5th Gen Intel Xeon Scalable Processors with up to 64 cores
- 16 DIMMs per processor for up to 4800 MT/s with 4th Gen Intel Xeon Scalable Processors
- 16 DIMMs per processor for up to 5600 MT/s with 5th Gen Intel Xeon Scalable Processors
- High network speeds via PCIe Gen5, with up to 2x 16 PCIe Gen5 and 2 OCP slots
- HPE Integrated Lights-Out 6 (iLO 6) server management software
- Smart Cooling Modules for high thermal design power (TDP) processors
- HPE NS204i-u Gen11 NVMe Hot Plug Boot Optimized Storage Device

HPE ProLiant DL380 Gen11 Server for SAP HANA

The HPE ProLiant DL380 Gen11 Server is a scalable 2U compute solution available in 1- and 2-socket configurations and delivers exceptional compute performance expandability and scalability for SAP S4 application and HANA database workloads. Offered as both an SAP HANA Certified Appliance and TDI, this server is also available for SAP application tier deployments. In addition, the HPE ProLiant DL380 Gen11 server supports up to 4 virtual machines (VMs), which can be deployed with SAP HANA databases, making it suitable not only for the SAP application tier, but also small databases in VMware VM-based environments.

The HPE ProLiant DL380 Gen11 server has the following features:

- Choice of 4th or 5th Gen Intel Xeon Scalable Processors with up to 64 cores
- 16 DIMMs per processor for up to 4800 MT/s with 4th Gen Intel Xeon Scalable Processors
- 16 DIMMs per processor for up to 5600 MT/s with 5th Gen Intel Xeon Scalable Processors
- High network speeds via PCIe Gen5, with up to 8x PCIe Gen5 slots
- 2 OCP form factor slots
- HPE Integrated Light-Out 6 (iLO 6) server management software
- HPE NS204i-u Gen11 NVMe Hot Plug Boot Optimized Storage Device

HPE ProLiant DL560 Gen11 Server for SAP HANA

The HPE ProLiant DL560 Gen11 Server is a scalable 2U compute solution available in 2 or 4-socket configurations which delivers high performance, scalability, and reliability. The HPE ProLiant DL560 Gen11 server is an excellent compute choice for an in-memory database as well as data analytics workloads like SAP HANA that require maximum core-count, memory scalability, storage I/O bandwidth and high throughput.

The HPE ProLiant DL560 Gen11 Server is available as an SAP certified appliance available in 2- and 4-socket configurations with up to 8TB of memory. In SAP HANA TDI configurations this server can scale up to 16TB of memory by using 256GB DIMMs. (Please consult an HPE Compute specialist for sizing information if using this configuration.)

The HPE ProLiant DL560 Gen11 server has the following features:

- Powered by 4th Gen Intel Xeon Scalable Processors with up to 60 cores
- HPE NS204i-u Gen11 NVMe Hot Plug Boot Optimized Storage Device
- 4th Gen Intel Xeon Scalable Processors with up to 60 cores
- 16 DIMMs per processor for up to 4800 MT/s
- High network speeds via PCIe Gen5, with up to 6x PCIe Gen5 slots
- 2 OCP form factor slots
- HPE Integrated Light-Out 6 (iLO 6) server management software
- HPE NS204i-u Gen11 NVMe Hot Plug Boot Optimized Storage Device

SOLUTION OVERVIEW

The SAP HANA Hardware Directory lists all hardware that has been certified within the SAP HANA hardware certification program or is supported under SAP HANA SPS releases and Intel® architecture.

The SAP Linux Lab certifies the partner's hardware that is supported for SAP HANA. The certification is valid for a stipulated time-period and valid for a particular group of appliances/storage family of the hardware manufacturer wherein many models might be included.

The HPE SAP HANA certified solutions offering for SAP HANA in SAP HANA appliance and TDI solutions offerings listed at SAP HANA Hardware Directory.

SAP HANA Certified Appliance Solutions

SAP HANA Certified Appliance Solutions are a combination of SAP software and preconfigured HPE hardware that has gone through a regressive process of full stack performance testing and, are fully validated and supported by both SAP and HPE. The following HPE ProLiant Gen11 Servers are available as SAP HANA Certified Appliances.

- HPE ProLiant DL380 Gen11
- HPE ProLiant DL560 Gen11

SAP HANA Tailored Datacenter Infrastructure Solutions

HPE's SAP HANA Tailored Datacenter Infrastructure (TDI) offers customers a more flexible method of deploying an SAP HANA system into their existing datacenter environment by shifting the responsibility of hardware configuration and support entirely to HPE. In doing so, HPE can provide a wider variety of individual components, like processors, to choose from, allowing our customers to leverage our decades of expertise in solution architecture to optimize performance and total cost of ownership. The following solutions are available as TDI for SAP HANA:

- HPE ProLiant DL360 Gen11 Server
- HPE ProLiant DL380 Gen11 Server
- HPE ProLiant DL560 Gen11 Server

HPE ProLiant Gen11 servers for SAP: SAP Certified Appliance and TDI

Table 1 shows the HPE ProLiant Gen11 server offerings for SAP HANA Appliance and TDI (Tailored Datacenter Integration) deployments along with the SKUs. These servers are also suitable for use as SAP Application servers.

These servers are listed on SAP HANA Hardware Directory.

TABLE 1. HPE ProLiant Gen11 servers for SAP HANA

SAP-certified HANA Server Platform	SKU	CPU Architecture	Appliance	Tailored Datacenter Integration (TDI)
HPE ProLiant DL360 Gen11 for Data Solutions Server	S0V51A	Sapphire Rapids SP	■	■
HPE ProLiant DL360 Gen11 for Data Solutions Server	S0V51A	Emerald Rapids SP	■	■
HPE ProLiant DL380 Gen11 for Data Solutions Server	S0V50A	Sapphire Rapids SP	■	■
HPE ProLiant DL380 Gen11 for Data Solutions Server	S0V50A	Emerald Rapids SP	■	■
HPE ProLiant DL560 Gen11 for DS Air Cooling Server	S0V52A	Sapphire Rapids SP	■	■
HPE ProLiant DL560 Gen11 for DS Smart Cooling Server	S0V53A	Sapphire Rapids SP	■	■

HPE PROLIANT DL560 GEN11 SERVER FOR SAP HANA

The HPE ProLiant DL560 Gen11 Server, available in 2- or 4-socket configurations, is an optimal solution for running SAP workloads like SAP Business Warehouse (BW) on HANA, SAP Business Suite on HANA (SoH) and S4/HANA. Figure 1 shows the memory footprints offered for 2- and 4-socket configurations.

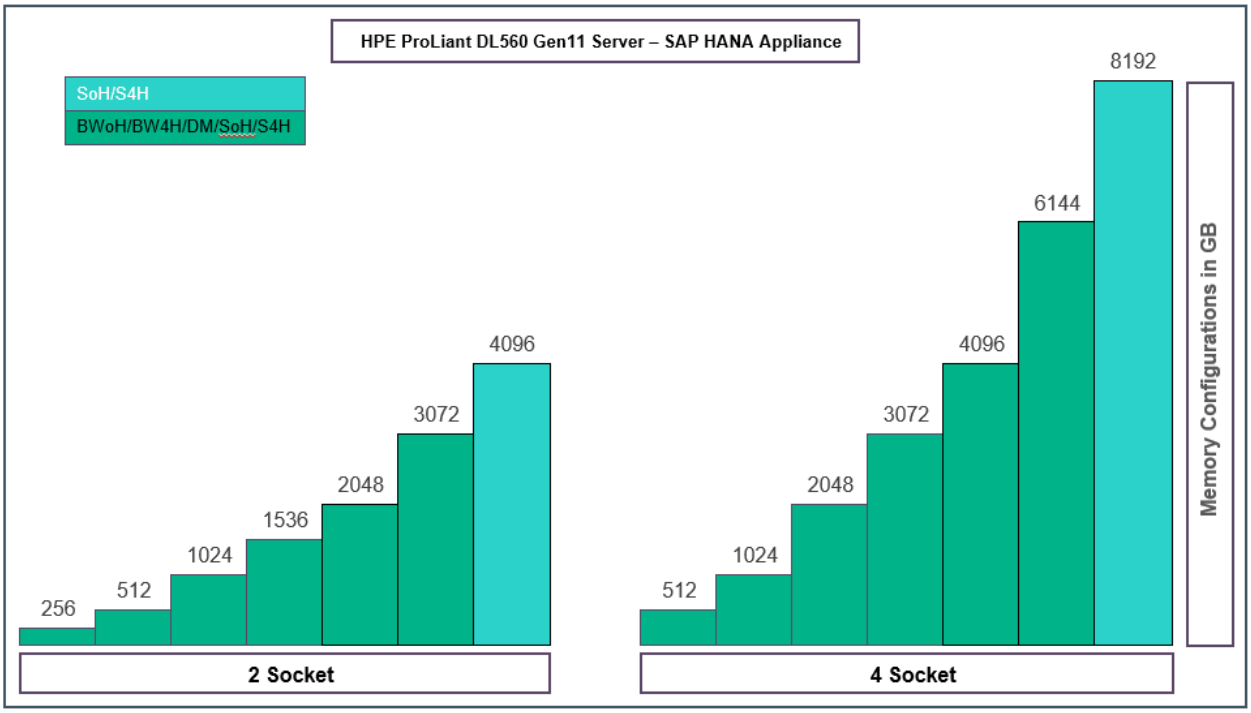

FIGURE 1. Memory configuration for HPE ProLiant DL560 Gen11 Server for SAP HANA

Figure 2 displays both the front and rear views of the server, with and without an optional dual-purpose storage box. Controller options for storage provisioning are detailed in later sections of this document. In SAP HANA Appliance implementations, either the "HPE MR416i-o Gen11 Controller" or the "HPE SR932i-p Gen11 Controller" is necessary and will be positioned at OCP 14/15 or PCIe Slot 2/5, as indicated in Figure 2. Note that the slotting arrangement shown in Figure 2 may be subject to change depending on the selected controller. For more information on product specification, please refer the HPE ProLiant DL560 Gen11 Quickspecs.

NOTE

Not all hardware components listed in product quick specs are supported in SAP configurations.

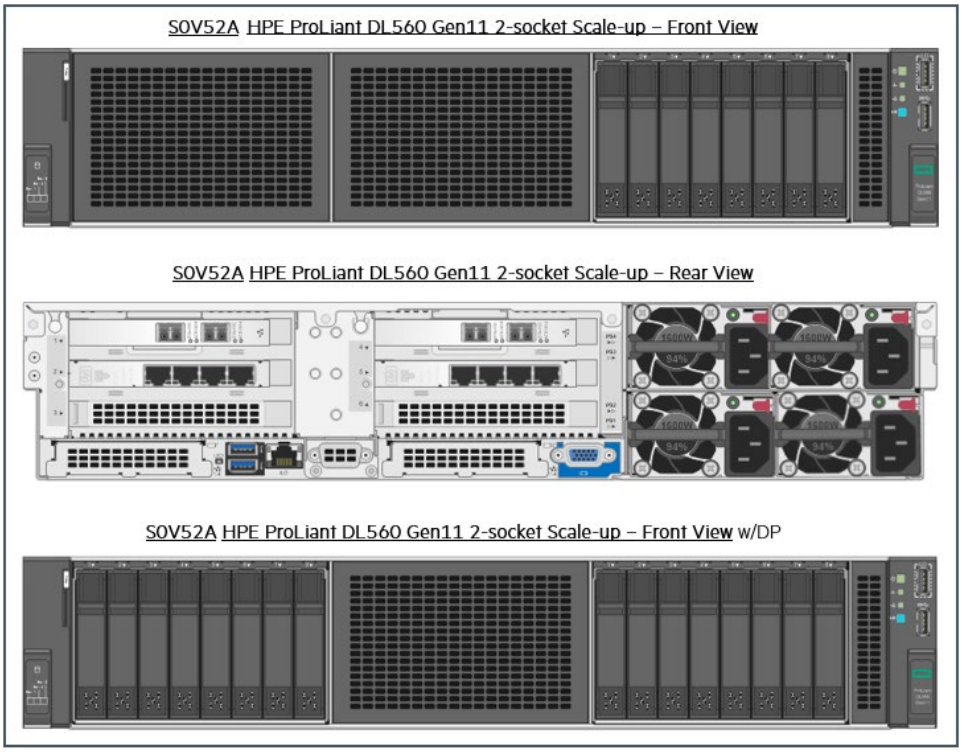

FIGURE 2. 2-socket HPE ProLiant DL560 Gen11 2-socket server

Figure 3 shows the HPE ProLiant DL560 Gen11 4-socket liquid cooling server front and rear view with and without optional dual-purpose storage . It's essential to note that air-cooled heatsinks might not always be adequate for higher wattage processor ratings. Due to the increased density of the HPE ProLiant DL560 Gen11 Server, closed loop liquid cooling may be necessary to ensure sufficient cooling. To learn more about closed loop liquid cooling and its components, refer to the "HPE ProLiant DL560 Gen11 User Guide".

For SAP HANA Certified Appliances, the OCP and PCIe Slotting will change based on the selection of storage controller. Also, based on the storage requirements, the locations of disk boxes will vary depending on selection dual-purpose non-production instance for SAP HANA along the SAP HANA persistent storage for production instance.

If there is a requirement for SAP HANA persistent storage for production instance, then server storage box 2 will be used for installation of storage drives. While the dual-purpose non-production storage instance is selected with SAP HANA persistent storage then server storage box 3 will be used for installation of storage drives designated to configured for SAP HANA persistent storage and server storage box 1 will be used for installation of storage drives designated for dual-purpose non-production instance.

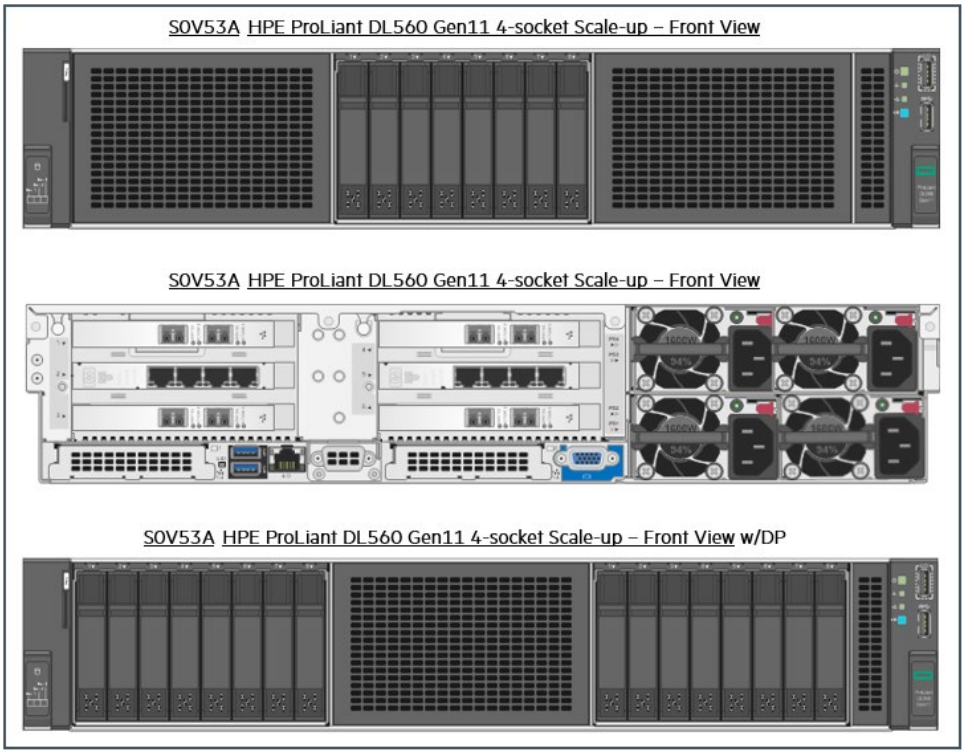

FIGURE 3. HPE ProLiant DL560 Gen11 4-socket server

HPE ProLiant DL560 Gen11 Server for SAP HANA Appliance Configuration

Table 2 lists the server components used to build an SAP HANA Certified Appliance using the HPE ProLiant DL560 Gen 11 Server. These listed components have been tested and offer optimal performance. Contact an HPE compute specialist to assist in configuring a solution for your specific needs.

TABLE 2. Components of HPE ProLiant DL560 Gen11 Server SAP HANA certified appliance

Components	Component description
HPE ProLiant DL560 Gen11 Data Solutions	S0V52A – HPE ProLiant DL560 Gen11 for Data Solutions Air Cooling Server
	Or
	S0V53A – HPE ProLiant DL560 Gen11 for Data Solutions Liquid Cooling Server
Processor name	4th Generation Intel® Xeon® Scalable (Sapphire Rapids) Processors
	Refer the processor Table 2 for detailed support matrix
Number of processors	Two 4th Generation Intel® Xeon® Scalable Processors
	Four 4th Generation Intel® Xeon® Scalable Processors
Memory options	HPE 16GB (1x16GB) 1 x8 DDR5-4800 Registered
	HPE 32GB (1x32GB) x8 DDR5-4800 Registered
	HPE 64GB (1x64GB) x4 DDR5-4800 Registered
	HPE 96GB (1x96GB) Dual Rank 2 x4 Registered.
	HPE 128GB (1x128GB) 4 x4 DDR5-4800 Registered 3DS
	HPE 128GB (1x128GB) 4 x4 DDR5-4800 Registered 3DS
Number of DIMMs	16 or 32 – 2-socket configuration
	32 or 64 – 4-socket configuration
Drive Backplanes (10 Drives Max/Chassis)	HPE ProLiant DL560 Gen11 8SFF x4 U.3 NVMe Drive Cage Kit
Storage controller	HPE MR416i-o Gen11 x16 Lanes 8GB Cache OCP SPDM Storage Controller
	Or
	HPE SR932i-p Gen11 x32 Lanes 8GB Wide Cache PCI SPDM Plug-in Storage Controller

Components	Component description
Number of the storage controller	1x for HANA Persistent Storage 1x for HANA Dual-purpose Storage
Storage drive	HPE 3.2TB NVMe Gen4 Mainstream Performance Mixed Use SFF BC U.3 SSD Or HPE 6.4TB NVMe Gen4 Mainstream Performance Mixed Use SFF BC U.3 SSD
Number of storage drive	Maximum 8 Drives for HANA Persistent Storage Maximum 8 Drives for HANA Dual-purpose Storage
Network cards (Base chassis)	Intel I350-T4 Ethernet 1Gb 4-port BASE-T OCP3 Adapter for HPE Broadcom BCM5719 Ethernet 1Gb 4-port BASE-T OCP3 Adapter for HPE Intel I350-T4 Ethernet 1Gb 4-port BASE-T Adapter for HPE Broadcom BCM5719 Ethernet 1Gb 4-port BASE-T Adapter for HPE
Number of network card	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE MLX MCX631102 10/25GbE 2p SFP28 Adapter
Fibre Channel HBA (Optional) (Base chassis)	16Gb/32Gb FC HBA
Dual-purpose storage drive option	HPE 1.6TB SAS 24G Mixed Use SFF BC Multi-Vendor SSD HPE 1.8TB SAS 12G Mission Critical 10K SFF BC 3-year Warranty 512e Multi-Vendor HDD HPE 3.2TB SAS 24G Mixed Use SFF BC Multi-Vendor SSD HPE 2.4TB SAS 10k SFF BC 512e MV HDD HPE 6.4TB SAS MU SFF BC MV SSD

Processor

The HPE ProLiant DL560 Gen11 Server supports many Sapphire Rapids processors in a variety of configurations based on specific thermal design power (TDP) ratings. The support matrix is listed in Table 3.

TABLE 3. HPE ProLiant DL560 Gen11 Server Processor Support Matrix

Model	Long Name	Frequency	Core	TDP	Die	Quantity	2 Processor AC	4 Processor AC	4 Processor LC	Appliance
8490H	Intel Xeon-P	1.9GHz	60	350W	XCC	2 / 4	■	■	■	■
6416H	Intel Xeon-G	2.2GHz	18	165W	MCC	2 / 4	■	■	■	■
6418H	Intel Xeon-G	2.1GHz	24	185W	MCC	2 / 4	■	■	■	■
6448H	Intel Xeon-G	2.4GHz	32	250W	MCC	2 / 4	■	■	■	■
6434H	Intel Xeon-G	3.7GHz	8	195W	MCC	2 / 4	■	■	■	■
8444H	Intel Xeon-P	2.9GHz	16	270W	XCC	2 / 4	■	■	■	■
8450H	Intel Xeon-P	2.0GHz	28	250W	XCC	2 / 4	■	■	■	■
8460H	Intel Xeon-P	2.2GHz	40	330W	XCC	2 / 4	■	■	■	■
8468H	Intel Xeon-P	2.1GHz	48	330W	XCC	2 / 4	■	■	■	■

Memory

The HPE ProLiant DL560 Gen11 Servers for SAP HANA Appliance can be configured with 2-sockets and up to 4TB memory or 4-sockets and up to 8TB of memory. This guide shows memory/processor configurations that are supported and tested. For production environments, customer performance and sizing requirements must be evaluated properly. SAP HANA sizing range of memory configurations is offered under SAP HANA Appliance and TDI categories. Table 4 shows the available memory configuration offering with a variety of DIMM combinations.

TABLE 4.HPE ProLiant DL560 Gen11 Server Appliance Memory Configuration

Configuration	SKU	256GB	512GB	1024GB	1536GB	2048GB	3072GB	4096GB	6144GB	8192GB
HPE ProLiant DL560 Gen11 for Data Solutions Air Cooling Server	S0V52A	X	X	X	X	X	X	X		
HPE ProLiant DL560 Gen11 for Data Solutions Liquid Cooling Server	S0V53A		X	X		X	X	X	X	X

Table 5 illustrates a variety of DIMM combinations that can be used to achieve different memory footprints. For more information on TDI and workload-driven sizing, refer to the SAP Document – "SAP HANA Tailored Data Center Integration – Overview".

The Gen11 Memory Population Rule Guide provides a comprehensive description of the memory population best practices.

TABLE 5. HPE ProLiant DL560 Gen11 Server Memory options and respective DIMM combinations

Server Memory in GB	Appliance	TDI	2-socket Server	4-socket Server
256 (0.25TB)	■	■	16 x 16GB	
512 (0.5TB)	■	■	16 x 32GB or 32 x 16GB	32 x 16GB
1024 (1.0TB)	■	■	16 x 64GB or 32 x 32GB	32 x 32GB or 64 x 16GB
1536 (1.5TB)	■	■	16 x 96GB	
2048 (2.0TB)	■	■	16 x 128GB or 32 x 64GB	32 x 64GB or 64 x 32GB
3072(3.0TB)	■	■	32 x 96GB	32 x 96GB
4096 (4.0TB)	■	■	32 x 128GB	32x 128GB or 64 x 64GB
6144 (6.0GB)	■	■		64 x 96GB
8192 (8.0TB)	■	■		64 x 128GB

NOTE

The following memory rules are mandatory for SAP HANA Deployments:

- 1 DIMM per channel, the same channel must be fully populated – a total of 8 DIMM per processor.
- 2 DIMM per channel, both channels must be fully populated – a total of 16 DIMM per processor.
- Only homogenous symmetric population is allowed.
- Higher rank DIMM must be populated at White DIMM slots.
- Mix DIMM – x4 cannot be mixed with x8.
- Mix DIMM – Ranks can be mixed but only with all 16 DIMMs sockets populated.
- Mix DIMM – Do not mix DIMM module types within a memory channel. All must be RDIMM or 3DS RDIMM module types, with same ECC configuration.
- 16TB memory footprints are possible using specific components as a TDI solution. Contact an HPE Compute specialist for configuration guidance.

Storage Controllers

The required storage controllers for both SAP HANA Certified Appliance and TDI are "HPE SR932i-p Gen11 Controller" and "HPE MR416i-o Gen11 Controller". Two controllers of the same type may be installed on the system, one each for SAP HANA Appliance persistent storage and the second one for dual-purpose non-production instance. Controller's models cannot be mixed.

For SAP HANA Certified Appliance implementation, to achieve optimal throughput and Input or Output operations per second (IOPS), the described configurations for controller choice and its implementations are based on the best practices defined by the HPE SAP HANA solutions team.

Supported controllers for SAP HANA Appliance and TDI implementations are listed in Table 6.

TABLE 6. Storage Controller offerings

Storage Controllers	Appliance (Production)	Tailored Datacenter Integration (TDI)
HPE MR416i-o Gen11 12G Controller Kit	■	■
HPE SR932i-p Gen11 24G Controller Kit	■	■
HPE MR408i-o Gen11 SPDM Storage Controller	■	■
HPE MR416i-p Gen11 12G Controller Kit	■	■

Table 7 features an overview of these controllers' properties. For more details about controllers please check the Quickspec guide: HPE Compute MR Gen11 Controllers and HPE Compute SR Gen11 Controllers.

TABLE 7. HPE Compute- SR Gen11 Storage controller features

Feature	HPE MR416i-o Gen11 12G Controller	HPE MR408i-o Gen11 SPDM Storage	HPE SR932i-p Gen11 24G Controller
Platform	HPE ProLiant Gen11	HPE ProLiant Gen11	HPE ProLiant Gen11
Ports	2x8 LP SlimSAS	1x8 LP SlimSAS	4x8 SlimSAS
Internal SAS Lane	x16	X8	X32
Form Factor	OCP	OCP	PCIe FH/HL
Host Interface	PCIe Gen4 x8	PCIe Gen4 x8	X16 PCIe 4.0
Cache Size (FBWC)	8GB	4GB	8GB
Storage Protocol	6G SATA, 12G SAS, 16G NVMe	16G NVMe, 24G SAS, 6G SATA	6G SATA, 24G SAS, 16G NVMe
RAID	0, 1, 5, 6, 10, 50, 60	Yes	0/1/5/6/10/50/60/1T/10T

Feature	HPE MR416i-o Gen11 12G Controller	HPE MR408i-o Gen11 SPDM Storage	HPE SR932i-p Gen11 24G Controller
Mixed Mode (RAID & HBA)	Yes	Yes	Yes
SSD Enhancement	FASTPATHI	FASTPI®	Smart Path & SmartCache
Host Tools (GUI & CLI)	StorCLI & MR Storage Administrator	StorCLI & MR Storage Administrator	HPE Smart Storage Administrator (SSA)

Storage Drives and Sizing for Appliance

An SAP HANA Certified Appliance configuration must fulfil the minimum storage requirements and KPIs defined by SAP. This section describes the storage configuration rules for SAP HANA Appliances using the HPE ProLiant DL560 Gen11 server.

For SAP HANA TDI solutions, storage sizing has been relaxed by SAP. The TDI storage requirement is further discussed in section Storage Sizing Chart for TDI Implementation.

To configure an SAP HANA Certified Appliance, two drives SKUs are available.

- HPE 3.2TB NVMe Gen4 Mainstream Performance Mixed Use SFF BC U.3 SSD
- HPE 6.4TB NVMe Gen4 Mainstream Performance Mixed Use SFF BC U.3 SSD

Persistent storage sizing is dependent on memory footprint. Table 8 shows the minimum required storage for Appliances using 6.4TB NVMe Drives. 6.4TB NVMe drives are preferred drives for larger memory footprints. Future memory expansion should be considered when selecting storage drive sizes.

TABLE 8. SAP HANA Appliance Persistent Storage sizing using 6.4TB NVMe MU Drives

2-socket	4-socket	Memory	Nos of Drive	RAID	Shared	Log	DATA
Y	N	256	3	5	2048	1536	6144
Y	Y	512	3	5	2048	1536	6144
Y	Y	1024	3	5	2048	1536	6144
Y	N	1536	3	5	2048	1536	6144
Y	Y	2048	3	5	2048	1536	6144
Y	Y	3072	5	5	4096	1536	12288
Y	Y	4096	5	5	4096	1536	12288
N	Y	6144	8	50	8192	1536	24576
N	Y	8192	8	50	8192	1536	24576

Table 9 shows the SAP HANA persistent storage layout using 3.2TB NVMe Drives. Note that these drives cannot support memory footprints above 4TB.

TABLE 9. SAP HANA Appliance Persistent Storage sizing using 3.2TB NVMe MU Drives

2-socket	4-socket	Memory	Nos of Drive	RAID	Shared	Log	DATA
Y	N	256	3	5	1024	1536	1536
Y	Y	512	3	5	1024	1536	1536
Y	Y	1024	4	5	1024	1536	3072
Y	N	1536	5	5	2048	1536	6144
Y	Y	2048	5	5	2048	1536	6144
Y	Y	3072	8	50	4096	1536	12288
Y	Y	4096	8	50	4096	1536	12288

Storage Layout and Configuration

Storage layout is similar for all memory configurations; however, the size of each volume varies. Additionally, the drive cage location of the HPE ProLiant DL560 Gen11 Server differs on 2 and 4-socket configurations due to the difference in cooling.

The following subtopics describe 2 and 4-socket configurations with only primary storage and dual-purpose non-production instances.

Refer the HPE ProLiant DL560 Gen11 Server User Guide for more detailed information.

Figure 4 shows the brief storage implementations.

HPE ProLiant DL560 Gen11 - SAP HANA Appliance Configuration											
2-socket Air-cooled and 4-socket Liquid-cooled up to 350W Platinum Processor											
Configuration	Memory	Socket	Chassis Cooling	Storage for HANA Production Instance				Storage for HANA Non-production Instance (Dual-purpose)			
Config – 1	256 GB 512 GB 1024 GB 1536 GB 2048 GB 3072 GB 4096 GB 6144 GB 8192 GB	2S	AC	MR416i-o	SLOT - OCP 14	x2 Speed	Box 3				
Config – 2		4S	LC	MR416i-o	SLOT - OCP 15	x2 Speed	Box 2				
Config – 3		2S & 4S	AC & LC	MR416i-o	SLOT - OCP 14	x2 Speed	Box 3	MR416i-o	SLOT - OCP 15	x2 Speed	Box 1
Config – 4		2S	AC	SR932i-p	SLOT – PCIe 2	x4 Speed	Box 3				
Config – 5		4S	LC	SR932i-p	SLOT – PCIe 5	x4 Speed	Box 2				
Config – 6		2S & 4S	AC & LC	SR932i-p	SLOT – PCIe 2	x4 Speed	Box 3	SR932i-p	SLOT – PCIe 5	x4 Speed	Box 1

FIGURE 4. Storage controller and connections for the HPE ProLiant DL560 Gen11

2-Socket HPE ProLiant DL560 Gen11 Server

For 2-Socket configurations, primary storage is installed in Box 3 as shown in Figure 5.

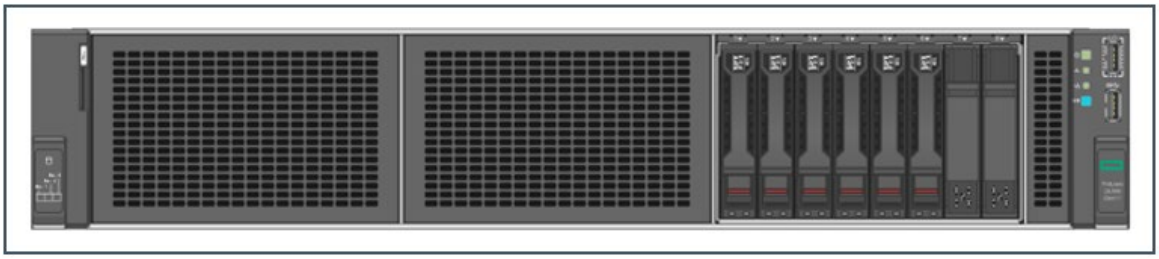

FIGURE 5. 2-socket HPE ProLiant DL560 Gen11 server with drives installed on Box 3 for SAP HANA persistent storage

Figure 6 shows how the “HPE MR416i-o Gen11 Controller” is installed on OCP Slot 14 and the connection is done using “x2” cables to Box 3. HPE MR416i-o Gen11 Controller can serve a maximum of eight (8) drives in SAP HANA Certified Appliance configurations.

The HPE SR932i-p Gen11 storage controller is installed on PCIe Slot 2 and connected to Box 3 and can support up to eight (8) drives for persistent storage.

Mixing of the controller is not supported.

FIGURE 6. 2-socket HPE ProLiant DL560 Gen11 server Box 3 for SAP HANA persistent storage – Controllers to Box 3 connections

4-socket HPE ProLiant DL560 Gen11 Server

Figure 7 of the HPE ProLiant DL560 Gen11 server shows the installation of the drive cage at Box 2.

FIGURE 7. 4-socket HPE ProLiant DL560 Gen11 server with drives installed Box 2 for SAP HANA persistent storage

Figure 8 shows the internal connections to the drive cage installed at Box 2 of the server.

In the HPE MR416i-o installation, at OCP Slot 15 and connected to Box 2, using 'by 2', "Y Type" OCP cables. With the HPE SR932i-p controller installation, at 'by 16" PCIe Slot 5 and connected to Box 2, using 'by 4', "straight" tri-mode cables.

FIGURE 8. 4-socket HPE ProLiant DL560 Gen11 server Box 2 for SAP HANA persistent storage – Controllers to Box 2 connections

2 and 4-socket HPE ProLiant DL560 Gen11 server with dual-purpose storage

Figure 9 illustrates 2 and 4-socket HPE ProLiant DL560 Gen11 servers where primary storage is installed in Box 3, and dual-purpose storage is installed in Box 1. This implementation is the same for both 2 and 4-socket servers for Appliance and TDI implementations.

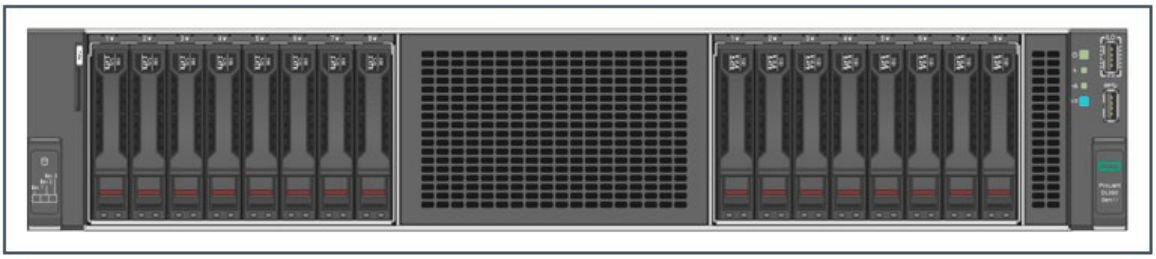

FIGURE 9. 2 or 4-sockets HPE ProLiant DL560 Gen11 server Box 3 for SAP HANA persistent storage and Box 1 for dual-purpose

Figure 10 shows the HPE MR416i-o installation at OCP Slot 14 and is connected to Box 3 using 'by 2', "Y Type", OCP cable, and a second HPE MR416i-o controller installed on OCP Slot 15 is connected to Box 1, using 'by 2', 'Y Type' cables.

Dual-purpose storage is similarly configured; the controller is installed on OCP Slot 15 with the drives installed on Box 1.

The HPE SR932i-p storage controller is installed at 'by 16" PCIe Slot 2, and connected to Box 3, using 'by 4', "straight" tri-mode cables. The dual-purpose is provisioned through HPE SR932i-p storage controller its installed, on PCIe Slot 5, and connected to Box 1.

The config choices; three (3), and six (6); show the implementations of SAP HANA persistent storage, in addition to the dual-purpose implementation.

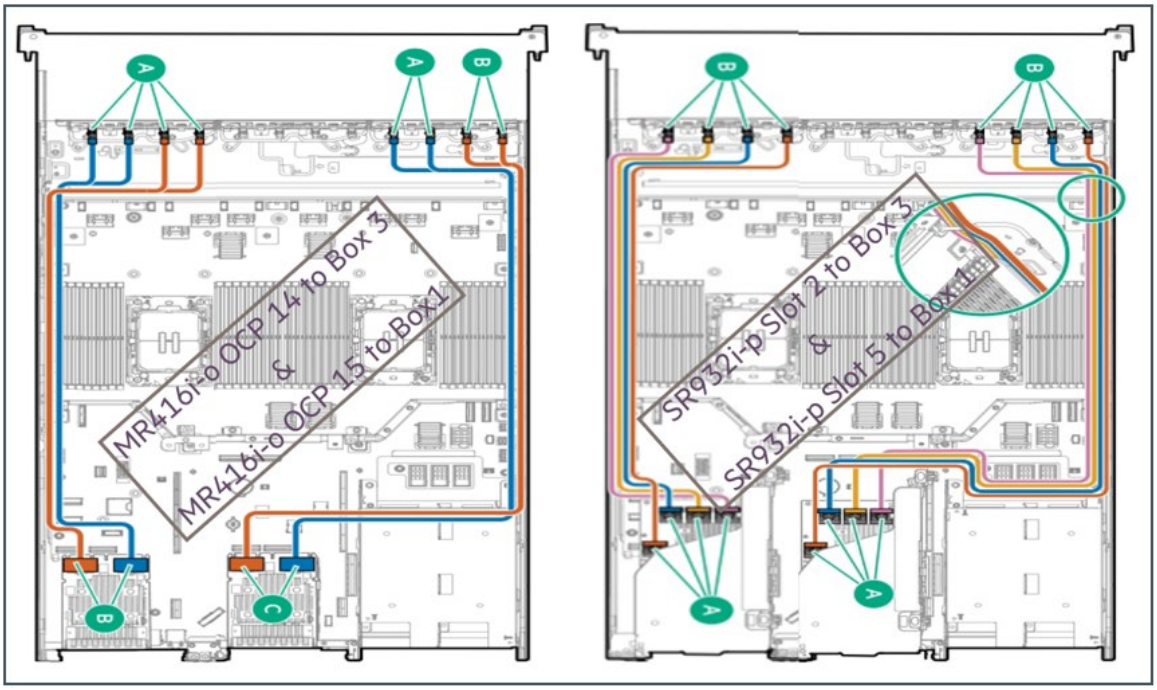

FIGURE 10. 2 or 4-socket HPE ProLiant DL560 Gen11 server Box 3 for SAP HANA persistent storage and Box 1 for Dual-purpose – Controller connections

HPE PROLIANT DL380 GEN11 SERVER FOR SAP HANA

The HPE ProLiant DL380 Gen11 supports both 4th and 5th Gen Intel Xeon Scalable Processors and up to 64 cores. Memory configurations range from 256GB to 4TB for SAP HANA implementations. It supports high-performance DDR5 DIMMs at speeds up to 4800MT/s (1 DPC) or 4400MT/s (2 DPC) with 4th Gen Intel Xeon Scalable Processors and DIMMs at speeds up to 5600MT/S (1 DPC) and 5200MT/s (2DPC) with 5th Gen Intel Xeon Scalable Processors. The design and implementation recommendations made in this document are only for SAP HANA Appliance and TDI implementations.

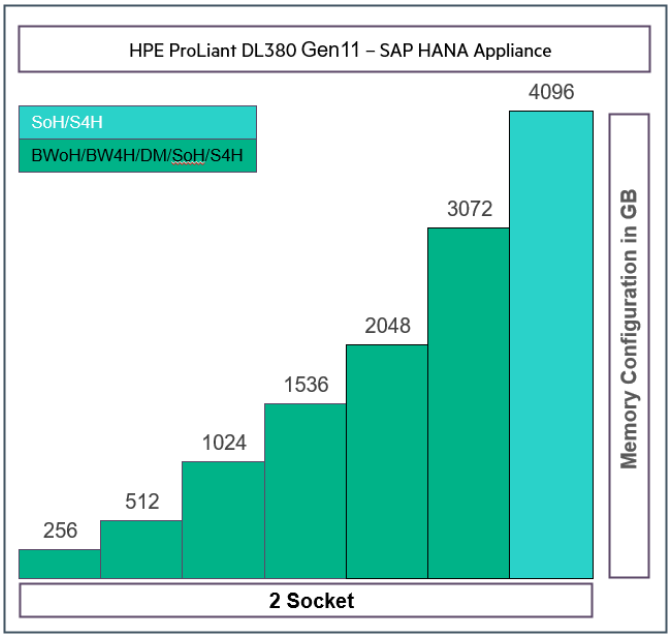

FIGURE 11. Memory configuration for HPE ProLiant DL380 Gen11 Server for SAP HANA

Figure 12 shows the front view and the rear view of a standard HPE ProLiant DL380 Gen11 server offering for SAP HANA Certified Appliance and TDI. The Server supports the HPE MR416i-o storage controller for SAP HANA Certified Appliance offerings; the view of backplane will change based on the chosen component.

See additional HPE ProLiant DL380 Gen11 Server documentation for more information:

- HPE ProLiant DL380 Gen11 Server - Quickspecs
- HPE ProLiant DL380 Gen11 Server - User Guide
- HPE ProLiant DL380 Gen11 Server - Document List

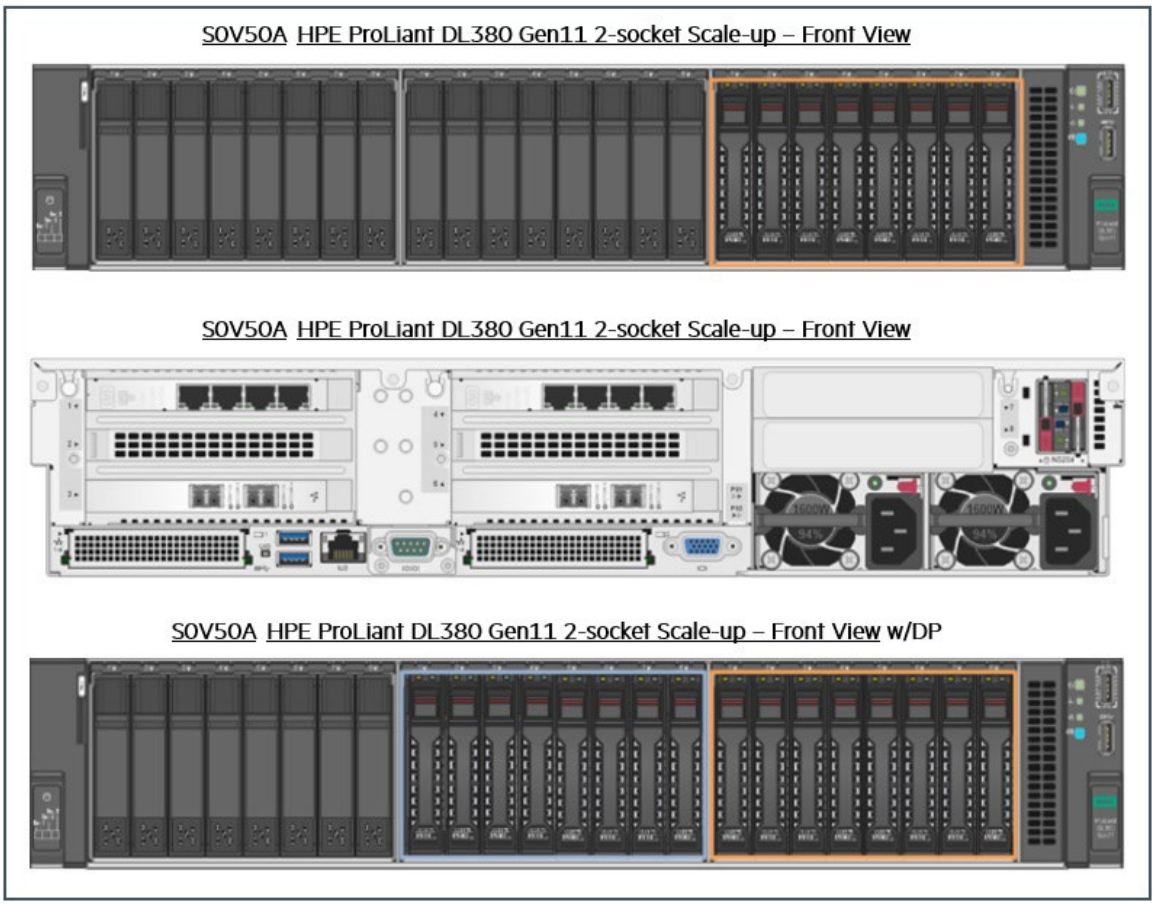

FIGURE 12. HPE ProLiant DL380 Gen11 server Box 3 for SAP HANA persistent storage and Box 2 for dual-purpose

HPE ProLiant DL380 Gen11 SAP HANA Appliance

Table 10 illustrates the components necessary to configure both an SAP HANA Certified Appliance and TDI solution using the HPE ProLiant DL380 Gen11 Server. These are only recommended hardware components for TDI solutions. Contact an HPE specialist to consider additional configuration options to meet unique customer needs.

Table 10 lists several mandatory components. The solution configurations and combinations mentioned in Table 10 have been tested in a standard lab environment and offer optimal performance and quality build for SAP Solutions.

TABLE 10. Components of HPE ProLiant DL380 Gen11 Server SAP-certified HANA Appliance

Components	Component description
HPE ProLiant DL380 Gen11 Data Solutions Product SKU	S0V50A - HPE ProLiant DL380 Gen11 for Data Solutions Server
Processor name	4th Generation Intel® Xeon® Scalable (Sapphire Rapids) Processors Intel Xeon-Platinum 8480+ 2.0GHz 56-core 350W Processor for HPE – [Appliance] Intel Xeon-Platinum 8470 2.0GHz 52-core 350W Processor for HPE – [Appliance] 5th Generation Intel® Xeon® Scalable (Sapphire Rapids) Processors (TDI Only)
Number of processors	Two 4th Generation Intel® Xeon® Scalable Processors Two 5th Generation Intel® Xeon® Scalable Processors (TDI Only)
Memory options (Sapphire Rapids)	HPE 16GB (1x16GB) 1 x8 DDR5-4800 Registered HPE 32GB (1x32GB) 2 x8 DDR5-4800 Registered HPE 64GB (1x64GB) 2 x4 DDR5-4800 Registered

Components	Component description
	HPE 96GB (1x96GB) 2 x4 DDR5-4800 Registered HPE 128GB (1x128GB) 4 x4 DDR5-4800 Registered 3DS HPE 256GB (1x256GB) 8 x4 DDR5-4800 Registered 3DS
Memory options (Emerald Rapids)	HPE 16GB (1x16GB) 1 x8 DDR5-5600 Registered HPE 32GB (1x32GB) 2 x8 DDR5-5600 Registered HPE 64GB (1x64GB) 2 x4 DDR5-5600 Registered HPE 96GB (1x96GB) 2 x4 DDR5-5600 Registered HPE 128GB (1x128GB) 4 x4 DDR5-5600 Registered 3DS
Number of DIMMs	16 or 32 – 2-socket configuration
Drive Backplanes	HPE DL380 Gen11 8SFF U.3 Prem Drive Cage Kit
Storage controller	HPE MR416i-o Gen11 x16 Lanes 8GB Cache OCP SPDM Storage Controller
Number of the storage controller	1x for HANA Persistent Storage 1x for HANA Dual-purpose Storage
Storage drive	HPE 3.2TB NVMe Gen4 Mainstream Performance Mixed Use SFF BC U.3 SSD Or HPE 6.4TB NVMe Gen4 Mainstream Performance Mixed Use SFF BC U.3 SSD
Number of storage drive	Maximum 8 Drives for SAP HANA Persistent Storage Maximum 8 Drives for SAP HANA Dual-purpose Storage
Network cards (Base chassis)	Intel I350-T4 Ethernet 1Gb 4-port BASE-T OCP3 Adapter for HPE Broadcom BCM5719 Ethernet 1Gb 4-port BASE-T OCP3 Adapter for HPE Intel I350-T4 Ethernet 1Gb 4-port BASE-T Adapter for HPE Broadcom BCM5719 Ethernet 1Gb 4-port BASE-T Adapter for HPE
Number of network card	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE MLX MCX631102 10/25GbE 2p SFP28 Adapter
Fibre Channel HBA (Optional) (Base chassis)	16Gb/32Gb FC HBA
Dual-purpose storage drive option	HPE 1.6TB SAS 24G Mixed Use SFF BC Multi-Vendor SSD HPE 1.8TB SAS 12G Mission Critical 10K SFF BC 3-year Warranty 512e Multi-Vendor HDD HPE 3.2TB SAS 24G Mixed Use SFF BC Multi-Vendor SSD HPE 2.4TB SAS 10k SFF BC 512e MV HDD HPE 6.4TB SAS MU SFF BC MV SSD

Processor

Table 11 lists the recommended or required processors for both SAP HANA Appliance and TDI solutions. Any general purpose or IMDB optimized processor can be used for TDI implementation from the ordering menu. There are many processors available in the ordering menu and any supported processor for SAP HANA from the ordering menu can be chosen. The following table lists recommendations.

TABLE 11. Recommended list of processors for HPE ProLiant DL380 Gen11 server

Model	Long Name	Frequency	Core	TDP	Die	2 Processor	Appliance
4th Generation Intel® Xeon® Scalable (Sapphire Rapids) Processors							
8480+	Intel Xeon-P	2.0	56	350	XCC	■	■
8470	Intel Xeon-P	2.0	52	350	XCC	■	■
8490H	Intel Xeon-P	2.1	60	350	XCC	■	■
8468	Intel Xeon-P	2.1	48	350	XCC	■	■
6448H	Intel Xeon-G	2.4	32	250	MCC	■	■
6430	Intel Xeon-G	2.1	32	270	XCC	■	■

8460Y+	Intel Xeon-P	2.0	40	300	XCC	■	■
8452Y	Intel Xeon-P	2.0	36	300	XCC	■	■
6438Y+	Intel Xeon-G	2.0	32	205	MCC	■	■
6442Y	Intel Xeon-G	2.6	24	225	MCC	■	■
5th Generation Intel® Xeon® Scalable (Sapphire Rapids) Processors							
8592+	Intel Xeon-P	1.9	64	350	XCC	■	■
8580	Intel Xeon-P	2.0	60	350	XCC	■	■
8570	Intel Xeon-P	2.1	56	350	XCC	■	■
8558	Intel Xeon-P	2.1	48	330	XCC	■	■
6530	Intel Xeon-G	2.1	32	195	XCC	■	■

Memory

The HPE ProLiant DL380 Gen11 Servers for SAP HANA can be configured with 2-sockets and up to 4TB memory. This guide shows memory/processor configurations that are available and tested. For production environments, customer performance and sizing requirements must be evaluated properly. SAP HANA sizing range of memory configurations is offered under SAP HANA Appliance and TDI categories.

Table 12 shows the available memory configurations for SAP HANA Appliance Configurations

TABLE 12. HPE ProLiant DL380 Gen11 DS Server Appliance Memory Configuration

Configuration	SKU	256GB	512GB	1024GB	1536GB	2048GB	3072GB	4096GB
HPE ProLiant DL380 Gen11 for Data Solutions Server	S0V51A	X	X	X	X	X	X	X

Memory population rules are comprehensively described in https://www.hpe.com/psnow/doc/a50007437enwGen11 Memory Population Rule Guide. Table 13 shows the combinations of DIMMs available for SAP HANA specific memory sizing. You must select the correct memory options from the ordering menu based on selection of processors.

- 4th Generation Intel® Xeon® Scalable (Sapphire Rapids) Processors supports 4800MT/s DIMMs.
- 5th Generation Intel® Xeon® Scalable (Sapphire Rapids) Processors supports 5600MT/s DIMMs.

TABLE 13. HPE ProLiant DL Gen11 Server DIMM combination

Server Memory in GB	Appliance	TDI	2-socket server
256 (0.25TB)	■	■	16 x 16GB
512 (0.5TB)	■	■	16 x 32GB or 32 x 16GB
1024 (1.0TB)	■	■	16 x 64GB or 32 x 32GB
1536 (1.5TB)	■	■	16 x 96GB
2048 (2.0TB)	■	■	16 x 128GB or 32 x 64GB
3072 (3.0TB)	■	■	32 x 96GB
4096 (4.0TB)	■	■	32 x 128GB

NOTE

- 1 DIMM per channel, the same channel must be fully populated – a total of 8 DIMM per processor.
- 2 DIMM per channel, both channels must be fully populated – a total of 16 DIMM per processor.
- Homogenous symmetric population is only allowed.
- Higher rank DIMM must be populated at White DIMM slots.
- Mix–DIMM - x4 cannot be mixed with x8.
- Mix–DIMM - Ranks can be mixed but only with all 16 DIMMs sockets populated.
- Do not mix DIMMs module types within a memory channel. All must be RDIMM or 3DS RDIMM module types with the same ECC configuration.

Storage Controllers and layout

When configured as an SAP Certified Appliance, the HPE ProLiant DL380 Gen11 requires the "HPE MR416i-o Gen11 Controller" for configuring both primary and dual-purpose storage. Mixing different controllers on the same SAP HANA Appliance is not allowed. More details about the controller configuration and properties, can be found in the "Storage Controller" section under HPE ProLiant DL560 Gen11 Server.

Figure 13 illustrates configurations with and without dual-purpose storage For HPE ProLiant DL380 Gen11 server the SAP HANA persistent storage will always be configured on Box 3 and the dual-purpose will go on Box 2.

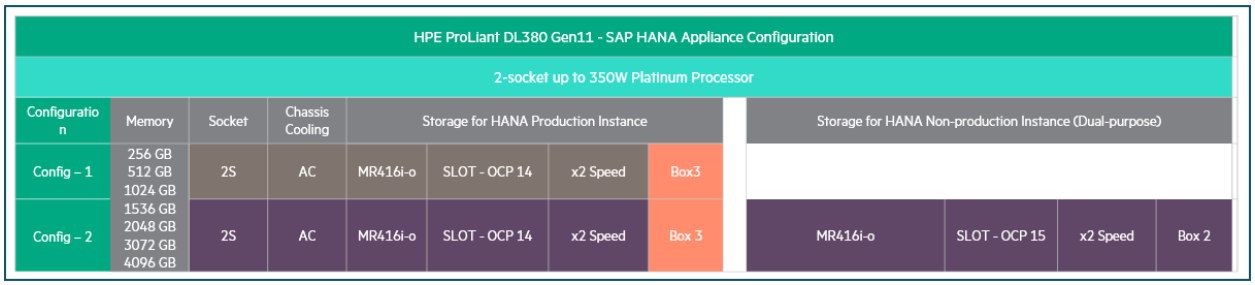

FIGURE 13. HPE ProLiant DL380 Gen11 servers Storage Connections

Figure 14 illustrates the "HPE MR416i-o Gen11 storage controller" connections; one controller is used for SAP HANA persistent storage and another for SAP HANA dual-purpose implementation. The controller installed on OCP 14 is connected to Box 3 to provide SAP HANA persistent storage while the controller installed on OCP Slot 15 is to provision SAP HANA dual-purpose storage.

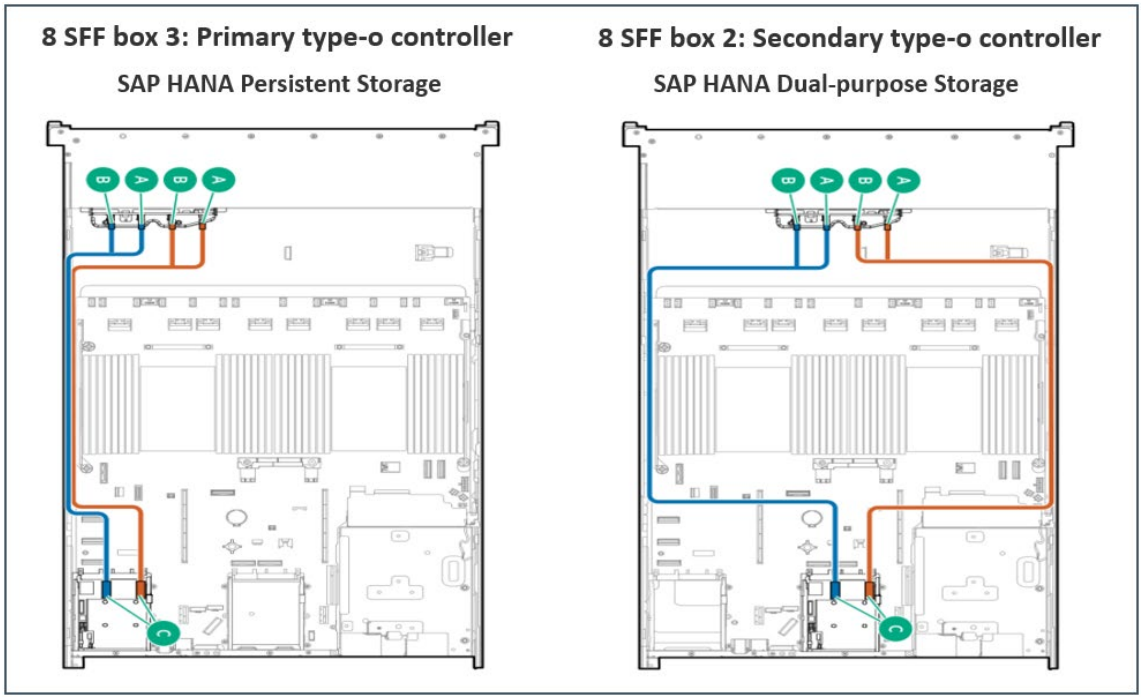

FIGURE 14. HPE ProLiant DL380 Gen11 2-socket Box 3 for SAP HANA persistent storage and Box 2 for dual-purpose

Storage Drives and Sizing for Appliance

Tables 14 and Table 15 show the minimum persistent storage requirement for SAP HANA Certified Appliance implementation on HPE ProLiant DL380 Gen11 server. Table 14 and Table 15 show the storage partition layout using 6.4TB NVMe and 3.2TB NVMe SSDs respectively.

For TDI solutions, the storage sizing has been relaxed by SAP. The TDI storage requirement is further discussed in the section Storage Sizing Chart for TDI Implementation.

To implement SAP HANA Appliance, two drives SKUs are allowed to carve out the SAP HANA persistent storage layout.

- HPE 3.2TB NVMe Gen4 Mainstream Performance Mixed Use SFF BC U.3 SSD
- HPE 6.4TB NVMe Gen4 Mainstream Performance Mixed Use SFF BC U.3 SSD

Considering future requirement and scalability, it is recommended to use 6.4TB NVMe Drives.

TABLE 14. SAP HANA Appliance Persistent Storage using 6.4TB NVMe MU Drives

2-socket	Memory	Nos of Drive	RAID	Shared	Log	DATA
Y	256	3	5	2048	1536	6144
Y	512	3	5	2048	1536	6144
Y	1024	3	5	2048	1536	6144
Y	1536	3	5	2048	1536	6144
Y	2048	3	5	2048	1536	6144
Y	3072	5	5	4096	1536	12288
Y	4096	5	5	4096	1536	12288

TABLE 15. SAP HANA Appliance Persistent Storage using 3.2TB NVMe MU Drives

2-socket	Memory	Nos of Drive	RAID	Shared	Log	DATA
Y	256	3	5	1024	1536	1536
Y	512	3	5	1024	1536	1536
Y	1024	4	5	1024	1536	3072
Y	1536	5	5	2048	1536	6144
Y	2048	5	5	2048	1536	6144
Y	3072	8	50	4096	1536	12288
Y	4096	8	50	4096	1536	12288

HPE PROLIANT DL360 GEN11 SERVER FOR SAP HANA

The HPE ProLiant DL360 Gen11 Server delivers performance, security, agility, and flexibility in a compact 1U form factor. The HPE ProLiant DL360 Gen11 server is a versatile compute block ideal for bare metal or virtualized environments. Due to its versatility, it is an ideal server for implementing SAP Application Servers and SAP Business One Solutions.

The HPE ProLiant DL360 Gen11 server supports 4th and 5th Generation Intel Xeon Scalable Processors, and memory footprints up to 4TB of DDR5 Smart Memory. 4th Generation Intel Xeon Scalable Processors feature up to 60 cores and memory speeds of 4800 MT/s. And 5th Generation Intel Xeon Scalable Processors feature up to 64 cores and memory speeds of 5600 MT/s.

HPE ProLiant DL360 Gen11 server is an excellent choice of SME Business and workloads in General Compute, Database Management, Virtualization. Figure 15 shows the basic front and rear view of HPE ProLiant DL360 Gen11 server.

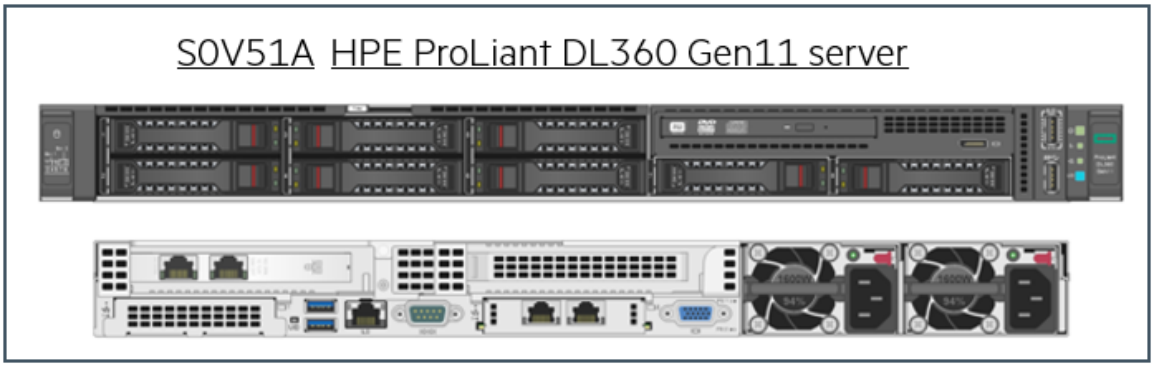

FIGURE 15. HPE ProLiant DL360 Gen11 2-socket Server

See additional HPE ProLiant DL380 Gen11 Server documentation for more information:

- HPE ProLiant DL360 Gen11 Server - Quickspecs
- HPE ProLiant DL360 Gen11 Server - User Guide
- HPE ProLiant DL360 Gen11 Server - Document List

COMPONENT, CAPACITY AND SIZING FOR SAP HANA

This section discusses the various requirements and common design options for the storage subsystem to install and configure SAP HANA on HPE ProLiant Gen11 servers.

Sizing is often performed during early project stages where the business process and application requirements will be translated into hardware infrastructure requirements. Sizing activity includes consolidating the requirement of CPU, memory, storage, power, network, and I/O throughput.

The persistent storage layer of the infrastructure must meet many requirements, with a key consideration being compatibility with SAP HANA Appliance or SAP HANA TDI Implementation. This section provides guidance to consumers on evaluating different sizing aspects.

For more information on SAP HANA Sizing, see SAP HANA Sizing.

Processors

With the launch of the 4th and 5th Generation Intel Xeon Scalable Processors, the new processor architecture supports higher per-core performance while growing the number of cores up to 64 per socket. As the number of cores per socket and overall processor speed increases, the processor to memory input/out subsystems needs to be enhanced. To this end the DDR5 memory provides 1.5x time the bandwidth over DDR4 totaling 5600 MT/s (Mega Transfer per Second). The PCIe Gen5 has increased the available lanes to 80.

4th Generation Intel Xeon Scalable Processors supports up to 4800 MT/s while 5th Generation Intel® Xeon® Scalable Processors supports up to 5600 MT/s based on supportability of processors SKU.

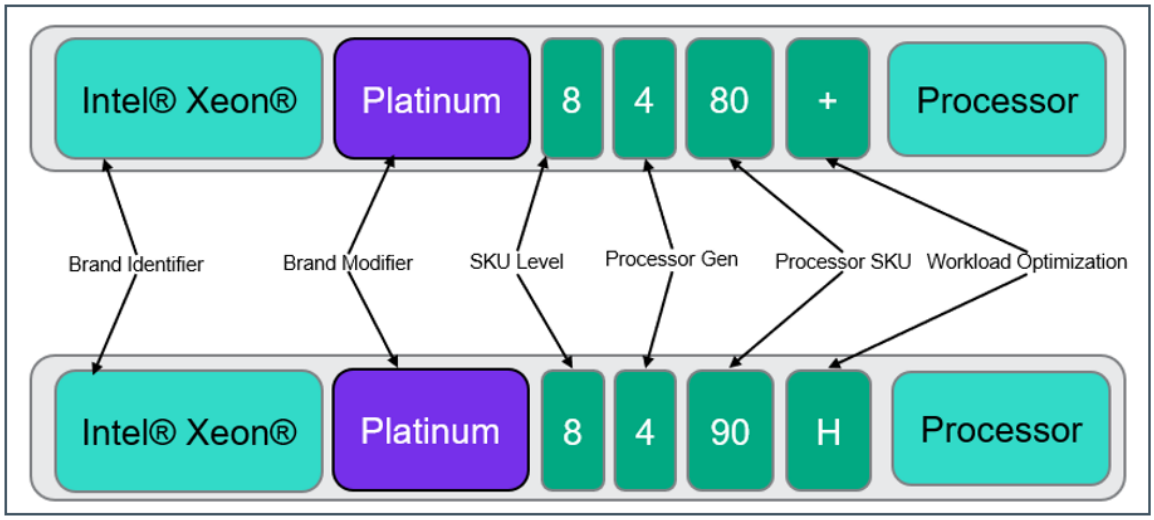

FIGURE 16. Intel® Xeon® Scalable 4th Generation processor

Table 16 shows the alphanumeric string which describes the characteristics of the Intel® Xeon® Processor.

TABLE 16. SKU Level 4th and 5th Generation Intel Xeon Scalable Processors

SKU Level	SKU Description	Scalability
8	Platinum	Advanced 2, 4 and 8 Socket performance, designed for most demanding workloads
6, 5	Gold	Up to 4 Socket scalable performance, advanced reliability, and security solutions
4	Silver	Performance and power efficient for entry level compute
3	Bronze	Small business

Table 17 shows the alphabetic character which describes the workload specific optimization of the Intel Xeon Scalable Processors.

TABLE 17. Alphanumeric string which describes the characteristics of Intel Xeon processor

Workload optimization	Description of workload optimization
Y	Speed Select Technology-Performance Profile (SST-PP) enabled
Y+	Speed Select Technology-Performance Profile (SST-PP) enabled and includes 1 of each of the accelerators.
P	Cloud and infrastructure as a service (IaaS) workload
V	Optimized for cloud and software as a service (SaaS) workloads

Workload optimization	Description of workload optimization
N	Network/5G/Edge workloads (High TPT/Low Latency)
U	Uniprocessor (some workload-specific SKUs may also be uniprocessor)
S	Storage & HCI workloads
+	Includes 1 of each of the four accelerators: DSA, IAA, QAT, DLB
H	Database and analytics workloads, supports 4S (Xeon Gold) and/or 8S (Xeon Platinum) configurations and includes all accelerators
M	Media transcode workloads
Q	Liquid cooling
T	Long-life use/High thermal case

Memory

SAP regularly releases "T-Shirt Sizes" for SAP HANA, defining the memory per core ratio.

These "T-Shirt Sizes" entail specific hardware requirements. The following rules must be followed when configuring server memory:

- 1 DIMM per channel, the same channel must be fully populated – a total of eight (8) DIMM per processor. [White Channel]
- 2 DIMM per channel, both channels must be fully populated – a total of sixteen (16) DIMM per processor. [Black Channel]
- Homogenous symmetric population is only allowed.
- Higher rank DIMM must be populated at White DIMM slots.

Table 18 shows the eight (8) and sixteen (16) DIMMs population scheme on HPE ProLiant Gen11 servers.

TABLE 18. DIMM SLOT population scheme for 8 and 16 DIMMs per processors

HPE ProLiant Gen11 Servers 16 slots per CPU DIMM population order for SAP HANA																
8 DIMMs	1		3		5		7			10		12		14		16
16 DIMMs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

For more details on sizing, see the SAP Sizing portal.

Storage Controller

The SAP HANA Certified Appliance configurations on both the ProLiant DL380 and DL560 Gen11 servers have specific storage controller requirements outlined in their respective storage controller sections. All other controllers in HPE ProLiant Gen11 Server are supported for SAP HANA TDI implementations if these TDI supported controllers achieve the minimum threshold of Storage KPIs defined by SAP.

Refer the quickspec documents for Gen11 controllers as follows:

- HPE Compute MR Gen11 Controllers
- HPE Compute SR Gen11 Controllers
- NVMe Hot Plug Boot Optimized Storage Device

NVMe Boot Optimized Storage Device

HPE NS204i-u is an operating system-specific boot device which offers a segregation of the operating system from the data storage controller and devices. This device is available through a dedicated slot at the server backplane and does not consume a PCIe slot. The NS204i-u is offered with two 480GB M.2 NVMe SSDs is configured in RAID 1 to provide the redundancy for storage drive. For SAP HANA deployments, the HPE NS204i-u can be used exclusively in TDI configurations. Refer the QuickSpecs of NS204i-u devices.

Table 19 shows the HPE NS204i-u features.

TABLE 19. HPE NS204i-u features

HPE NS204i-u Gen11 NVMe Hot Plug Boot Optimized Storage Device	
Product Number	P48183-B21
Platform supported	HPE ProLiant DL
RAID levels	Dedicated hardware RAID 1
Form factor	PCIe half-height, half-length (HHHL) card
Usable capacity	480GB
PCIe support	Gen3

Figure 17 shows the front view of the HPE NS204i-u OS boot device.

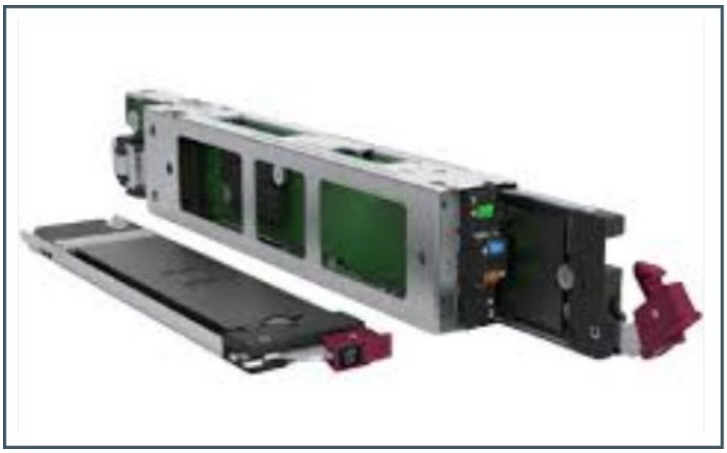

FIGURE 17. HPE NS204i-u Gen11 OS Boot Device

STORAGE REQUIREMENTS

This section of the document describes the requirements of persistent disk storage for SAP HANA Tailored Data Center Integration (TDI) and SAP HAN Certified Appliance Implementations.

For more information, see the SAP HANA Sizing Portal and the SAP HANA– TDI - Storage Requirements.

Storage Sizing Chart for TDI Implementation

This illustrates the standard minimum required sizing for SAP HANA TDI Implementations for HPE ProLiant DL360, DL380 and DL560 Gen11 servers. The sizing of these volumes can be changed per customer requirements.

Table 20 provides the overall formula used to estimate the minimum storage requirement for a TDI Implementation.

TABLE 20. Formula to derive TDI Storage requirement.

Purpose	Sizing formula
Operating System	256GB of Drive/Volume for Operating System
/usr/sap	64GB
LOG	[systems ≤ 512GB] Size redo ½ = 1/2 x RAM [systems > 512GB] Size redo log (min) = 512GB
SHARED	Size installation (single node) = MIN (1 x RAM; 1TB)

Purpose	Sizing formula
DATA	Size data = 1.2 x Total Server Memory

Table 21 outlines the SSD requirements for the TDI Implementation of HPE ProLiant DL360 Gen11, HPE ProLiant DL380 Gen11 and HPE ProLiant DL560 Gen11 servers. The SSD quantities are calculated using the formulas provided in Table 20, and the DATA Volumes are considered at 1.2 times the server's memory. The proposed disk numbers are determined based on size and are independent of the storage controller selection.

TABLE 21. Minimum storage requirement for SAP HANA TDI Implementation

Memory Type	Total Memory (GB)	For TDI, Total Space Required	800GB All SSD	1.6TB ALL SSD	2.4TB ALL SSD	3.2TB ALL SSD	6.4TB ALL SSD
DRAM	256	1075	3 - RAID 5	3 - RAID 5	3 - RAID 5	3 - RAID 5	3 - RAID 5
DRAM	512	1894	4 - RAID 5	3 - RAID 5	3 - RAID 5	3 - RAID 5	3 - RAID 5
DRAM	1024	3021	6 - RAID 5	3 - RAID 5	3 - RAID 5	3 - RAID 5	3 - RAID 5
DRAM	1536	4250	7 - RAID 5	4 - RAID 5	3 - RAID 5	3 - RAID 5	3 - RAID 5
DRAM	2048	4250	7 - RAID 5	4 - RAID 5	3 - RAID 5	3 - RAID 5	3 - RAID 5
DRAM	3072	6707	12 - RAID 50	6 - RAID 5	4 - RAID 5	4 - RAID 5	3 - RAID 5
DRAM	4096	6707	12 - RAID 50	6 - RAID 5	4 - RAID 5	4 - RAID 5	3 - RAID 5
DRAM	6144	11622		10 - RAID 50	6 - RAID 5	5 - RAID 5	3 - RAID 5
DRAM	8192	11622		10 - RAID 50	6 - RAID 5	5 - RAID 5	3 - RAID 5

HPE recommends using Solid State Drives (SSD) configured in RAID 5, 50, or 6 for SAP HANA implementation. Though there are a variety of drive options available in the TDI menu, this minimum storage sizing is recommended for TDI Implementation as shown in Table 21.

NOTE
For SAP HANA implementation, the HPE ProLiant DL380 and DL360 Gen11 servers support a maximum of 16 and 10 drives, respectively.

Storage Sizing Chart for SAP HANA Appliance Implementation

SAP allows for flexibility in storage sizing to cater to diverse customer needs. Refer to Table 22 for the formula utilized to estimate the minimum storage requirement for a single SAP HANA database instance in production Appliance environment.

TABLE 22. Formula to derive the storage requirement for Appliance configurations.

Purpose	Sizing Formula
Operating system	320GB of drive/volume for an operating system
/usr/sap	64GB
LOG	[systems ≤ 512GB] Size redo ½ = 1/2 x RAM [systems > 512GB] Size redo log (min) = 512GB
SHARED	Size installation (single node) = MIN (1 x RAM)
DATA	Size data = 3 x Total Server Memory

Table 23 shows the quantity of SSD's required for HPE ProLiant DL380 and DL560 Gen11 SAP Certified Appliance configurations. The SSD quantities are determined based on the formula described in Table 22. DATA Volumes are calculated as three times that of the server's memory.

The number of disks proposed is based on the size and independent from the storage controller selection. The recommended configurations in this paper have used RAID 5 or 50.

TABLE 23. Total Memory and No. of SSDs required.

Memory Type	Total Memory (GB)	For Appliance, Total Space Required	3.2TB ALL SSD	6.4TB ALL SSD
DRAM	256	2944	3 (R5)	3 (R5)
DRAM	512	3964	3 (R5)	3 (R5)
DRAM	1024	6016	4 (R5)	3 (R5)
DRAM	1536	8086	5 (R5)	3 (R5)
DRAM	2048	10112	5 (R5)	3 (R5)
DRAM	3072	14208	8 (R50)	5 (R5)
DRAM	4096	18304	8 (R50)	5 (R5)
DRAM	6144	26496		8 (R50)
DRAM	8192	34688		8 (R50)

NOTE

The HPE ProLiant DL380 Gen11 Server supports a maximum of 16 disks, while the HPE ProLiant DL360 Gen11 Server supports up to 10 disks.

Persistent Data Storage Configuration for SAP HANA Production Instance

This section describes how to carve out the persistent data storage for SAP HANA Appliance configurations on HPE ProLiant DL380 and DL560 Gen11 servers. The standard method is to use the Logical Drive created during storage controller configurations as shown in the standard partitioning layout table for SUSE and Red Hat operating systems.

Steps involved here are as follows:

- Use the "fdisk" to create a new partition.
- Toggle the partition to Raw Partition.
- See the newly created drive.
- Identify the newly created drive partitioning name/number.
- Create physical volume.
- Create volume group.
- Create logical volume.
- Format logical volume with XFS.
- Create a mount directory for each logical volume.
- Create /etc/fstab mount points.
- Mount all logical volumes.

Ensure to check and verify the size of each logical volume for SAP HANA persistent storage.

To complete the steps Linux Logical Volume Manager is used, and logical volumes are formatted using XFS.

Follow the steps to configure LVM for HANA Volume and create filesystems. The steps described in the section below are for 3 SSD configuration. The Logical Volumes are created with defined sizes in the Logical Drives sizing chart for SAP HANA Appliance installation. If the sizes of the Logical Drives change, there will be no change required in commands mentioned in section during creation of LVM layout and the steps defined will work for all SSD Combinations listed in Table 23.

Create the required file systems per SAP recommendations refer to the Recommended File System Layout.

The following two tables show the logical volumes sizes for each memory configuration using 3.2TB NVMe and 6.4TB NVMe Mixed Used Multi-vendor SSDs. SAP HANA persistent storage needs logical volumes for HANA Shared, LOG, DATA volumes; it is also recommended to create a 64 GB logical volume for "/usr/sap."

Logical Volumes using 6.4TB NVMe MU MV SSD

The following table shows the logical volumes for SAP HANA Appliance persistent data storage while using the 6.4TB NVMe MU MV SSD.

TABLE 24. Using 6.4TB NVMe SSD – Storage layout for SAP HANA Appliance production instance

2-socket	4-socket	Memory in GB	SSD Size	SSD	RAID	vgHANA-lvol1 /usr/sap	vgHANA-lvol2 /hana/share	vgHANA-lvol3 /hana/log	vgHANA-lvol4 /hana/data
Y	N	256	6.4TB	3	5	64 GB	2048GB	1536GB	6144GB
Y	Y	512	6.4TB	3	5	64 GB	2048GB	1536GB	6144GB
Y	Y	1024	6.4TB	3	5	64 GB	2048GB	1536GB	6144GB
Y	Y	2048	6.4TB	3	5	64 GB	2048GB	1536GB	6144GB
Y	Y	4096	6.4TB	5	5	64 GB	4096GB	1536GB	12288GB
N	Y	8192	6.4TB	8	50	64 GB	8192GB	1536GB	24576GB

Logical Volumes using 3.2 TB NVMe MU MV SSD

The following table shows the logical volumes for SAP HANA Appliance persistent data storage while using the 3.2TB NVMe MU MV SSD.

TABLE 25. Using 3.2TB NVMe SSD – Storage layout for SAP HANA Appliance production instance

2-socket	4-socket	Memory in GB	SSD Size	SSD	RAID	vgHANA-lvol1 /usr/sap	vgHANA-lvol2 /hana/share	vgHANA-lvol3 /hana/log	vgHANA-lvol4 /hana/data
Y	N	256	3.2 TB	3	5	64 GB	1024 GB	1536 GB	1536 GB
Y	Y	512	3.2 TB	3	5	64 GB	1024 GB	1536 GB	1536 GB
Y	Y	1024	3.2 TB	4	5	64 GB	1024 GB	1536 GB	3072 GB
Y	Y	2048	3.2 TB	5	5	64 GB	2048 GB	1536 GB	6144 GB
Y	Y	4096	3.2 TB	8	50	64 GB	4096 GB	1024 GB	12288 GB

Dual-Purpose Non-Production Storage

With HPE ProLiant Gen11 servers offering dual-purpose storage, non-production storage has been integrated within the server's internal storage. External storage is no longer required.

HPE ProLiant DL560 Gen11 server supports dual-purpose integration at Box 1 and HPE ProLiant DL380 Gen11 server supports this at Box 2.

For dual-purpose implementation following drives are recommended,

- HPE 1.6TB SAS 24G Mixed Use SFF BC Multi-Vendor SSD
- HPE 1.8TB SAS 12G Mission Critical 10K SFF BC 3-year Warranty 512e Multi-Vendor HDD
- HPE 3.2TB SAS 24G Mixed Use SFF BC Multi-Vendor SSD

- HPE 2.4TB SAS 10k SFF BC 512e MV HDD
- HPE 6.4TB SAS MU SFF BC MV SSD

Figure 18 shows the HPE ProLiant DL560 Gen11 Server with dual-purpose storage installed on Box 1.

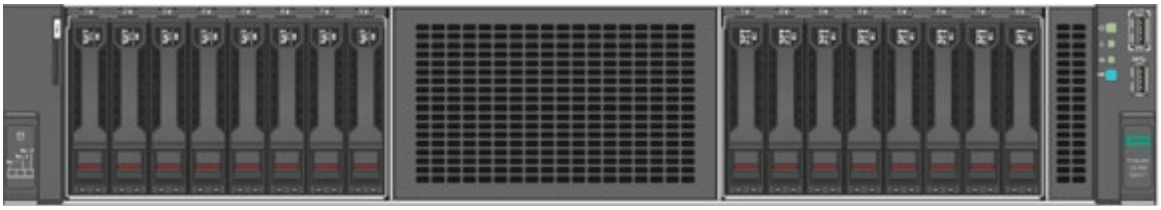

FIGURE 18. HPE ProLiant DL560 Gen11 server with dual-purpose at Box 1

Figure 19 shows the HPE ProLiant DL380 Gen11 Server with Dual-purpose storage installed on Box 2.

FIGURE 19. HPE ProLiant DL380 Gen11 server with dual-purpose at Box 2

Storage connection layout is shown in the respective section for HPE ProLiant DL560 Gen11 and HPE ProLiant DL380 Gen11 servers.

NETWORK REQUIREMENTS

Components of the SAP HANA landscape communicate via different network channels. It is recommended by SAP to have a well-defined network topology to control, limit, and isolate the network access and usage to only those communication channels required for the implementation scenarios.

The independent and secured network channels that we can use are as follows:

- Client Network Zone
  - SQL Client Communication
  - HTTP Client Communication
  - Management Network
- Internal Network Zone
- Internode Network
  - System Replication
  - Storage Replication
  - Backup Network
- Storage Network Zone
  - Shared/NFS Network
- Fiber Channel Network

For more information, see the SAP HANA Network Requirements Technical paper.

Network, Bond, and VLAN for SAP HANA

To promote high availability, it is important to create bonds between more than one physical NIC. If there are options to use the high-speed Network Adapters, it is a better choice to use the VLAN configuration over the bonding network. It is also important to restrict the maximum utilization of each VLAN.

Table 26 shows the Network bond or VLAN for SAP HANA purposes.

TABLE 26. Network bond or VLAN for SAP HANA configuration

Network Zone	Purpose	Bandwidth and Bond/VLAN
DATA 10	Purposed for data traffic from other SAP applications. Generally, this network is connected to SAP application servers and other source systems, which are supposed to interact with the HANA landscape	10Gbps / Bond or VLAN; 2 NIC Port
DATA 1	Same as DATA 10 with 1Gbps	1Gbps / Bond or VLAN; 2 NIC Port
Management network	To connect to the landscape and handle the management task	1Gbps / Bond or VLAN; 2 NIC Port
Backup	Dedicated backup link to take the backup of HANA landscape log, data, and shared volumes	10Gbps / Bond or VLAN; 2 NIC Port
User/BI	Purposed to external connection for SAP HANA client to run SQL queries and/or for external application to connect to SAP HANA for fetching the analytical data	10Gbps / Bond or VLAN; 2 NIC Port
Replication	Network connections network two HANA Landscape to replicate the HANA Landscape from primary to secondary HANA system	10Gbps / Bond or VLAN; 2 NIC Port
Quorum for SG	Required if HPE Serviceguard is used to automate failover process across two systems, used to manage the failover and failback of HANA Landscape	10Gbps / Bond or VLAN; 2 NIC Port

Network Configuration for HPE ProLiant DL560 Gen11 Server

The HPE ProLiant DL560 Gen11's networking configuration is dependent on the storage controller selection because the type and slotting will differ. The two supported controllers are the "HPE MR416-o Gen11 storage controller", an OROC controller, and is the PCIe based "HPE SR932i-p Gen11 storage controller". The type and location of 1Gbps NICs are dependent on the chosen storage controller.

For the "HPE MR416i-o Gen11 storage controller", 1Gpbs PCIe based network card must been chosen while with "HPE SR932i-p Gen11 storage controller", the 1Gbps network required to been chosen based on OROC form-factor. Table 27 shows the OROC and PCIe slot population with "HPE MR416i-o Gen11 storage controller". You must refer to the following section in this document to understand the bonding configuration.

TABLE 27. Network cards options for HPE ProLiant DL560 Gen11 server with HPE MR416i-o Gen11 storage controller

Bonding Purpose	Bond	Bonding NIC 1
2-socket / 4-socket	OCP 14	HPE MR416i-o Gen11 storage controller
2-socket / 4-socket	OCP 15	HPE MR416i-o Gen11 storage controller
2-socket / 4-socket	PCIe 1	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE Or Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE
2-socket / 4-socket	PCIe 2	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE Or Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE
4-socket	PCIe 3	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE Or Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE
2-socket / 4-socket	PCIe 4	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE Or Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE
2-socket / 4-socket	PCIe 5	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE

Bonding Purpose	Bond	Bonding NIC 1
		Or Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE
2-socket / 4-socket	PCIe 6	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE Or Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE

NOTE
For 2-socket DL560 Gen11 server 2x 10 or 10/25Gbps cards are sufficient but 2 more cards can be added based on additional requirement.

"HPE SR932i-p Gen11 storage controller", will install on PCIe Slot 2 and PCIe Slot 5, due to the selection of "HPE SR932i-p storage controller" the 1Gbps card need to be chosen of OCP form-factor. Please refer to the following section for understanding the bonding configuration. Table 28 shows the PCIe and OCP Slot population while the storage controller is HPE SR932i-p.

TABLE 28. Network cards options for HPE ProLiant DL560 Gen11 server with HPE SR932i-p Gen11 storage controller

Bonding Purpose	Bond	Bonding NIC 1
2-socket / 4-socket	OCP 14	Intel I350-T4 Ethernet 1Gb 4-port BASE-T OCP3 Adapter for HPE Or Broadcom BCM5719 Ethernet 1Gb 4-port BASE-T OCP3 Adapter for HPE
2-socket / 4-socket	OCP 15	Intel I350-T4 Ethernet 1Gb 4-port BASE-T OCP3 Adapter for HPE Or Broadcom BCM5719 Ethernet 1Gb 4-port BASE-T OCP3 Adapter for HPE
2-socket / 4-socket	PCIe 1	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE Or Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE
2-socket / 4-socket	PCIe 2	HPE SR932i-p Gen11 storage controller
4-socket	PCIe 3	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE Or Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE
2-socket / 4-socket	PCIe 4	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE Or Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE
2-socket / 4-socket	PCIe 5	HPE SR932i-p Gen11 storage controller
2-socket / 4-socket	PCIe 6	Broadcom BCM57416 Ethernet 10Gb 2-port BASE-T Adapter for HPE Or Broadcom BCM57414 Ethernet 10/25Gb 2-port SFP28 Adapter for HPE

NOTE
For 2-socket HPE ProLiant DL560 Gen11 Server 2x 10 or 10/25Gbps cards are sufficient but two (2) more cards can be added based on additional requirement.

2-socket HPE ProLiant DL560 Gen11 server with MR416i-o Controller

Table 29, the network bonding configuration has been shown for 2-socket HPE ProLiant DL560 Gen11 server with "HPE MR416i-o Gen11 storage controller". In case an additional network card is chosen then additional bonding can be created as optional.

TABLE 29. Bonding NICs details for 2-socket HPE ProLiant DL560 Gen11 server with network configuration with MR416i-o

Bonding Purpose	Bond	Bonding NIC 1 Primary	Bonding NIC 2 Secondary	Speed
data10	bond2	PCI#1 Port1	PCI#4 Port2	10/25GbE
user/BI Client	bond3	PCI#2 Port 3	PCI#5 Port3	1GbE
management/quorum	bond4	PCI#5 Port2	PCI#2 Port2	1GbE
Replication	bond6	PCI#4 Port1	PCI#1 Port2	10/25GbE
Backup	bond7	PCI#5 Port4	PCI#2 Port4	1GbE
data1	bond8	PCI#2 Port1	PCI#5 Port1	1GbE
Optional bond	bond1	PCI#3 Port1	PCI#6 Port2	10/25GbE
Optional bond	bond9	PCI#6 Port1	PCI#3 Port2	10/25GbE

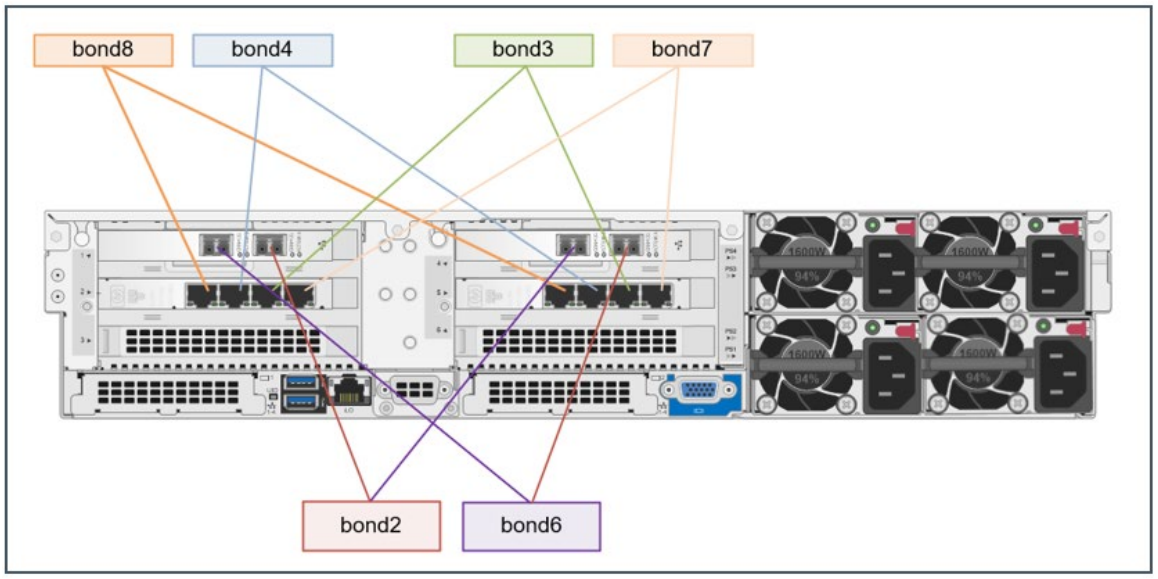

FIGURE 20. 2-socket HPE ProLiant DL560 Gen11 server with network configuration with MR416i-o

2-socket HPE ProLiant DL560 Gen11 server with SR932i-p Controller

In this scenario, the storage controllers are installed in PCIe Slot 2 and Slot 5. As a result, the 1Gbps network will utilize OCP form-factor cards. Specifically, two 1Gbps OCP Network Cards will be placed in OCP Slot 14 and OCP Slot 15 slots. Refer to Table 30 for details out the creation of bonding. Additional option cards can be added to the server as needed, and bonding can be established following the provided instructions.

TABLE 30. Bonding NICs details for 2-socket HPE ProLiant DL560 Gen11 server with network configuration with MR416i-o

Bonding Purpose	Bond	Bonding NIC 1 Primary	Bonding NIC 2 Secondary	Speed
data10	bond2	PCI#1 Port1	PCI#4 Port2	10/25GbE
user/BI Client	bond3	OCP#14 Port3	OCP#15 Port3	1GbE
management/quorum	bond4	OCP#15 Port2	OCP#14 Port2	1GbE

Bonding Purpose	Bond	Bonding NIC 1 Primary	Bonding NIC 2 Secondary	Speed
Replication	bond6	PCI#4 Port1	PCI#1 Port2	10/25GbE
Backup	bond7	OCP#15 Port4	OCP#14 Port4	1GbE
data1	bond8	OCP#14 Port1	OCP#15 Port1	1GbE
Optional bond	bond1	PCI#3 Port1	PCI#6 Port2	10/25GbE
Optional bond	bond9	PCI#6 Port1	PCI#3 Port2	10/25GbE

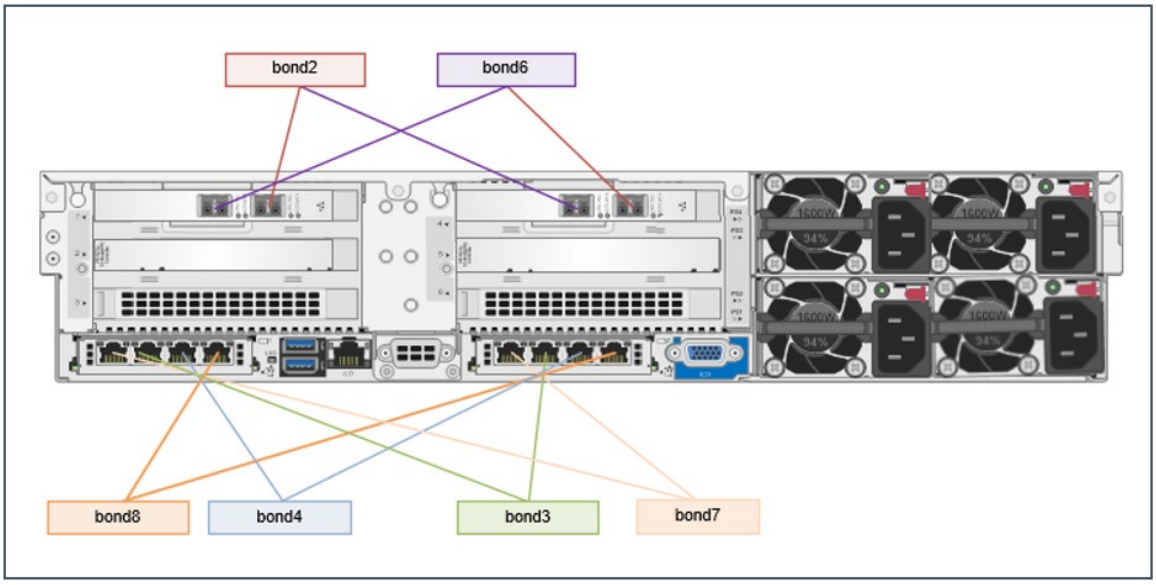

FIGURE 21. 2-socket HPE ProLiant DL560 Gen11 server network configuration with SR932i-p

4-socket HPE ProLiant DL560 Gen11 server with MR416i-o Controller

This scenario involves the use of the HPE MR416i-o storage controller and 4x 10 or 10/25Gbps cards for network configuration and bonding. The 1Gbps PCIe network cards are installed in PCIe Slot 2 and Slot 5. Consult Table 31 for details on how the bonding is created.

TABLE 31. Bonding NICs details for 4-socket HPE ProLiant DL560 Gen11 server with network configuration with MR416i-o controller

Bonding Purpose	Bond	Bonding NIC 1 Primary	Bonding NIC 2 Secondary	Speed
data10	bond2	PCI#1 Port1	PCI#4 Port2	10/25GbE
Optional Bond	bond3	PCI#2 Port 3	PCI#5 Port3	1GbE
Management	bond4	PCI#5 Port2	PCI#2 Port2	1GbE
Replication	bond6	PCI#4 Port1	PCI#1 Port2	10/25GbE
Quorum	bond7	PCI#5 Port4	PCI#2 Port4	1GbE
data1	bond8	PCI#2 Port1	PCI#5 Port1	1GbE
user/BI Client	bond1	PCI#3 Port1	PCI#6 Port2	10/25GbE
Backup	bond9	PCI#6 Port1	PCI#3 Port2	10/25GbE

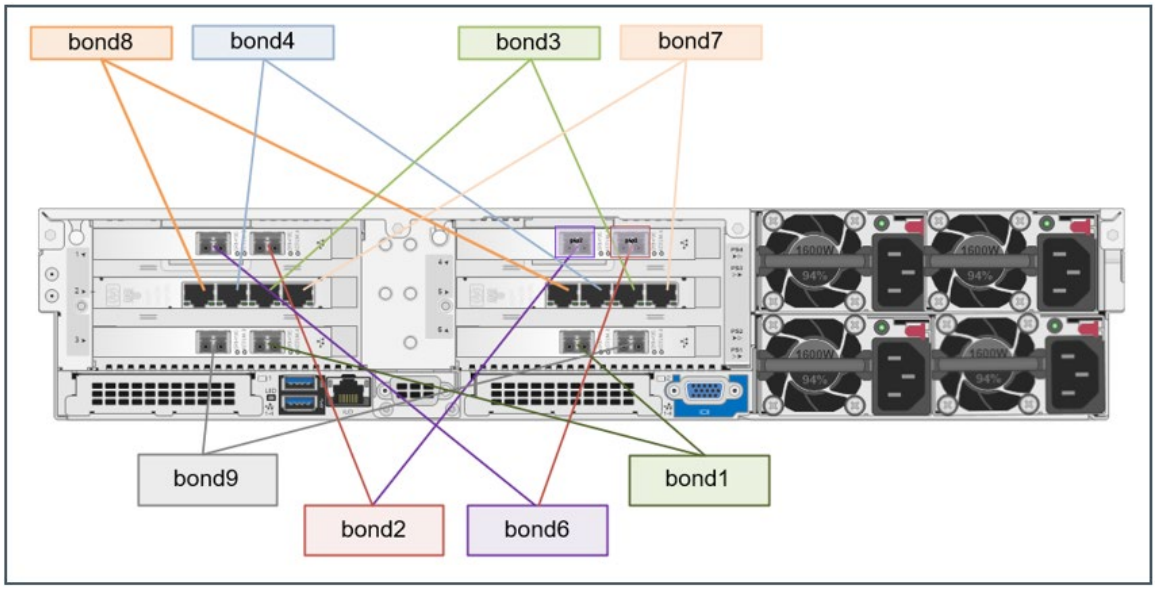

FIGURE 22. 4-socket HPE ProLiant DL560 Gen11 server network configuration with MR416i-o controller

2-socket HPE ProLiant DL560 Gen11 server with SR932i-p Controller

The HPE SR932i-p Gen11 storage controllers are positioned in Slot 2 and Slot 5. In this scenario, a 1Gbps 4 Port card with an OCP form-factor is utilized, placed in OCP Slot 14 and OCP Slot 15. Details on the bonding configuration can be found in Table 32.

TABLE 32. Bonding NICs details for 4-socket HPE ProLiant DL560 Gen11 server with network configuration with SR932i-p controller

Bonding Purpose	Bond	Bonding NIC 1 Primary	Bonding NIC 2 Secondary	Speed
data10	bond2	PCI#1 Port1	PCI#4 Port2	10/25GbE
Optional Bond	bond3	OCP#14 Port3	OCP#15 Port3	1GbE
Management	bond4	OCP#15 Port2	OCP#14 Port2	1GbE
Replication	bond6	PCI#4 Port1	PCI#1 Port2	10/25GbE
Quorum	bond7	OCP#15 Port4	OCP#14 Port4	1GbE
data1	bond8	OCP#14 Port1	OCP#15 Port1	1GbE
user/BI Client	bond1	PCI#3 Port1	PCI#6 Port2	10/25GbE
Backup	bond9	PCI#6 Port1	PCI#3 Port2	10/25GbE

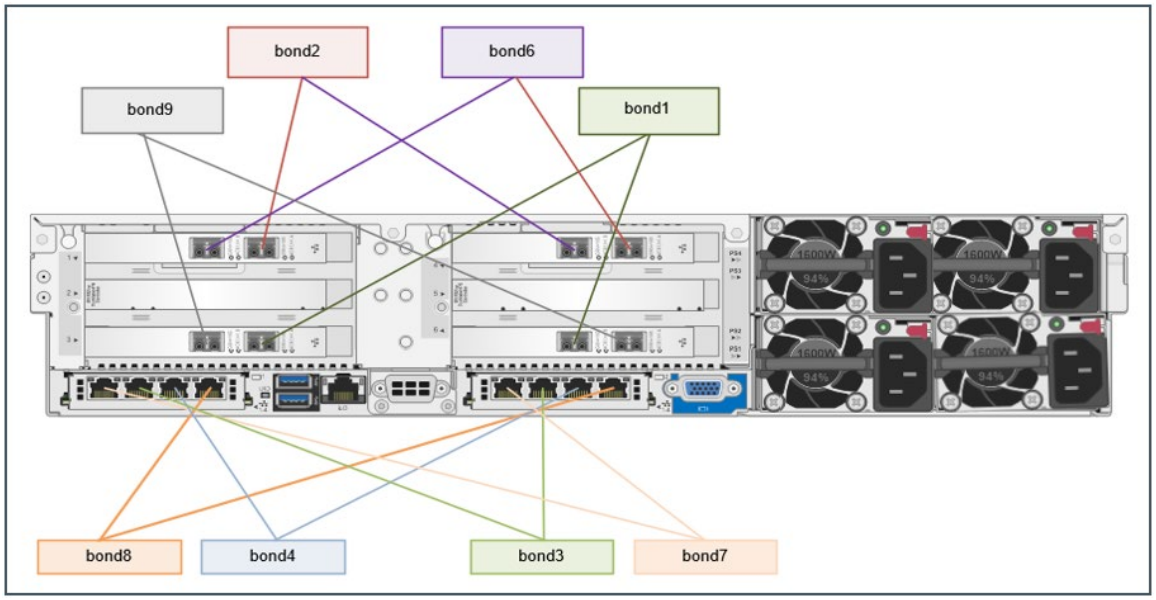

FIGURE 23. 4-socket HPE ProLiant DL560 Gen11 server with network configuration with SR932i-p controller

Network Configuration for HPE ProLiant DL380 Gen11 Server

Table 33, along with Figures 24 and 25, illustrates the network layout for the HPE ProLiant DL380 Gen11 Server for an SAP HANA Certified Appliance. This provides the recommended network and bonding configuration for SAP HANA installation in both Appliance and TDI deployments. The setup involves the use of two 1Gbps 4 Port PCIe cards and two or four 10/25Gbps network cards to meet the network requirements.

Table 33 shows the network zone and bonding NICs details.

TABLE 33. Network zone and bonding NICs details

Bonding Purpose	Bond	Bonding NIC One	Bonding NIC 2	Speed
data10	bond2	PCI#1 Port1	PCI#4 Port2	10/25GbE
user/BI Client	bond3	PCI#2 Port 3	PCI#5 Port3	1GbE
management/quorum	bond4	PCI#2 Port3	PCI#5 Port3	1GbE
Replication	bond6	PCI#4 Port1	PCI#1 Port2	10/25GbE
Backup	bond7	PCI#5 Port4	PCI#2 Port4	1GbE
data1	bond8	PCI#2 Port1	PCI#5 Port1	1GbE
Optional bond	bond1	PCI#3 Port1	PCI#6 Port2	10/25GbE
Optional bond	bond9	PCI#6 Port1	PCI#3 Port2	10/25GbE

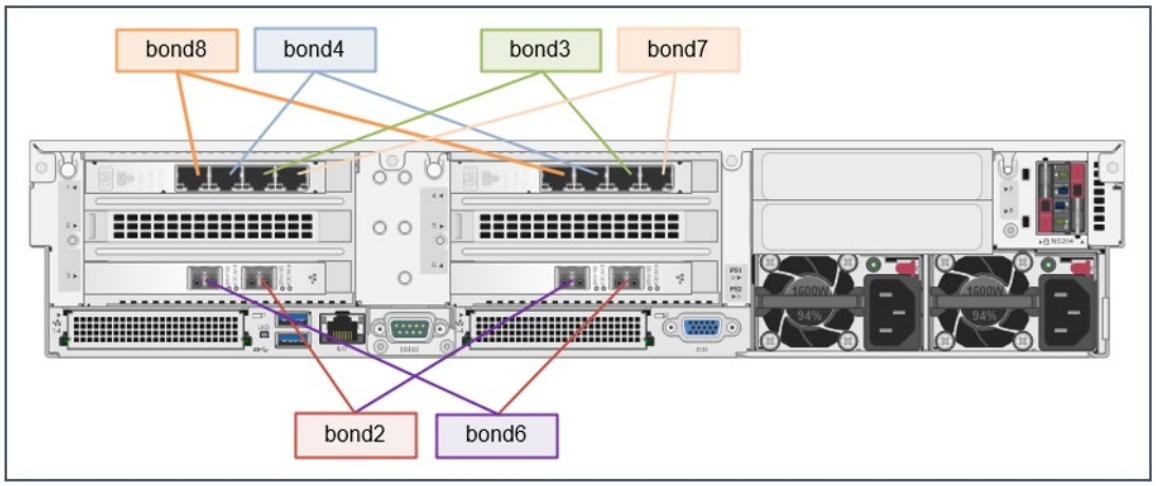

FIGURE 24. 2-socket HPE ProLiant DL380 Gen11 Appliance minimum required networking

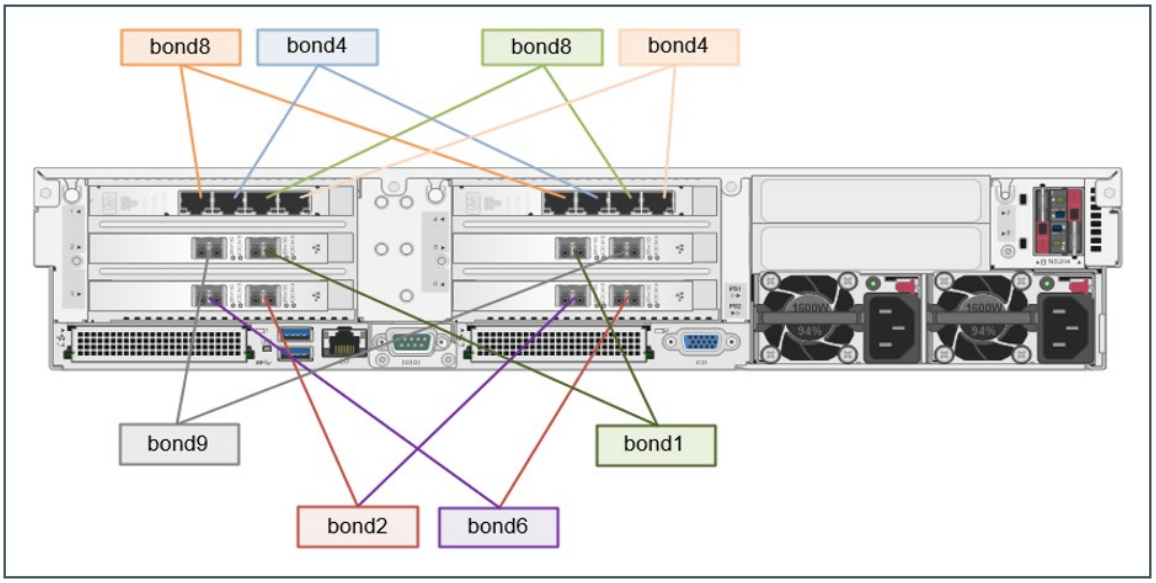

FIGURE 25. 2-socket PE ProLiant DL380 Gen11 server with additional networking

Network Configuration for HPE ProLiant DL360 Gen11Server

As the HPE ProLiant DL360 Gen11 Server is available exclusively as a TDI solution, there is no restriction for specific network requirement for network layout. Customers can pick network cards from available choices in the offerings.

SOFTWARE

Before deploying SAP HANA, the server must be certified by SAP and must be listed on the SAP Hardware Directory. During this process, the combination of certified hardware, operating system, and compatible version of SAP HANA will be deployed. To ensure supportability the following software has been used during the SAP Certification Process:

Operating system

The following operating systems have been certified to deploy SAP HANA in Appliance and TDI environment. Operating system certification is a continuous process. Visit the SAP HANA Hardware Directory to see the latest supported operating system on HPE ProLiant Gen11 servers. The following operating systems are minimum supported:

- SUSE Linux® Enterprise Server 15 SP4
- SUSE Linux® Enterprise Server 15 SP5
- Red Hat® Enterprise Server 8.6
- Red Hat® Enterprise Server 8.8
- Red Hat® Enterprise Server 9.2

Refer to this link for the HPE latest OS support matrix and the minimum supported OS version

Storage Partitioning Layout for SAP HANA Persistent Storage

The partition layout shown here has been used to certify the HPE ProLiant DL380 server and DL560 Gen11 server for deployment as an SAP HANA Certified Appliance. Figure 26 and Figure 27 show the standard partitioning layout for SUSE and RHEL operating systems respectively. These two figures showcase the partitioning layout for SAP HANA persistent storage for memory configuration of 2048GB (2.0TB).

Operating system partitioning will remain the same for all memory offerings, while the partitioning layout for persistent storage for SAP HANA will vary according to memory configuration for SAP HANA database. Refer to Table 24 for 6.4TB NVMe SSD sizing and Table 25 for 3.2TB NVMe SSD sizing.

Refer to the partition tables during the installation of operating system as well as at the time of creating persistent storage for SAP HANA Certified Appliance configurations.

SUSE Enterprise Linux for SAP

Figure 26 illustrates the recommended partitioning table for installing the SUSE operating system, including the partitioning layout and logical volumes for SAP HANA's persistent storage. The figure provides details on partition names, sizes, filesystems, and the use of LVM for each partition in the SUSE Operating System. You can create LVM for SAP HANA persistent storage during the operating system installation partitioning process or even after the operating system installation.

MegaRAID Controller – MR416i-o OR Microsemi Controller – SR932i-p										
Array 1										
Logical Drive 1 (LD1)										
Partition	UEFI	/dev/sda2 – 320GiB			/dev/sda3 – Remaining Space					
		Volume Group Name – "system"			Volume Group Name – "vgHANA"					
Device	/dev/sda1	LV Name	swap	root	LV Name	lvol1	lvol2	lvol3	lvol4	Free Space
FS Type	EFI (VFAT)	LV Size	2.0 GiB	252.0 GiB	LV Size	64.0 GiB	2.0 TiB	1.5 TiB	6.0 TiB	
Mount Point	/boot/efi	Mount Point	swap	/	Mount Point	/usr/sap	/hana/shared	/hana/log	/hana/data	
Size	500 MiB	FS Type		BTRFS	FS Type		XFS	XFS	XFS	

FIGURE 26. SUSE OS Partition Table and SAP HANA Persistent Data Storage Partitioning Layout

Red Hat Enterprise Linux for SAP

This is the recommended partitioning table for installing the RHEL operating system, including the configuration of partitions and logical volumes for SAP HANA's persistent storage. The figure outlines the partition names, sizes, filesystems, and the use of LVM for each partition in the RHEL operating system. You have the flexibility to create LVM for SAP HANA persistent storage during the operating system installation partitioning process or even after the operating system installation.

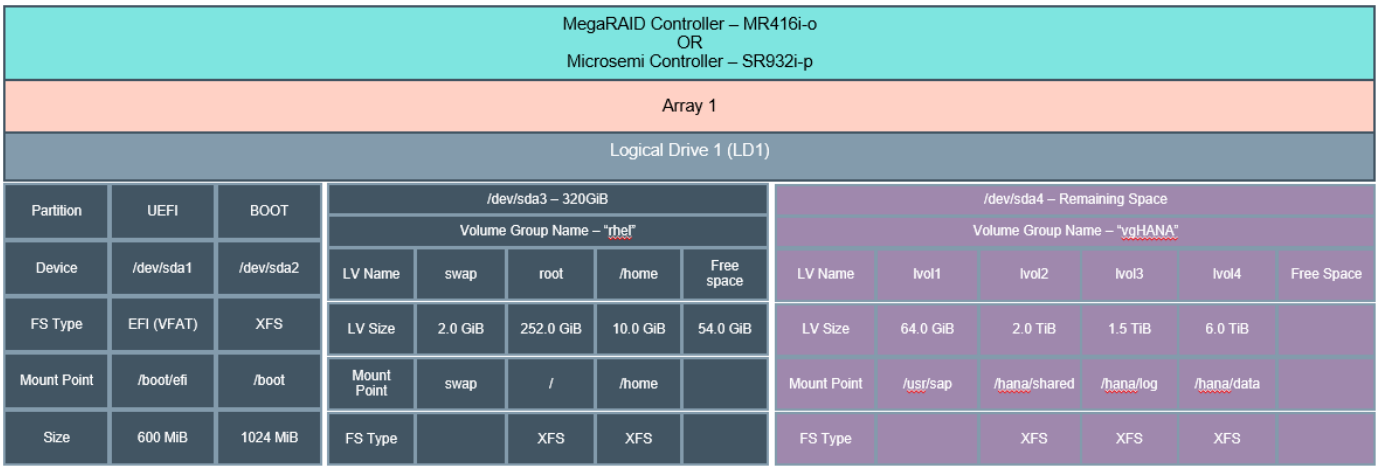

FIGURE 27. RHEL OS Partition Table and SAP HANA Persistent Data Storage Partitioning Layout

In following section, examples of commands are given, these command examples are based on the SAP HANA persistent data storage layout as shown in Figure 26 for SUSE and Figure 27 for Red Hat operating systems. The sizes for each logical volume have been mentioned.

in Table 24 using 6.4TB NVMe SSD and Table 25 using 3.2TB NVMs SSD. You must use these figures and tables together to layout the logical volumes for HANA configurations.

Create Physical Volume

```
560spr01:~ # pvcreate -f <physical volume name>
Ex: 560spr01:~ # pvcreate -f /dev/sda#
```

Create Volume Group for HANA LOG, SHARED, DATA

```
560spr01:~ # vgcreate -f <vg_name> <physical_volume_name>
Ex: 560spr01:~ # vgcreate -f vgHANA /dev/sda#
```

Create Logical Volumes for HANA /usr/sap, SHARED, LOG and DATA

Create lvol1 for /usr/sap

```
560spr01:~ # lvcreate -name lvol1 -L <lvol Size> vgHANA <pv_name> -v -y > for /usr/sap
Ex: 560spr01:~ # lvcreate -name lvol1 -L 64G vgHANA /dev/sda# -v -y
```

Create lvol2 for /hana/shared

```
560spr01:~ # lvcreate -name lvol2 -L <lvol Size> vgHANA <pv_name> -v -y > for /hana/shared
Ex: 560spr01:~ # lvcreate -name lvol2 -L 2048G vgHANA /dev/sda# -v -y
```

Create lvol3 for /hana/log

```
560spr01:~ # lvcreate -name lvol3 -L <lvol Size> vgHANA <pv_name> -v -y > for /hana/log
Ex: 560spr01:~ # lvcreate -name lvol3 -L 1536G vgHANA /dev/sda# -v -y
```

Create lvol4 for /hana/data

```
560spr01:~ # lvcreate -name lvol4 -L <lvol Size> vgHANA <pv_name> -v -y > for /hana/data
Ex: 560spr01:~ # lvcreate -name lvol4 -L 6144G vgHANA /dev/sda# -v -y
```

Create File system for HANA LOG, /usr/sap, SHARED, DATA and temp

```
560spr01:~ # mkfs.xfs -f -l su=256k -i size=2048 -b size=4k -s size=4k /dev/vgHANA/lvol1
560spr01:~ # mkfs.xfs -f -l su=256k -i size=2048 -b size=4k -s size=4k /dev/vgHANA/lvol2
560spr01:~ # mkfs.xfs -f -l su=256k -i size=2048 -b size=4k -s size=4k /dev/vgHANA/lvol3
560spr01:~ #  mkfs.xfs -f -l su=256k -i size=2048 -b size=4k -s size=4k /dev/vgHANA/lvol4
```

Create mount points for HANA Volumes

```
560spr01:~ # mkdir   -p /hana/{data,shared,log}
```

```
560spr01:~ # mkdir   /usr/sap
```

FSTAB Entry. Enter the following entry in /etc/fstab for HANA Volume required to be auto mount during reboot. Save the file and Exit.

```
<logical_volume_dev_path> <OS_mount_point> xfs defaults 1 2
Ex: for /etc/fstab entry for /usr/sap, /hana/shared, /hana/log and /hana/data

/dev/vgHANA/lvol1          /usr/sap         xfs            _netdev,inode64,logbufs=8,logbsize=256k,swalloc 0 0
/dev/vgHANA/lvol2         /hana/shared              xfs
       _netdev,inode64,logbufs=8,logbsize=256k,swalloc 0 0
/dev/vgHANA/lvol3        /hana/log          xfs            _netdev,inode64,logbufs=8,logbsize=256k,swalloc 0 0
/dev/vgHANA/lvol4        /hana/data         xfs            _netdev,inode64,logbufs=8,logbsize=256k,swalloc 0 0
```

Mount all the filesystems as /etc/fstab entries are now set

```
560spr01:~ # mount -a
```

To complete the Pre-Defined Appliance Building Process, reboot the server once the configuration is completed.

Applying the SPP

Apply the SPP and ensure that firmware and drivers are matching to the latest available version as described by HPE for the respective server and generation.

To apply SPP, follow the SPP documentation or manuals available at support.hpe.com.

SAP HANA Hardware and Cloud Measurement Tools

SAP HANA hardware and cloud measurement tools (HCMT) are a new set of tools that can help the user to measure and analyze hardware or cloud systems performance parameters required before deploying SAP HANA. HCMT is the preferred tool to be used while applying for SAP HANA Certification for hardware.

The HCMT tools consist of the following components:

- SAP HANA hardware and cloud measurement tool
- SAP HANA hardware and cloud measurement analysis

For more details, see SAP Note: 2493172.

Tuning the SAP HANA Operating System

See the following SAP Notes to adhere to the requirement to install SAP HANA Database:

- For recommended OS settings for SLES 15, refer to the SAP Note: 2684254
- For recommended OS settings for RHEL 8, refer to the SAP Note: 2777782
- To optimize the Network Configuration on SAP HANA and OS Level, refer to the SAP Note: 2382421
- For the supported operating system, refer to the SAP Note: 2235581

To prepare SLES for SAP environments, refer to the SAP Note: 1275776

SERVICE AND SUPPORT

HPE is the world's number one vendor for SAP HANA, not just because of the sales of the server and the solutions provided, but also for post-sales support. HPE provides world-class and expert service for SAP HANA installation, deployment, and integration. The services in lifecycle support through the dedicated team of experts in the solutions area around the SAP Software Stack. Service and support highlights are briefly outlined here. For more details, see the HPE ProLiant DL360 Gen11, HPE ProLiant DL380 Gen11 and HPE ProLiant DL560 Gen11 servers Quickspecs.

- Installation, integration, and deployment services for SAP HANA
  - HPE Installation Service for HPE Installation and Startup Service
  - HPE Factory Express Integration Service for SAP HANA

  - HPE Rapid Deployment Services for SAP HANA
- HPE Pointnext Operational Services for SAP HANA
- HPE COE Service for SAP HANA
- HPE Service Credits (Lifecycle Service)

SUMMARY

HPE ProLiant DL360 Gen11, HPE ProLiant DL380 Gen11 and DL560 Gen11 servers are industry-leading compute building blocks and serve enterprises of all sizes to power critical SAP S/4HANA and SAP BW/4HANA workloads.

This document has shown the SAP HANA landscape and HPE offerings surrounding the SAP HANA Database.

The solution highlighted in this Technical White Paper is economical, efficient, and flexible for short-term and long-term analytics. Using HPE's award-winning servers, storage, networking infrastructure, and support services, mission-critical applications will be functioning at their best while protecting them from the worst.

RESOURCES AND ADDITIONAL LINKS

HPE Reference Architectures, hpe.com/info/ra

HPE Servers, hpe.com/servers

HPE Storage, hpe.com/storage

HPE Networking, hpe.com/networking

HPE QuickSpecs Homepage, https://www.hpe.com/psnow/document-types?doctype=quickspecs&cc=us&lc=en&f=1&s=1&jumpid=in_pb-psnow-red

HPE portfolio for SAP HANA, https://www.hpe.com/us/en/solutions/sap-hana.html

HPE Technology Consulting Services, hpe.com/us/en/services/consulting.html

To help us improve our documents, please provide feedback at hpe.com/contact/feedback.

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