



**Hewlett Packard**  
Enterprise

# **HPE ProLiant DL580 Gen9 and HPE ProLiant DL560 Gen9 server technology**

Four-socket HPE scale-out servers

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## Introduction

The HPE ProLiant DL580 Gen9 and HPE ProLiant DL560 Gen9 servers represent the next step in the evolution of four-socket (4S) servers that deliver maximum performance, expandability, and reliability for use in environments handling demanding data-intensive workloads. Both the HPE ProLiant DL580 Gen9 and the DL560 Gen9 are scale-up servers, designed to scale up their processing and I/O capabilities as required to meet the requirements of workload intensive applications/solutions running on a single compute node. These demanding workload environments include:

- Business processing and large database workloads—including enterprise resource planning (ERP) and customer relationship management (CRM)—that are typically non-partitionable, compute-intensive workloads that require greater resources on the computing node.
- Decision support applications such as data warehousing, business intelligence, and analytics that require both significant compute and I/O capacity.
- Large-scale consolidation—including virtualization.

## Overview of the HPE ProLiant DL560 Gen9 and DL580 Gen9 architectures

The HPE ProLiant DL580 and DL560 Gen9 servers are designed specifically to meet the needs of scale-up workloads. These 4S servers deliver unparalleled scalability, reliability, and availability for enterprise and high-performance computing (HPC) environments.

The HPE ProLiant DL560 Gen9 server (Figure 1) delivers scale-up computing capability in a compact 2U form factor. It is a high-density 4S server designed with balanced performance, scalability, and expandability that is ideal for multi-workload computing, virtualization, and business processing application environments where data center space and price/performance is paramount.



**Figure 1.** The HPE ProLiant DL580 and DL560 Gen9 servers.

The HPE ProLiant DL580 Gen9 Server is a 4S scale-up platform designed to deliver the ultimate in 4S scalable performance, expandability, and system reliability/availability for use in mission-critical application environments.

To meet the evolving requirements for demanding and data-intensive workloads, both the HPE ProLiant DL560 Gen9 and DL580 Gen9 servers include key advancements in processor performance, memory capacity, I/O bandwidth, and storage performance. Table 1 shows a high-level comparison of the system architectures of the two servers.

**Table 1.** Comparison of HPE ProLiant DL580 Gen9 and DL560 Gen9 system architecture features

	<b>DL580 GEN9</b>	<b>DL560 GEN9</b>
<b>System Processors</b>	Up to 4 Xeon E7-4800/8800 v4 series 4/8/10/12/14/16/18/20/22/24 cores	Up to 4 Xeon E5-4600 v4 series 6/8/10/12/14/16/18/22 cores
<b>Memory</b>	DDR4 at 1600 or 1866 Megatransfers/sec (MT/s) max 6 TB max, using 64 GB LRDIMMs 12 TB max using 128 GB LRDIMMs (available 2H2016)	DDR4 at 2400 MT/s max 3 TB max using 64 GB LRDIMMs 6 TB max using 128 GB LRDIMMs (available 2H2016)
<b>I/O Expansion Slots</b>	9 PCIe 3.0 Full size slots (5 x16 and 4 x8)	4 PCIe 3.0 x8 Half Length std. 3 PCIe 3.0 (1 x16, 2 x8) Half Length (opt. riser)

**HPE ProLiant DL560 Gen9 server**

The HPE ProLiant DL560 Gen9 server is a 4S scale-up platform designed for balanced performance and scalability in a 2U rack-mount form factor. This makes the DL560 server ideal for use in the following application environments:

- Server consolidation and virtualization environments with a focus on data-intensive applications.
- Database, messaging, and business processing environments.
- Space-constrained corporate data centers and service provider environments.
- Software-defined storage applications that can optimally utilize a high number of internal drives.

**Processors and basic architecture**

The HPE ProLiant DL560 Gen9 server accommodates up to four Intel® Xeon® E5-4600 v4 series processors as well as the earlier Intel Xeon E5-4600 v3 processors. The v4 series of processors are available in a variety of models. Each processor model delivers a particular level of performance defined by processor speed, number of cores, QPI bus speed, and level of cache memory. This new generation of processors is available with maximum number of 22 cores per processor using up to 55 MB of lower-level cache and communicating with other processors over a 9.6 Megatransfers/sec (MT/s) QPI bus. Depending on the model, the E5-4600 v4 series of processors deliver a 6% to 20% performance improvement over the previous generation of E5-4600 v3 processors. Table 2 shows the various models of the E5-4600 v4 and E5-4600 v3 processors that are available for the HPE ProLiant DL560 Gen9 server.

**Table 2.** Intel Xeon E5-4600 v4 and E5-4600 v3 series processors for HPE ProLiant DL560 Gen9 servers

PROCESSOR MODEL NUMBER	CPU FREQUENCY	CORES	LEVEL 3 CACHE SIZE	POWER	QPI SPEED	MAXIMUM MEMORY SPEED
E5-4669v3	2.1 GHz	18	45 MB	135 W	9.6 GT/s	2133 MT/s
E5-4667v3	2.0 GHz	16	40 MB	135 W	9.6 GT/s	2133 MT/s
E5-4660v3	2.1 GHz	14	35 MB	120 W	9.6 GT/s	2133 MT/s
E5-4655v3	2.9 GHz	6	30 MB	135 W	9.6 GT/s	2133 MT/s
E5-4650v3	2.1 GHz	12	30 MB	105 W	9.6 GT/s	2133 MT/s
E5-4640v3	1.9 GHz	12	30 MB	105 W	8.0 GT/s	1866 MT/s
E5-4627v3	2.6 GHz	10	25 MB	135 W	8.0 GT/s	2133 MT/s
E5-4620v3	2.0 GHz	10	25 MB	105 W	8.0 GT/s	1866 MT/s
E5-4610v3	1.7 GHz	10	25 MB	105 W	6.4 GT/s	1600 MT/s
E5-4669v4	2.2 GHz	22	55 MB	135 W	9.6 GT/s	2400 MT/s
E5-4667v4	2.2 GHz	18	45 MB	135 W	9.6 GT/s	2400 MT/s
E5-4660v4	2.2 GHz	16	40 MB	120 W	9.6 GT/s	2400 MT/s
E5-4655v4	2.5 GHz	8	30 MB	135 W	9.6 GT/s	2400 MT/s
E5-4650v4	2.2 GHz	14	35 MB	105 W	9.6 GT/s	2400 MT/s
E5-4640v4	2.1 GHz	12	30 MB	105 W	8.0 GT/s	2133 MT/s
E5-4627v4	2.6 GHz	10	25 MB	135 W	8.0 GT/s	2400 MT/s
E5-4620v4	2.1 GHz	10	25 MB	105 W	8.0 GT/s	2133 MT/s
E5-4610v4	1.8 GHz	10	25 MB	105 W	6.4 GT/s	1866 MT/s

Figure 2 shows a block diagram of the HPE ProLiant DL560 Gen9 server architecture. In essence, the DL560 is an extension and scale up of the 2P architecture featured on the HPE ProLiant DL360 and DL380 Gen9 servers. With more processors and an expanded memory footprint in a 2U rack configuration, the DL560 Gen9 is designed as the high-density four-processor server with scalability that is ideal for multi-workload computing, virtualization, and high performance business computing. Depending on the application environment, the HPE ProLiant DL560 is capable of showing up to a 70% performance increase compared to 2P servers.

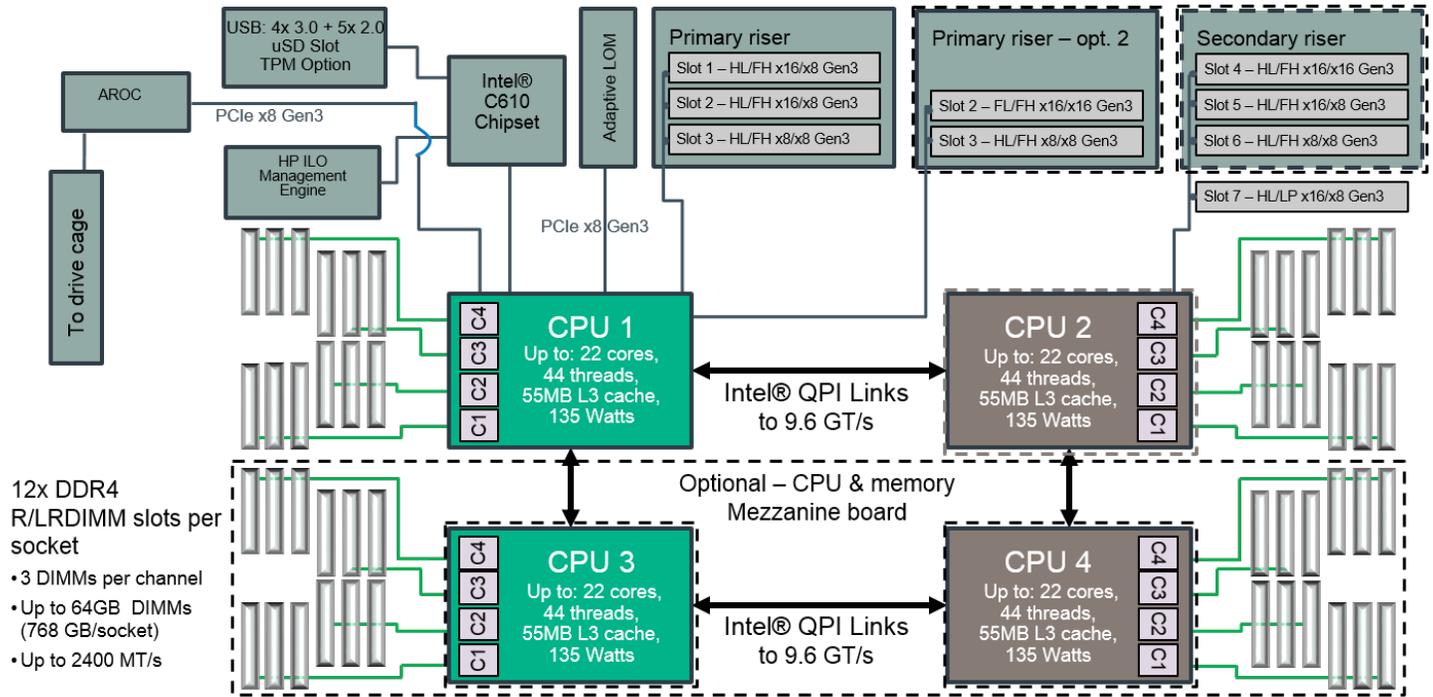


Figure 2. HPE ProLiant DL560 Gen9 server architecture.

**System memory architecture**

As Figure 2 shows, the HPE ProLiant DL560 Gen9 uses an expanded version of the same memory architecture used in 2P servers. Each processor uses two memory controllers and features four memory channels that can use up to three DIMM modules each. With four processors in the system, this means that the DL560 is capable of having twice the memory footprint of HPE ProLiant 2P servers for a maximum memory of up to 3 TB (using 64 GB LRDIMMs).

The HPE ProLiant DL560 Gen9 server with E5-4600 v4 series processors uses HPE SmartMemory DDR4-2400 DIMM memory modules. These modules are capable of operating at 2400 MT/s, giving them a raw speed advantage of 12.5% over memory used with the previous v3-series of processors. In addition to this, the DL560 Gen9 maintains its superior memory performance over comparable servers by taking advantage of the extended performance capabilities of HPE SmartMemory. For server configurations using 3 DIMMs per channel, the DL560 is capable of operating memory at a higher speed than the standard industry specification for platforms using the E5-4600 v4 processors. Table 3 shows the performance advantage when using HPE SmartMemory in the HPE ProLiant DL560.

Table 3. Extended performance for HPE SmartMemory DDR4 DIMMs in the HPE ProLiantDL560 Gen9 server with E5-4600 v4 processors

DIMMS PER CHANNEL	THIRD-PARTY RDIMMS	HPE SMARTMEMORY 1R RDIMMS	HPE SMARTMEMORY 2R RDIMMS	THIRD-PARTY LRDIMMS	HPE SMARTMEMORY ALL LRDIMMS
1	2400 MT/s	2400 MT/s	2400 MT/s	2400 MT/s	2400 MT/s
2	2133 MT/s	2133 MT/s	2400 MT/s	2133 MT/s	2400 MT/s
3	1600 MT/s	1866 MT/s	1600 MT/s	1866 MT/s	2133 MT/s

## HPE Advanced Fault Resiliency for system memory

In addition to superior memory performance using HPE DDR4 SmartMemory, the HPE ProLiant DL560 also enables a number of memory features designed to enhance overall system reliability and availability. These capabilities are part of HPE's Advanced Fault Resiliency system and include all of the following:

- Single Device Data Correction (SDDC)
- Online Sparing (or Rank Sparing)
- Memory Mirroring

### Single Device Data Correction

SDDC detects and corrects multi-bit errors within a single DRAM chip. Using error checking and correction code, it can safely correct for the failure of an entire x4 DRAM on a DIMM. SDDC can also be used to detect, but not correct, for the failure of an entire x8 DRAM chip.

### Online Sparing

Online Sparing, also known as Rank Sparing, provides protection against persistent DRAM failure. It tracks excessive number of correctable errors and copies the contents of an unhealthy rank to an available spare rank in advance of multi-bit or persistent single-bit failures that may result in future uncorrectable faults. It does not identify or disable individual failed DRAMs, but instead it disables the DIMM rank. Since a DIMM rank is needed to perform sparing, this technique reduces the total amount of available memory by the amount of memory used for sparing. Sparing can only handle one failure per DIMM. With Online Sparing, DIMMs that are likely to receive a fatal/uncorrectable memory error are automatically removed from operation, resulting in less system downtime.

### Memory Mirroring

Memory Mirroring provides protection against uncorrectable memory errors that would otherwise result in system failure. In this mode, the system maintains two copies of all data. If an uncorrectable memory error occurs, the system automatically retrieves the good data from the mirrored (redundant) copy. The system continues to operate normally without any user intervention. By providing added redundancy in the memory subsystem, Memory Mirroring provides the greatest protection against memory failure not corrected by ECC or SDDC.

The performance impact for implementing Memory Mirroring is very small. There is no Read performance or Write performance impact when memory traffic is light. With heavy memory traffic loads, memory Write performance will be impacted to a greater degree than Read performance. Since Memory Mirroring consumes 50% of the system memory capacity, it is merited for server workloads that must receive a higher level of protection from memory device failures.

## HPE ProLiant DL560 I/O expansion

Both the HPE ProLiant DL560 Gen9 and the HPE ProLiant DL580 Gen9 servers feature PCIe 3.0 expansion bus technology for I/O. PCIe 3.0 is an expansion bus technology that is the successor to earlier PCI and PCIe technologies. Each PCIe slot in a server supports a PCIe interface that consists of one or more lanes, where each lane is capable of a serial transfer rate of 8 Giga transfers per second (GT/s) and a maximum bandwidth of 985 MB/s. PCIe connectors are specified by the number of lanes that they support. For example, a PCIe connector capable of using 8 lanes is specified as a x8 ("by eight") PCIe slot. The more lanes that a PCIe slot supports, the higher the total data bandwidth capability for that slot.

HPE has engineered the ProLiant DL560 Gen9 server to enable significant I/O capabilities in a 2U rack server form factor. Using the optional secondary riser, each DL560 is capable of accommodating seven PCIe expansion cards—six of which are Half Length/Full Height. The remaining PCIe slot is Low Profile. These slots are in addition to the two daughterboard slots in the DL560 that are included specifically for use by a Flexible Smart Array controller and a Flexible LAN-on-motherboard (LOM) NIC controller, respectively.

## HPE ProLiant DL580 Gen9 server

The HPE ProLiant DL580 Gen8 server is a powerful, 4U enterprise server incorporating technologies that extends the capabilities of industry standard x86 computing. This high-performance server can run both 32-bit and 64-bit applications simultaneously. The ability to accommodate 4 processors running up to 96 cores with access to 6 TB of high-performance DDR4 memory yields a dramatic increase in performance over previous generation systems.

The HPE ProLiant DL580 Gen9 server meets the needs of the following:

- Large and medium enterprises seeking the highest performance and availability.
- Highest performance across compute, memory, and expandability for databases, business processing (ERP, CRM), virtualization, and application consolidation in private cloud or public cloud deployments.
- The right performance for demanding applications like in-memory analytics.

### **Processors and architecture**

The HPE ProLiant DL580 Gen9 server now features the Intel Xeon E7-4800/8800 v4 processor family as well as the existing E7-4800/8800 v3 processors. These new processors deliver improved performance, superior scale-up capability, and reliability designed to meet the needs for mission critical servers. The E7-4800/8800 v4 processors include the following new technologies:

- A new microarchitecture using 14 nm process technology.
- An increase in the maximum of cores per processor to 24, supporting up to 48 separate threads.
- Up to 60 MB of last-level cache per CPU.
- Three QPI v1.1 links per processor socket.
- High-performance improvements for virtualization—including posted interrupts, page modification logging, and reductions in latency for virtual machine (VM) Enter/Exit.
- New and increased resource monitoring and allocation capabilities—including cache monitoring, cache allocation, and memory bandwidth monitoring.

Taken as a whole, these advances allow the HPE ProLiant DL580 Gen9 servers using the comparable processor to deliver a 20% to 25% increase in performance over the previous generation of E7-4800/8800 v3 processors. Table 4 shows the various models of the E7-4800/8800 v4 and E7-4800/8800 v3 processors that are available for the HPE ProLiant DL580 Gen9 servers.

**Table 4.** Intel Xeon E7-4800/8800 v4 processor family for HPE ProLiant DL580 Gen9 servers

PROCESSOR MODEL NUMBER	CPU FREQUENCY	CORES	LEVEL 3 CACHE SIZE	POWER	QPI SPEED	MAXIMUM MEMORY SPEED
E7-8893v3	3.2 GHz	4	45 MB	140 W	9.6 GT/s	1866 MT/s
E7-8891v3	2.8 GHz	10	45 MB	165 W	9.6 GT/s	1866 MT/s
E7-8890v3	2.5 GHz	18	45 MB	165 W	9.6 GT/s	1866 MT/s
E7-8880v3	2.3 GHz	18	45 MB	150 W	9.6 GT/s	1866 MT/s
E7-8880Lv3	2.0 GHz	18	45 MB	115 W	9.6 GT/s	1866 MT/s
E7-8870v3	2.1 GHz	18	45 MB	140 W	9.6 GT/s	1866 MT/s
E7-8867v3	2.5 GHz	16	45 MB	165 W	9.6 GT/s	1866 MT/s
E7-8860v3	2.2 GHz	16	40 MB	140 W	9.6 GT/s	1866 MT/s
E7-4850v3	2.2 GHz	14	35 MB	115 W	8.0 GT/s	1866 MT/s
E7-4830v3	2.1 GHz	12	30 MB	115 W	8.0 GT/s	1866 MT/s
E7-4820v3	1.9 GHz	10	25 MB	115 W	6.4 GT/s	1866 MT/s
E7-4809v3	2.0 GHz	8	20 MB	115 W	6.4 GT/s	1866 MT/s
E7-8893v4	3.2 GHz	4	60 MB	140 W	9.6 GT/s	1866 MT/s
E7-8891v4	2.8 GHz	10	60 MB	165 W	9.6 GT/s	1866 MT/s
E7-8890v4	2.2 GHz	24	60 MB	165 W	9.6 GT/s	1866 MT/s
E7-8880v4	2.2 GHz	22	55 MB	150 W	9.6 GT/s	1866 MT/s
E7-8870v4	2.1 GHz	20	50 MB	140 W	9.6 GT/s	1866 MT/s
E7-8867v4	2.4 GHz	18	45 MB	165 W	9.6 GT/s	1866 MT/s
E7-8860v4	2.2 GHz	18	45 MB	140 W	9.6 GT/s	1866 MT/s
E7-4850v4	2.1 GHz	16	40 MB	115 W	8.0 GT/s	1866 MT/s
E7-4830v4	2.0 GHz	14	35 MB	115 W	8.0 GT/s	1866 MT/s
E7-4820v4	2.0 GHz	10	25 MB	115 W	6.4 GT/s	1866 MT/s
E7-4809v4	2.1 GHz	8	20 MB	115 W	6.4 GT/s	1866 MT/s

Figure 3 shows the architecture of the DL580 Gen8 server.

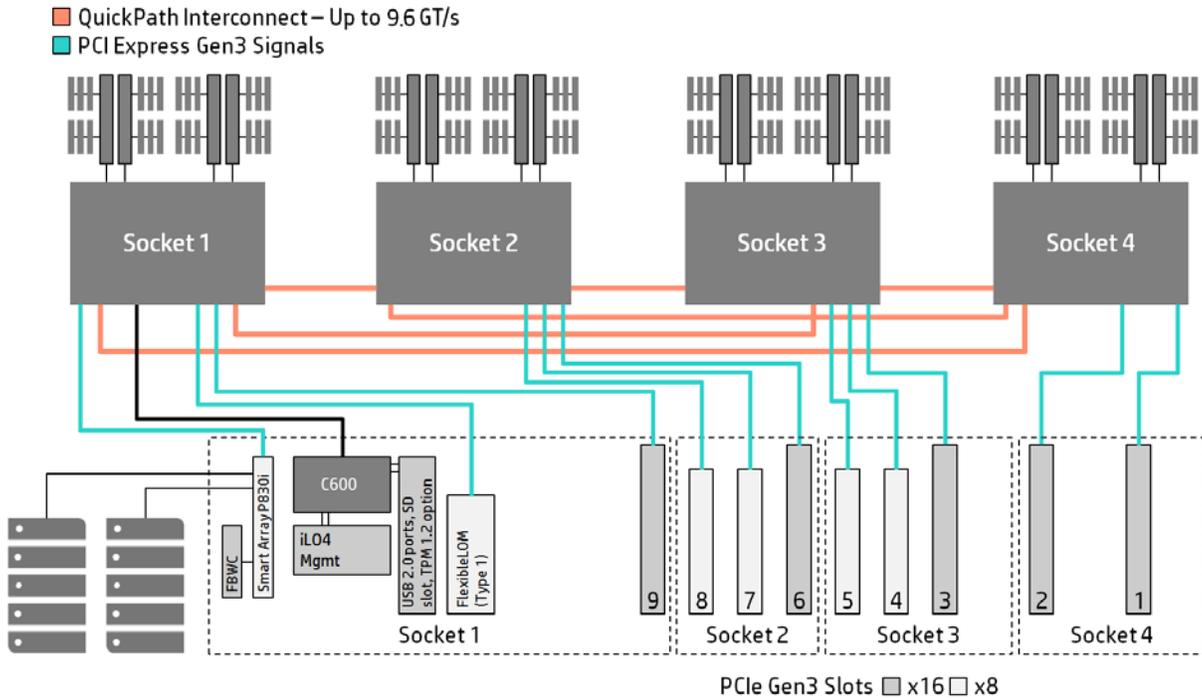
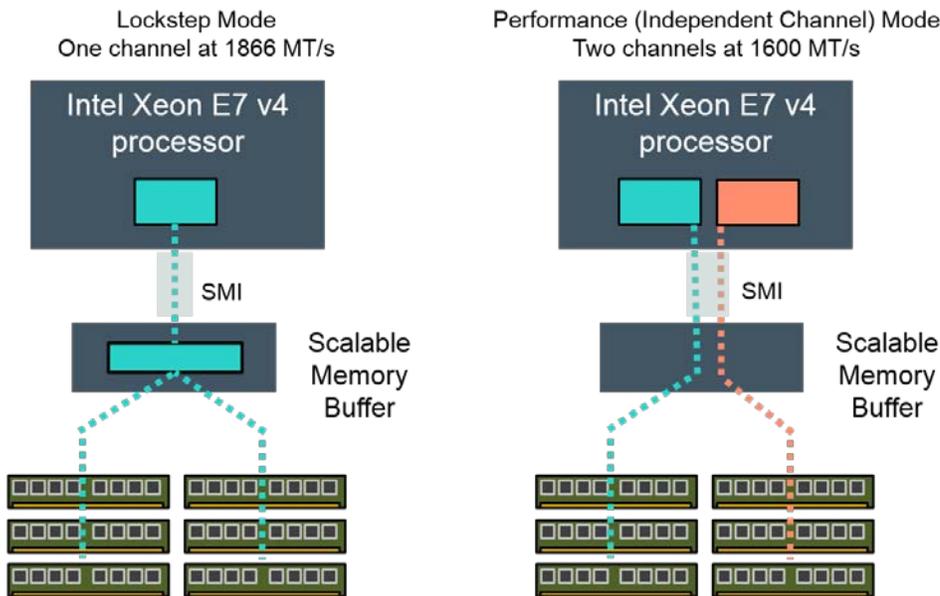


Figure 3. HPE ProLiant DL580 Gen9 Server architecture.

**HPE ProLiant DL580 Gen9 system memory**

The HPE ProLiant DL580 Gen9 server features an expanded memory architecture that allows the server to support a larger system memory footprint than the DL560 Gen9 server. Instead of using 4 memory channels tied directly to the processor memory controllers, the DL580 architecture employs 4 Scalable Memory Buffers (SMBs) per processor—each communicating to the processor’s memory controllers over a Scalable Memory Interface (SMI) capable of transmitting memory data at up to 3200 MT/s (Figure 4). Each SMB is tied to 2 traditional memory channels that use up to 3 DIMMs per channel.



**Figure 4.** Detail of a single SMI and SMB arrangement for the ProLiant DL580 Gen9 memory system.

In normal operations (known as performance mode), each SMI runs at 3200 MT/s. Since it is aggregating bandwidth from 2 memory channels, each memory channel runs at 1600 MT/s. With this extended memory architecture, each E7 processor features 8 total memory channels rather than the 4 channels associated with the E5 processors. As a result, the HPE ProLiant DL580 server enables total memory footprints of up to 6 TB (using 64 GB LRDIMMs)—twice that of DL560. This makes the DL580 ideally suited to high-end applications using large in-memory databases.

In Lockstep mode, the SMI runs up to 1866 MT/s for the single combined memory channel. Although this lowers system memory throughput in memory-intensive application environments, it provides additional memory protection by enabling Double Device Data Correction (DDDC), one of the Advanced Memory Protection features of the HPE ProLiant DL580 Gen9 server.

Although individual DIMMs installed in the DL580 are operating at a slower speed than those in a DL560, the DL580 is capable of generating higher overall memory throughput. With 32 total memory channels operating at 1600 MT/s, the DL580 has a theoretical maximum memory throughput of 410 GB/s compared to 238 GB/s for the DL560 Gen9 with 16 memory channels operating at 2133 MT/s.

**DL580 Advanced Memory Protection features**

In addition to the memory protection features found on the HPE ProLiant DL560, the HPE ProLiant DL580 Gen9 provides a set of Advanced Memory Protection modes that are only available on this server. These advanced features deliver the highest possible level of system reliability and availability, making the DL580 ideally suited for mission-critical scale-out application environments. HPE ProLiant DL580 memory reliability, availability, and serviceability (RAS) features include all the following:

- Double Device Data Correction (DDDC)
- HPE Memory Quarantine
- HPE Advanced Error Recovery

While DDDC works at a hardware/firmware level to increase system memory reliability, HPE Memory Quarantine and HPE Advanced Error Recovery require operating systems or hypervisors that support the Intel Machine Check Architecture (MCA) recovery capabilities unique to the E7-4800/8800 v4 processors and enabled for the ProLiant DL580.

### **Double Device Data Correction, also known as Double-Chip Sparing**

DDDC requires the use of Lockstep mode of memory operation on the HPE ProLiant DL580 server. In Lockstep mode, the system configures each pair of standard 64-bit wide memory channels as a single 128-bit wide channel. This configuration provides 16 redundant ECC bits for each 128-bit channel, allowing the system to provide the more powerful error correction capability of DDDC. Lockstep mode does not reduce the total amount of available memory in the server. However, it effectively reduces the number of memory channels in use. This impacts performance, especially for memory-intensive application workloads. Lockstep mode also requires that the DIMMs in each paired memory channel be identical.

DDDC is a more robust and more efficient method of memory sparing. It can detect and correct single- and dual-DRAM chip failures for every x4 DIMM pair in the server. By reserving one DRAM chip in each rank as a spare—and using standard ECC techniques on the remaining DRAMs—it ensures continued uninterrupted operation after the failure of a single x4 DRAM device on any DIMM pair. In the unlikely occurrence of a second DRAM failure within a DIMM pair, the system can continue to operate by using ECC to correct for the error. When this happens, the platform firmware alerts you that the DIMM should be replaced, but the failure of the second DRAM chip does not cause a system crash. DDDC provides the highest level of memory data correction available.

### **HPE Memory Quarantine**

HPE Memory Quarantine is designed to identify and isolate memory regions with potential uncorrectable hardware errors before they are accessed and used by the operating system (OS). It does this by using a patrol scrubber that constantly inspects the system memory for errors, providing early identification of a failed component. If uncorrectable hardware errors are found, system firmware will notify the OS. The memory address is tagged as bad so that the OS or hypervisor will not use it.

HPE Memory Quarantine uses the Machine Check Architecture (MCA) Recovery capability of Intel Xeon E7–4800/8800 v4 series processors. It increases system availability by enabling the server and the OS (or hypervisor) to work together so the server can recover from uncorrectable memory errors that would have otherwise caused a system crash. This makes it ideal for use in servers that host a large number of VMs and/or a small number of VMs hosting important workloads.

### **HPE Advanced Error Recovery**

HPE Advanced Error Recovery extends uncorrectable error detection to the processor chipset itself, detecting and flagging any potential uncorrectable errors that may exist in the processor's caches or execution pipeline. As with Memory Quarantine, HPE Advanced Error Recovery works with the OS or hypervisor to end and restart applications or VMs associated with the uncorrectable error found in the processor cache.

### **HPE ProLiant DL580 Gen9 I/O expansion**

PCIe 3.0 is an expansion bus technology that is the successor to earlier PCI and PCIe technologies. Each PCIe slot in a server supports a PCIe interface that consists of one or more lanes, where each lane is capable of a serial transfer rate of 8 GT/s and a maximum bandwidth of 985 MB/s. PCIe connectors are specified by the number of lanes that they support. For example, a PCIe connector capable of using 8 lanes is specified as a x8 (“by eight”) PCIe slot. The more lanes that a PCIe slot supports, the higher the total data bandwidth capability for that slot.

The HPE ProLiant DL580 Gen9 server offers large-scale I/O capabilities in a 4U form factor by providing nine I/O full length, full height PCIe 3.0 (Gen3) expansion slots. The HPE ProLiant DL580 Gen9 server allows concurrent operation of all nine slots, delivering substantial aggregate bandwidth. Table 5 shows the PCIe slot composition of the DL580.

**Table 5.** HPE ProLiant DL580 Gen9 server PCIe 3.0 expansion slots

SLOT	NUMBER OF PCI LANES	CONNECTOR WIDTH	SLOT SIZE	PROCESSOR LINK
9	x16	x16	Full Height, Full Length Dual-width	CPU 1
8	x8	x16	Full Height, Full Length, Single-width	CPU 2
7	x8	x16	Full Height, Full Length Single-width	CPU 2
6	x16	x16	Full Height, Full Length Dual-width	CPU 2
5	x8	x16	Full Height, Full Length Single-width	CPU 3
4	x8	x16	Full Height, Full Length single-width	CPU 3
3	x16	x16	Full Height, Full Length Dual-width	CPU 3
2	x16	x16	Full Height, Full Length Dual-width	CPU 4
1	x16	x16	Full Height, Full Length Dual-width	CPU 4

As Table 5 shows, all nine slots in the HPE ProLiant DL580 Gen9 server feature x8 or x16 PCI connections in order to support large-scale I/O bandwidth in the server. Additionally, five of the nine PCIe slots will accommodate dual-width PCIe add-in cards:

- Slots 1, 2, and 3 are truly dual-width, allowing you to install dual-width cards without affecting adjacent slots.
- Slots 9 and 6 can only use dual-width cards when the adjacent slots (slots 8 and 5) are not used.

The HPE ProLiant DL580 has six auxiliary power connectors to support the higher power requirements for these types of cards. This makes the DL580 ideal for application environments making significant use of GPGPUs for computationally intense application workloads.

## HPE ProLiant Smart Storage for HPE ProLiant DL580 Gen9 and DL560 Gen9 servers

HPE continues to make Smart Storage simpler to configure and manage while offering more flexibility in controller choices and greater performance across the entire controller line. For ProLiant Gen9 servers, HPE offers three tiers of traditional storage controllers—each intended to meet specific sets of workload requirements. Smart controllers work with both traditional SAS and SATA hard drives as well as HPE Solid State drives, which are designed to deliver increased low-latency and high throughput random I/O performance.

HPE also offers PCIe-based storage products that provide the highest bandwidth, lowest latency storage performance by communicating directly with the OS and applications directly over the PCIe bus rather than through a traditional array controller. PCIe-based storage is available as either PCIe Workload Accelerators or as NVMe PCIe Solid State Drives on the HPE ProLiant DL560 Gen9 and DL580 Gen9 servers.

### Standard storage controllers for the HPE ProLiant DL580 Gen9 and HPE ProLiant DL560 Gen9 servers

As with other HPE ProLiant Gen9 servers, both the DL580 and the DL560 come with embedded storage controllers that do not occupy any of the standard PCIe I/O slots. The DL560 features an embedded B140i array controller that delivers basic storage and RAID functionality. The DL560 also supports the HPE Smart HBA H240ar controllerP440ar and the P880ar Flexible Smart Array controllers. These daughter card controllers give you the ability to upgrade the base storage-controller capability of the DL560 to meet your needs without using one of the standard PCIe slots. Higher-level models of the DL560 server come standard with one of these more powerful Smart Array controllers.

The HPE ProLiant DL580 Gen9 server features an embedded Smart Array P830i controller that provides full HPE Smart Array functionality for the server without using a PCIe slot. Because it comes with an embedded Smart Array controller, the DL580 does not use any of the Flexible Smart Array daughterboard controllers.

Both the DL580 and the DL560 support a full range of additional HPE Smart Storage adapters, including HPE Smart Host Bus Adapters (HBAs) and HPE Smart Array controllers. Table 6 provides a quick storage overview on both the DL580 and DL560 Gen9 servers.

**Table 6.** HPE ProLiant DL580 Gen9 and DL560 Gen9 storage capabilities

	DL580 GEN9	DL560 GEN9
<b>Standard Storage Controller</b>	HPE embedded Smart Array P830i Controller 2 GB or 4 GB FBWC	HPE embedded B140i SATA Controller (Entry models)
	12 Gb/s SAS or 6 Gb/s SATA Hardware RAID Support: 1 & 10 (drive mirroring), 1 & 10 (ADM) 5 (DDG), 50 6 (ADG), 60	6 Gb/s SATA Software RAID Only: RAID 0 RAID 1, 10 RAID 5
<b>Storage Bays</b>	10 SFF drives	8 SFF drive bays std. 24 SFF drives bays max.
<b>NVMe Drive Support</b>	Yes. Up to 5 NVMe Drives	Yes Up to 6 NVMe drives
<b>M.2 Support</b>	Yes	Yes

Notes:  
ADM = Advanced Data Mirroring

As shown in Table 6, the DL560 Gen9 server can accommodate as many as 24 SFF drives, making it ideal for solutions environments that can utilize a large number of internal drives.

### HPE Smart Host Bus Adapter (HBA) Controllers

For ProLiant Gen9 servers, HPE has a new generation of HPE Smart SAS HBA controllers that provide high performance SAS storage connectivity. These new H-series controllers—combined with the new server infrastructure—deliver full 12 Gb/s SAS performance across the ProLiant Gen9 product line.

HPE has designed the Smart SAS HBA controllers to provide a high performance and scalable SAS storage solution for environments that do not require the full feature set of HPE Smart Array controllers. The HBAs address the need for low-cost direct-attached storage, single-domain JBODs, tape drives, libraries, and shared storage arrays.

**Table 7.** HBA Controllers for HPE ProLiant DL580 and DL560 Gen9 servers

	HPE SMART HBA H240AR (DL560 ONLY)	HPE SMART HBA H240	HPE SMART HBA H241
<b>Specification</b>	Flexible Smart SAS HBA (daughter card)	Low profile PCIe 3.0 x8 card	Low profile PCIe 3.0 x8 card
<b>Storage Transfer Protocols</b>	12Gb/s SAS 6 Gb/s SATA	12 Gb/s SAS 6 Gb/s SATA	12 Gb/s SAS 6 Gb/s SATA
<b>Drive Connections</b>	2 internal x4 Mini-SAS connectors with expander support	2 internal x4 Mini-SAS connectors	2 external x4 Mini-SAS HD connectors with expander support
<b>RAID Support</b>	1 & 10 (drive mirroring), 5 (Distributed Data Guarding)	1 & 10 (drive mirroring), 5 (Distributed Data Guarding)	1 & 10 (drive mirroring), 5 (Distributed Data Guarding)

Over the last several years, the bandwidth and throughput of the memory and processor subsystems has grown exponentially with advent of additional processor cores, higher bandwidth, more DIMMs, and other advances. While storage performance has grown steadily, it has not always kept pace with other system advances. One such example of this performance gap is in the area of database applications. In order to achieve industry leading benchmark numbers, HPE has developed technologies that balance storage performance with ever-increasing processor and memory speeds.

### HPE Smart Array controllers

The new HPE Smart Array controllers for Gen9 servers deliver improved performance, more features, and increased reliability over previous generations. All Gen9 Smart Array controllers feature built-in flash-backed write cache (FBWC) that is backed up by the new HPE Smart Storage Battery incorporated into the server itself. With their faster processors, faster memory, 12 Gb/s SAS channels—as well as optimized controller firmware—HPE Smart Array controllers are now optimized to support the higher I/O capabilities of Solid State Drives (SSDs). Gen9 Smart Array controllers can deliver more than four times the I/O rate for read operations, more than six times the I/O operations per second (IOPs) rate for database workloads and are capable of achieving over 1 million random IOPs performance.

Table 8 compares the optional Smart Array controllers for the HPE ProLiant DL560 and DL580 Gen9 servers.

**Table 8.** HPE Smart Array controllers for HPE ProLiant DL560 Gen9 and DL580 Gen9 servers

	<b>P440AR (DL560)</b>	<b>P440 (DL560) P430 (DL580)</b>	<b>P441 (DL560) P431 (DL580)</b>	<b>P840 (DL560) P830 (DL580)</b>	<b>P841 (DL560)</b>
<b>Form factor</b>	Flexible Smart Array card	Low Profile PCIe 3.0 x8 card	Low profile PCIe 3.0 x8 card	Full height PCIe 3.0 x8 card	Flexible Smart Array card (DL360 and DL380 only)
<b>Transfer protocol</b>	12 Gb/s SAS & 6 Gb/s SATA	12 Gb/s SAS & 6 Gb/s SATA	12 Gb/s SAS & 6 Gb/s SATA	12 Gb/s SAS & 6 Gb/s SATA	12 Gb/s SAS & 6 Gb/s SATA
<b>Cache</b>	2 GB FBWC	4 GB FBWC	4 GB FBWC	4 GB FBWC	4 GB FBWC
<b>Connector</b>	2 internal x4 Mini- SAS	1 internal x 8 Mini-SAS double-wide	2 external x4 Mini- SAS HD	2 internal x8 double-wide	2 internal x8 double-wide
<b>Ports</b>	8 internal SAS lanes	• 8 internal SAS lanes	– 8 internal SAS lanes	• 16 internal SAS lanes	• 16 external SAS lanes
<b>Max # of drives [2]</b>	26 (with expander)	• 8 (no expander) 48 (two expanders)	– 200 (direct attached)	• 16 (no expander), 48 (two expanders)	• 200 (direct attached)
<b>RAID support</b>	0, 1, 10, 5, 50, 6, 60, 10 ADM	0, 1, 10, 5, 50, 6, 60, 10 ADM	0, 1, 10, 5, 50, 6, 60, 10 ADM	0, 1, 10, 5, 50, 6, 60, 10 ADM	0, 1, 10, 5, 50, 6, 60, 10 ADM
<b>HPE Secure Encryption</b>	Optional	Optional	Optional	Optional	Optional
<b>HPE SmartCache</b>	Optional	Optional	Optional	Standard	Standard

Notes:  
ADM = Advanced Data Mirroring

In addition to their support for advanced RAID modes, HPE Smart Array Controllers also feature a number of other advanced features.

### Predictive Spare Activation technology

Predictive Spare Activation technology protects data by rebuilding an identified problem drive to a spare drive before it is needed. This eliminates a period of exposure during the drive rebuild when an additional drive could fail. HPE drives can report a predictive failure before an actual drive failure occurs.

Predictive Spare Activation automatically copies the data from a predictive failure drive to a global spare drive. The copy operation reduces the time before the spare drive becomes active. After the copy completes, the predictive failure drive is marked as a drive failure. You can then remove it from the RAID set for servicing.

### **Advanced Data Mirroring**

HPE Smart Array Advanced Pack 2.0 features Advanced Data Mirroring (ADM). ADM uses additional drives for redundancy, but data is actively read from and written to the drives. ADM allows triple mirroring of RAID 1 and 1+0 configurations, which provides the highest level of fault tolerance offered by Smart Array. Since three copies of data offer protection from two drive failures, ADM is considerably more reliable than two-drive mirroring and offers significantly better performance.

### **HPE SmartCache**

HPE SmartCache utilizes SSDs for caching to accelerate workload performance. This solution uses HPE Smart Analytics technology to intelligently assign frequently accessed “hot data” to high-performance SSD drives. By providing workload-aware intelligence to optimize system operations, this smart caching capability helps clients achieve higher performance for transactional workloads. HPE SmartCache performance outcomes are application dependent.

### **Dynamic Workload Acceleration**

To optimize solid-state media performance and to eliminate controller bottlenecks, Smart Array controllers are optimized for SSDs with six times the performance of previous generation controllers. Recently, this technology helped HPE ProLiant achieve the TPC-C 10 benchmark in the industry. To drive further gains in application performance, we’ve doubled the cache capacity in our next generation servers for faster writes and reads of data.

### **HPE Secure Encryption option**

HPE Secure Encryption is an HPE Smart Array controller-based data encryption solution for protecting sensitive data. This data-at-rest solution works on locally-attached bulk storage devices (excepting tape or external arrays), and is available for both local and remote key management deployments. HPE Secure Encryption encrypts all data-at-rest (in the cache module and on the storage medium) and works with all hard disk drives (HDDs) and SSDs in the HPE Drive portfolio.

### **HPE drives for controller-based storage**

HPE offers a number of drive types and technologies that address the needs of the enterprise environment. This variety provides a broad range of storage solutions that give IT managers the flexibility to choose storage devices based on reliability, performance, and cost.

#### **HPE hard disk drives**

The SAS architecture enables system designs that deploy high-performance SAS and high-capacity SATA SFF and LFF HDDs. SFF drives provide higher performance than large form factor drives. The smaller SFF platters reduce seek times because the heads have a shorter distance to travel. RAID performance improves by increasing the numbers of spindles.

#### **HPE solid state drives**

HPE Enterprise SSDs are suited to enterprise environments with highly random data under a variety of write-workload applications. The HPE SAS and SATA SSDs provide significantly better random read and write IOPs compared to HDDs. While sequential read and write throughput is also improved over HDDs, the greatest benefit is recognized in random data applications. As a result, these high-performance, low-latency, and low-power SSDs provide significant system benefits for applications that previously over-provisioned HDD capacity to achieve better performance.

The HPE SmartSSD Wear Gauge is a unique HPE technology for monitoring the lifespan of SSDs. SSDs have a limited write cycle lifetime and the HPE Wear Gauge technology calculates how much life remains on your SSDs so you can plan for their replacement ahead of time.

#### **Classes of HPE SSDs**

In order to meet the varying needs of different application workload environments, HPE offers SSDs in three distinct classes—each intended to meet a particular set of performance and endurance requirements. Read-Intensive SSDs deliver fast read performance at a low cost for environments that do not experience large volumes of writes. Write-Intensive SSDs deliver fast write (and read) performance while being able to sustain larger volumes of writes. Mixed-Use SSDs offer a balance between Read/Write performance and overall endurance. Table 9 summarizes the characteristics and usage models for each of the three types of SSD.

**Table 9.** Classes of HPE SSDs for ProLiant Gen9 Storage

	READ INTENSIVE	MIXED USE	WRITE INTENSIVE
<b>Performance</b>	Good read performance at a low price	Mixed workloads	Best write performance
<b>Endurance</b>	Equivalent of 1 full drive write per day during the SSD lifecycle	Equivalent of 3–4 full drive writes per day during the SSD lifecycle	Equivalent of 10 full drive writes per day during the SSD lifecycle
<b>Target Workloads</b>	Read caching, web servers, social media, boot, etc.	Mixed read/write workloads	Business intelligence, Big Data analytics, virtualization, etc.

**M.2 SSDs**

M.2 Solid State Storage delivers SSD-based storage for HPE ProLiant Gen9 ML/DL servers via M.2. Enablement Kits. These kits consist of PCIe option cards that connect to the embedded B140i SATA controller and contain onboard M.2 devices that communicate using the 6 Gb/s SATA protocol. M.2 SSDs provide SSD-based storage for ML/DL servers and are typically used as higher speed boot devices. M.2 SSDs are available for the HPE ProLiant DL560 Gen9 only in the form of the HPE 120GB Value Endurance Solid State M.2 Enablement Kit for ProLiant ML/DL servers.

**PCIe-base storage using HPE NVMe Drives and HPE Express Bay**

HPE NVMe PCIe 2.5” SSDs utilize the Non-Volatile Memory Express (NVMe) interface to implement SSD storage that is directly attached to the PCIe bus. NVMe uses a streamlined register and command set to improve random and sequential access performance and provides a new standards-based approach for a PCIe-based storage interface that is designed specifically for the low-latency performance of SSDs. Key benefits of NVMe over SAS or SATA interfaces include reduced latency, increased IOPs, and lower power consumption.

HPE NVMe 2.5” SSDs operate exclusively in the HPE Express Bay, which is available as an Enablement kit for the HPE ProLiant DL580 and DL560 Gen9 servers. Using the HPE Express Bay Enablement kit, you can add up to five NVMe-enabled drive bays on the DL580 and up to six on the DL560. NVMe drives are front-panel accessible for hot add and orderly remove.

**Networking for the HPE ProLiant DL580 and DL560**

**HPE networking adapters**

For HPE ProLiant Gen9 servers, HPE provides the next generation networking adapters designed to meet the needs of converged IT infrastructure with higher performance and support for key Ethernet features. The advanced Gen9 networking adapters also feature several new capabilities such as NIC partitioning (NPAR) and RDMA over Converged Ethernet (RoCE) that deliver improved network performance and efficiency in specific environments. HPE ProLiant DL560 Gen9 and DL580 Gen9 servers feature network adaptors in 1 GbE, 10 GbE, and 25 GbE speeds.

**FlexibleLOM technology**

LAN-on-motherboard (LOM) technology provides essential network connectivity without requiring an optional network card to be installed in an expansion slot. While standard LOM design leaves standard expansion slots available for expansion functions, it also limits your connectivity options. We developed FlexibleLOM technology, which uses a FlexibleLOM module that attaches to a dedicated edge connector on the system board. FlexibleLOM technology maintains the close-coupled interface of a LOM while allowing you to select the connectivity you need now—and still adapt to network changes in the future without using a standard PCIe slot. FlexibleLOM technology is available on both the HPE ProLiant DL580 Gen9 and DL560 Gen9 Servers.

**HPE Standard Ethernet adapters**

HPE Standard series networking adapters offer a cost-effective Ethernet solution for HPE ProLiant networking needs. These adapters are intended to meet the price/performance goals for core enterprise workloads. HPE Standard series adapters are available at 1 GbE speed in both dual-port and quad-port configurations and as 10 GbE dual-port adapters. Standard series adapters also support both Single Root I/O Virtualization (SR-IOV) and NPAR functionality.

### Single Root I/O Virtualization

SR-IOV is a technology created primarily to benefit the performance of NICs when they are used in virtualized environments. SR-IOV allows a PCIe network adapter to appear to be multiple separate physical devices—or virtual network functions—that can be assigned to individual VMs within a Virtualized Server environment. By allowing individual VMs to actually access a portion of the physical NIC, SR-IOV reduces the server processor overhead for network I/O and decreases I/O latencies.

### NIC Partitioning

NIC Partitioning (NPAR) allows a single port to be presented to the OS as four separate adapters—or partitions—per port. Each partition is an actual PCIe function that appears to the system ROM, OS, or virtualization OS as a discrete physical NIC with its own software driver, and each partition behaves as an independent NIC port. With NPAR, you must configure the partitions in a pre-boot environment, which you must also manage locally on each server.

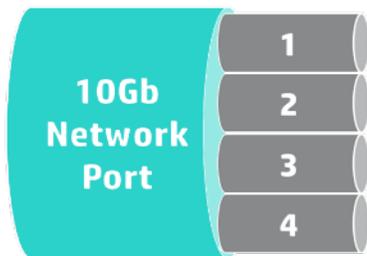


Figure 5. NPAR NIC Partitioning.

### HPE Advanced FlexFabric Adapters

HPE Advanced network adapters help simplify the networking and networking storage topology to build a hybrid server networking infrastructure using HPE FlexFabric Converged Network Adapters (CNAs). HPE's FlexFabric architecture gives the flexibility to configure the network ports on FlexFabric adapters as any of the following:

- Standard Ethernet adapter
- Fibre Channel over Ethernet (FCoE) adapter
- iSCSI adapter

When configured as either FCoE or iSCSI, the network port is made to look like either a Fibre Channel adapter or a SAS HBA, respectively, to the server host OS. In these configurations, the FlexFabric adapter also delivers additional performance benefits since the processing of the storage part of the stack occurs on the adapter and not on the host CPU. This is sometimes referred to by the term storage offloading.

As a result of this flexibility, FlexFabric adapters deliver the additional advantage of allowing you to connect to different types of storage and data networks without requiring additional NICs, reducing cabling and switch requirements.

On ProLiant Gen9 rack and tower servers, HPE offers FlexFabric as dual-port 10 GbE adapters. FlexFabric adapters also support other advanced networking capabilities, including RoCE and Tunnel Offload capability.

### RDMA over Converged Ethernet

RoCE allows applications to directly access memory on other nodes across a fabric for very low latency communications. RoCE works well for endpoints that communicate frequently, such as storage functions, database environments, or VM migrations. RoCE is available with the HPE ProLiant 556FLR-SRP+ and 650FLR-SRP+ adapters.

### Tunnel offload for Overlay Networks

Tunnel offload minimizes the impact of overlay networking on host performance for Virtual Extensible LAN (VXLAN) and Network Virtualization using Generic Routing Encapsulation (NVGRE). By offloading packet processing to adapters, customers can use overlay networking to increase VM migration flexibility and network scale with minimal impact to performance. HPE Tunnel Offloading increases I/O throughput, reduces CPU utilization, and lowers power consumption.

## HPE 25 GbE performance adapters

Data center network traffic is continuing to increase significantly, driven in part by the rise in the volume of mobile data and video and the frequency at which customers are accessing it. Current approaches to managing this increase in traffic (e.g., using a four-port 10 GbE NIC to aggregate 40 Gb of bandwidth) are both expensive and require extra infrastructure.

HPE is introducing new 25 GbE Ethernet adapters to deliver significantly increased networking throughput to and from the server using fewer networking resources. The new 25 GbE adapters are available for both the HPE ProLiant DL580 Gen9 and DL560 Gen9 servers and deliver all of the following benefits:

- 2.5 times the bandwidth of 10 GbE adapters.
- Compatibility with the current copper or fiber cabling used for 10 GbE.
- Lower CAPEX and OPEX costs compared to 40 GbE solutions using more ports/switches to achieve required throughput.
- Easier scalability to 100 GbE standards.

HPE is currently offering the following 25 GbE capable adapters for use in the HPE ProLiant DL580 Gen9 and HPE ProLiant DL560 Gen9 servers:

- HPE Ethernet 10/25Gb 2-port 640SFP28 Adapter.
- HPE Ethernet 10/25Gb 2-port 640FLR-SFP28 Adapter.
- HPE Ethernet 10/25Gb 4-port 620SFP28 Adapter.

## Managing the HPE ProLiant DL580 Gen9 and DL560 Gen9 servers

HPE offers a set of server management capabilities that give you complete control of your IT infrastructure. For Gen9 servers, we have introduced a number of management innovations for ProLiant servers, all working together to give you complete control of the monitoring and management of the servers and infrastructure in your data center.

### Embedded management

On System management consists of a set of essential yet powerful server management capabilities that are embedded on all HPE servers. These capabilities are designed to meet the needs of any organization, from enterprise to smaller IT environments. On System management provides embedded tools and system utilities that increase server administrator productivity.

HPE ProLiant Gen9 servers feature a wide range of embedded management features. HPE introduced many of these capabilities with ProLiant Gen8 servers—further refining and enhancing them for Gen9. Others—such as iLO Federation and the HPE RESTful API—are new for Gen9.

### HPE iLO and iLO Federation

For Gen9 servers, HPE has added several new features to HPE iLO as well as making improvements to existing functionality. The most significant new feature is iLO Federation.

#### iLO Federation

iLO Federation is a new and powerful method for organizing and managing large numbers of HPE ProLiant servers by using the iLO4 Management Engine in each server to discover and communicate with other ProLiant servers in the network. iLO Federation also allows you to organize servers into groupings of your choosing. The iLO web interface allows you to create iLO Federation Groups, with each group containing any number of ProLiant servers, and each server/iLO capable of being included in up to 10 groups.

The true power of iLO Federation lies in the ability to use the federated structure to perform distributed execution of iLO management functions to all of the systems in an iLO Federation Group. This distributed model is both faster and more efficient than using centralized control to serially perform management functions against a set of servers, enabling better management at scale for ProLiant Gen9 servers.

iLO Federation capabilities enable you to perform many different iLO management functions—including Group Firmware Update, Group Power Capping and others—at scale across groups of servers. HPE iLO Federation is also leveraged by other HPE management tools such as HP Smart Update Manager (SUM) to provide faster and more scalable System Update capability.

### Additional iLO features for HPE ProLiant Gen9 servers

In addition to iLO Federation and improvements to Agentless Management, HPE iLO for ProLiant Gen9 servers includes the following new features:

- iLO Reboot Switch, allowing you to reset the iLO or HPE ProLiant hardware via the Unit ID (UID) button when iLO is not responding.
- Pre-Boot Health Summary, allowing you to troubleshoot and view iLO diagnostic information through the server's external monitor prior to powering on.
- A 1 GB Embedded User partition that is accessible for storage (on select servers).

### Agentless Management

Agentless Management allows HPE ProLiant servers to collect and deliver hardware and other server management information to HPE Management platforms without requiring the installation of traditional agents or providers on the host OS. For Gen9 servers, Agentless Management has been enhanced to collect and display the following additional information:

- Health status and serial number for external storage attached to HPE Smart Array controllers.
- Health status, model, serial number, and firmware version for storage attached to Gen9 Smart HBA controllers.
- Status, model, serial number, and capacity of the HPE Smart Storage Battery.
- Health status of HPE Smart Cache.

For Gen9 servers, Agentless Management also supports SNMP v3 and IPv6.

### Smart Update Manager

Smart Update Manager (SUM) is the system maintenance tool for systematically updating firmware and drivers for HPE server Infrastructure at data center scale. For Gen9 servers, HP SUM is being updated to deliver better performance when performing updates by using the new iLO Federation capabilities.

SUM uses the Service Pack for ProLiant (SPP) to deliver system updates efficiently and reliably. Each SPP provides a consolidated set of solution-tested ProLiant system software (firmware, drivers, agents, utilities) available as a single download.

### UEFI

For Gen9, HPE ProLiant servers are transitioning to the Unified Extensible Firmware Interface (UEFI) as the new and default system firmware. UEFI is a complete redesign and re-engineering of firmware and offers functionality, performance, and configuration management capabilities beyond those of legacy BIOS firmware. For HPE ProLiant Gen9 servers, UEFI delivers a number of benefits, including the following:

- A new graphical preboot environment for configuring the server platform, NICs, and iLO.
- HPE UEFI Shell, which provides a command line and a scripting environment for server platform configuration. The UEFI Shell environment for HPE ProLiant Gen9 servers provides enhancements over the standard UEFI Shell with additional commands and improved security.
- Implementation of Secure Boot functionality, which requires the BIOS to verify signatures on all UEFI drivers, OS boot, and UEFI applications as part of the boot process.
- Enhanced storage support, including the following:
  - Boot volumes over 2.2 TB.
  - Flexible boot order. Ability to boot from any device on any controller.
- Support for IPv6 PXE and USB 3.0 in the preboot environment.

HPE ProLiant Gen9 servers support both UEFI Boot mode and Legacy Boot mode. HPE recommends using the UEFI boot mode, which should work in almost all situations.

### RESTful-compliant API for configuration scripting

Representational state transfer (REST) is an http-based web services architecture that can be used to communicate information and commands across networks using the GET, PUT, and POST commands within the http protocol. For Gen9 servers, HPE has implemented a REST-compliant (or RESTful) API in iLO for communicating and setting system configuration and management information across the network.

The new HPE RESTful API delivers numerous benefits to enterprise users, including:

- Delivering a common remote configuration and management interface for configuring ProLiant systems—including the server platform, NICs, storage, and iLO.
- Providing tool-less access to configuration and management. Enterprise customers can write their own configuration and management scripts directly to the API without having to adopt an HPE tool.
- Replacing older, less flexible and extensible APIs such as IPMI.

For HPE ProLiant Gen9 servers, the HPE RESTful API is available both in-band and out-of-band as well as through iLO when the server is offline (aux power). It also serves as a base for the next generation of HPE remote configuration tools, allowing HPE to develop a more comprehensive and powerful utility for remotely managing and configuring the entire ProLiant platform.

### Converged Management using HPE OneView v3.0

HPE continues to offer HPE Systems Insight Manager (SIM) and HPE Insight Control to manage Gen9 servers within your data center.

For data centers with a large number of devices that require 24x7 management and maximum uptime, HPE offers HPE OneView. HPE OneView is a converged management platform providing infrastructure management across servers, storage, and networking. It provides powerful software-defined process templates for automating infrastructure configuration and provisioning, as well as for robust infrastructure health and monitoring. The HPE OneView ecosystem provides an open programmable system using RESTful-based APIs that allow you to automate deployment and management processes. HPE OneView also integrates with enterprise management tools such as VMware vCenter Server and Microsoft System Center to streamline operations—saving you time and cost.

HPE OneView continues to evolve and grow, with OneView v3.0 incorporating the following new features:

- **HPE OneView Global Dashboard** delivers enterprise scale management of HPE ProLiant DL servers as well as HPE Synergy and HPE BladeSystem c-Class servers into a single view. HPE OneView Global Dashboard also unifies management of HPE OneView and HPE Synergy Composer instances and manages up to 10 HPE OneView appliances.
- **Server-level management.** Complete server-level management for HPE ProLiant DL servers (including RAID).
- **Integrated Remote Support** for HPE ProLiant DL servers to receive 24x7 monitoring, prefailure alerts, automatic call logging, and automatic parts dispatch to enhance overall customer experience supporting HPE infrastructure.
- **Scopes** to logically group resources such as finance, sales, and ERP.
- **Automated backup.** Scheduled and on demand backup of management appliances.
- **Additional Integration.** HPE OneView v3.0 continues to add integration with the following platforms:
  - Microsoft System Center. Integration with OneView v3.0 as well as firmware and driver support from SPP 2016.06.0.
  - VMware vCenter. Integration is now delivered as a virtual appliance, simplifying initial setup.
- **New partner integrations.** Integrations from Ansible, SaltStack, SUSE and VMTurbo further enhances customers' ability to deploy new apps and services faster through the HPE Composable Infrastructure Partner Program.

## Support management with HPE Insight Online

HPE Insight Online is the web-based portal service that provides secure management access to the HPE devices in your IT environment, allowing you to monitor and manage your servers, storage, and network across the web. Insight Online delivers converged support of servers, storage, and networking, providing a comprehensive view of your IT infrastructure that includes the following:

- A personalized dashboard for “at-a-glance” monitoring device and support status.
- A devices area to provide a visual status of your individual devices and device groups.
- Monitoring of contract and warranty status for devices.
- Monitoring of all your support cases.

The latest implementation of HPE Insight Online includes all the following:

- A new dashboard user interface as well as mobile dashboard capability, allowing you to monitor your IT infrastructure from mobile devices.
- Insight Remote Support 7.4 software with increased scaling capabilities, allowing you to monitor as many as 3500 devices through Insight Online.
- Central Management Server (CMS) heartbeat monitoring.

## Power efficiency and provisioning

We have designed power supplies with industry-leading efficiency ratings and have developed technologies that allow you to precisely monitor and control ProLiant Gen9 servers' energy use.

### HPE Common Slot power supplies

Both the HPE ProLiant DL580 Gen9 and the DL560 Gen9 servers use HPE Common Slot power supplies that operate at up to 94% efficiency. Common Slot power supplies share a common electrical and mechanical design that allows for tool-less hot-swap installation into the servers' Common Slot power supply bays. Depending on your power requirements, the HPE ProLiant DL580 and DL560 servers use either the HPE 1500W or the HPE 1200W Common Slot Power Supply. The DL580 server requires a minimum of two power supplies and can use up to four total power supplies for N+N redundancy. The DL560 server supports N+1 power supply redundancy. The ability to use HPE Common Slot power supplies across multiple platforms simplifies maintenance for your IT department. Using a common power supply form factor requires fewer spares and decreases your inventory costs and facility space requirements.

### HPE 3D Sea of Sensors

HPE 3D Sea of Sensors provides the data to control the server fans precisely and to cool specific components directly, while not overcooling other components. This significantly reduces fan power consumption per server. HPE Sea of Sensors extends the use of sensors to select PCI Express option cards and FlexibleLOM Adapters to get a three-dimensional temperature profile in the server. This additional data enables more precise and efficient cooling of ProLiant Gen9 servers. The data is included in the always-on diagnostic information of the HPE Active Health System.

### Power provisioning tools

HPE Power Provisioning tools include Dynamic Power Capping, Power Regulator for ProLiant, and the HPE Power Advisor Utility. These tools, summarized below, help administrators maximize data center power usage by fitting more IT equipment in the available power and cooling capacity.

### **HPE Power Regulator for ProLiant**

HPE Power Regulator for ProLiant is a hardware feature that enables ProLiant servers to control performance states of the system processors dynamically. Insight Control Power Management monitors and uses HPE Power Regulator technology. Performance states (p-states) are affected by processor frequency and voltage:

- Processor frequency—A lower p-state causes the processor to operate at a lower frequency. For example, a 3.773 GHz processor might operate at 3.0 GHz in a lower p-state.
- Processor voltage—A lower p-state causes the processor to operate at a lower level of voltage. For example, a processor operating at 1.4 V at maximum p-state might operate at 1.2 V in the minimum p-state.

HPE Power Regulator features Dynamic Power Capping, sophisticated monitoring and control circuitry that prevents server power from exceeding a preset level. Because Dynamic Power Capping is hardware-based, it can quickly control sudden surges in power consumption by servers and prevent tripping even the fastest circuit breakers used in HPE Power Distribution Units (PDUs). You can set a power cap for an individual server from the iLO user interface. For groups of servers, you can set the power caps from the power management module within HPE Insight Control and with iLO Federation Group Power Capping within HPE iLO. HPE iLO functionality of Group Power Capping requires an iLO Advanced or iLO Scale-Out license.

Power Regulator operates in the following modes:

- HPE Static Low Power Mode
- HPE Static High Performance Mode
- HPE Static High Performance Mode
- HPE Dynamic Power Savings Mode
- OS Control mode

You can find more information about Power Regulator in the [\*Power efficiency and power management in HPE ProLiant servers\*](#) technology brief.

### **HPE Power Advisor utility**

The HPE Power Advisor utility helps you calculate the expected power use of ProLiant and Integrity servers to determine power distribution, power redundancy, and battery backup requirements. It lets you calculate the power requirements for a single server, a rack of servers, or multiple racks of servers. These calculations are based on data collected through extensive testing of various HPE ProLiant and Integrity server configurations, running a particular synthetic workload. You can adjust the calculations to determine server power requirements at different server utilization levels that more closely match your expected workload. For more information, refer to the HPE Power Advisor site at [hpe.com/us/en/products/integrated-systems/rack-power-cooling.html#poweradvisor](http://hpe.com/us/en/products/integrated-systems/rack-power-cooling.html#poweradvisor).

### **HPE extended ambient temperature support for ASHRAE operating ranges**

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) establishes temperature and humidity guidelines for data center operation. In the past, 35°C has been the traditional maximum inlet air temperature for servers. In 2011, ASRAE established new guidelines for classifying ambient temperature operating ranges in the data center. HPE has designed the ProLiant DL560 Gen9 and DL580 Gen9 servers to meet ASHRAE ambient temperature operating classes A3 and A4, which define maximum allowable ambient temperatures of 40°C and 45°C, respectively. By supporting these extended operating ranges, the DL560 and DL580 Gen9 servers may allow you to raise your data center's operating temperature and/or use more efficient cooling strategies in your facility, significantly reducing energy consumption.

### **Data security technology with the Trusted Platform Module 2.0**

The Trusted Platform Module (TPM) is a hardware-based system security feature that can securely store information such as passwords and encryption keys to authenticate the platform. The TPM also enables Microsoft Windows® BitLocker™ Drive encryption capability. Administrators can further use TPM to store platform measurements that help ensure that the platform remains trustworthy.

HPE is now delivering the TPM 2.0 for ProLiant Gen9 servers. TPM 2.0 is one of the first products to implement the Trusted Computing Group's TPM 2.0 specification 1.16. A rivet supplied with the TPM module attaches and secures the module to the system board. To prevent possible damage to the TPM module or to the system board, the TPM cannot be removed from the board after it has been installed.

## Conclusion

Both the HPE ProLiant DL560 and DL580 Gen9 servers are designed to provide scale-up performance for demanding workload environments requiring processing, memory, and I/O capabilities of 4S servers. This makes these servers ideal for larger-scale application environments, including the following:

- Business processing applications with large database workloads (ERP or CRM).
- Decision support applications (Data warehousing, Business Intelligence, Analytics) in I/O intensive environments.
- Large-scale consolidation of virtualization environments.

The HPE ProLiant DL560 Gen9 server delivers scale-up capabilities that balance performance, scalability, and expandability in a compact 2U rack-mount server. This makes the DL560 Gen9 server well suited for environments where optimization of data center space, performance, and costs are vital. In addition to scalable performance, memory, and I/O capabilities, the DL560 Gen9 server also supports significant internal storage, making it ideal for solutions environments that can utilize a large number of internal drives.

The HPE ProLiant DL580 Gen9 server is a true enterprise-class server delivering the best performance, expandability, and reliability in a 4S rack-mount server. With the ability to use up to 6 TB of system memory and its Advanced Memory Protection features, the DL580 Gen9 server is an ideal choice for mission-critical enterprise, business intelligence, and database application environments requiring the utmost in reliability and availability. With its nine full-length, full-height PCIe slots, the DL580 Gen9 server also delivers maximum I/O bandwidth capabilities, including the ability to accommodate multiple GPGPU cards.

The HPE ProLiant DL560 and DL580 Gen9 servers also feature HPE's other advanced technologies—including HPE Smart Storage, HPE Server Networking technologies, and HPE server and infrastructure management using iLO4, HPE Insight Online, and HPE OneView.

## Resources, contacts, or additional links

HPE ProLiant DL580 Gen9 server  
[hpe.com/servers/dl580gen9](http://hpe.com/servers/dl580gen9)

HPE ProLiant DL560 Gen9 server  
[hpe.com/servers/dl560gen9](http://hpe.com/servers/dl560gen9)

HPE Server Options  
[hpe.com/info/serveroptions](http://hpe.com/info/serveroptions)



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