

Technologies in HP ProLiant Gen9 rack and tower servers



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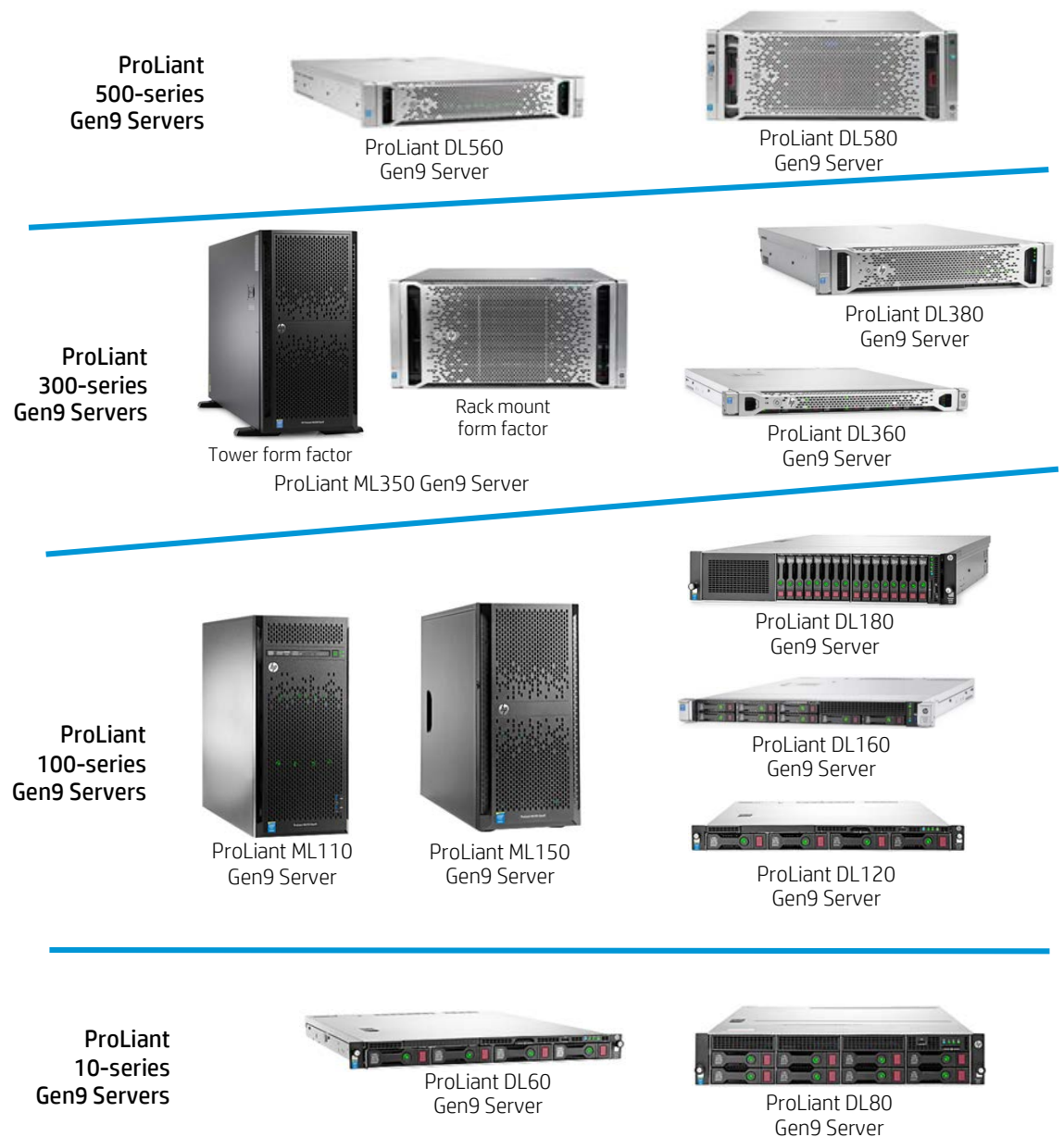
Abstract

Reducing IT complexity, improving operational efficiency, and protecting information are key goals for your data center. This technical brief describes how the latest innovations and technologies offered in HP ProLiant Gen9 rack and tower servers allow you to achieve these goals.

Introduction

HP ProLiant Gen9 rack and tower servers deliver the right compute for the right workload at the right economics. We've engineered these servers to include the latest technologies and management capabilities that optimize your TCO by increasing compute performance, reducing IT complexity, and improving operational efficiency. These servers are available in several form factors (Figure 1) giving you control over your data center's server density.

Figure 1. HP ProLiant Gen9 rack and tower servers.



HP ProLiant 500-Series Gen9 Servers

The HP ProLiant DL580 and DL560 Gen9 servers are designed for the most demanding scale-up workloads. These 4-socket servers deliver unparalleled scalability, reliability, and availability for enterprise and high-performance computing (HPC) environments. The ProLiant DL580 Gen9 Server offers a massive memory footprint and is ideal for mission-critical intelligence or database applications and can handle your most demanding workloads.

The ProLiant DL560 Gen9 Server brings 4-socket performance and exceptional expandability and reliability in a compact 2U form factor.

HP ProLiant 300-Series Gen9 Servers

The HP ProLiant 300-Series Gen9 servers offer exceptional flexibility for configuring their compute, storage, networking, and power capabilities, allowing you to “future proof” your investment. Available in a choice of tower and rack mount form factors, these servers provide the high performance you need in your data center. The ProLiant DL380 Gen9 Server offers the expandability required of a workhorse system.

The ProLiant DL360 Gen9 Server answers the need for a high density data center with high I/O density capability over previous 1U systems.

The ProLiant ML350 Gen9 Server offers robust performance, expandability, and reliability in a tower and rack mount form factor to meet all the needs of growing businesses and data centers.

HP ProLiant 100-Series Gen9 Servers

The HP ProLiant DL180, DL160, and DL120 Gen9 Servers deliver rack-mountable right-sized performance, availability, and serviceability required by SMBs, enterprise environments, and service providers. The ProLiant DL180 Gen9 Server offers performance and scalability in a 2U package to meet availability and dense-storage requirements. The ProLiant DL160 and DL120 Gen9 Servers offer enterprise-class architectures in 1U packages. The ProLiant DL160 Gen9 Server features a 2P design optimized for very dense, hyperscale environments. The ProLiant DL120 features a 1P design making it easy to deploy dense, performance-driven infrastructures.

ProLiant ML150 and ML110 Gen9 Servers, each in a tower form factor, are designed for today's demanding scale-up workloads for small-to-medium businesses (SMBs).

HP ProLiant 10-Series Gen9 Servers

HP ProLiant 10-series Gen9 Servers are designed for SMBs looking for simple-to-deploy right-sized servers for first-time workload deployment. These servers feature the right combination of density, performance, and manageability for cost-conscious service providers.

Innovations in ProLiant Gen9 servers

HP ProLiant Gen9 servers include significant innovations that dramatically accelerate application performance and address your IT complexity, efficiency, and management concerns:

- Flexible designs and options (such as Universal Media Bay, M.2 Solid State Drive enablement kit, and rear drive bay option for select models) to accommodate changing needs and meet specific configurations for changing workloads.
- Increased I/O density on 1U form factors for more expansion capabilities
- HP DDR4 Smart Memory providing up to 2133 MT/s
- Improved component layout and airflow; systems are compliant with ASHRAE expanded operating ranges allowing more energy-efficient cooling strategies
- HP Embedded, Converged, and Support Management technologies for accelerating IT service delivery.
- HP FlexibleSlot design accommodating power supply and battery backup options (ProLiant DL300-series)
- Embedded hardware management enhancements (NAND flash available/dedicated management ports) for OneView (select DL solutions)
- HP Flexible Smart Array offering a choice of controller without consuming a PCIe slot (ProLiant DL300-series).

Comparison of ProLiant Gen9 rack and tower servers

HP ProLiant Gen9 rack and tower servers share the following technologies:

- Memory: HP Smart Memory; DDR4 2133 MHz
- Embedded HP B140i Smart Array Controller (except ProLiant DL580)
- System ROM: UEFI (default) and legacy BIOS
- Minimum ASHRAE A3 operating class
- Common processors across most ProLiant Gen9 systems
- Common hard disk drives
- OneView support for all DL systems
- Standup cards including Networking, SA controllers

Table 1 offers a comparison of ProLiant Gen9 rack and tower servers.

Table 1. Comparison of ProLiant Gen9 Rack and Tower Servers

	ProLiant 10 series	ProLiant 100 series	ProLiant 300 series	ProLiant 500 series
Models	DL60, DL80	ML110, ML150, DL120, DL160, DL180	ML350, DL360, DL380	DL560, DL580
Form factor	DL60: 1U rack mount DL80: 2U rack mount	ML110, ML150: tower DL120, DL160: 1U rack mount DL180: 2U rack mount	ML350: tower or 5U rack mount DL360: 1U rack mount DL380: 2U rack mount	DL560: 2U rack mount DL580: 4U rack mount
Processor type	Xeon E5-2600 v3	Xeon E5-2600 v3	Xeon E5-2600 v3	DL560: Xeon E5-4600 v3 DL580: Xeon E7-4800 v3 or E7-8800 v3
# of processor sockets	Two	ML110 & DL120: one ML150, DL160, DL180: two	Two	Four
HP Smart Memory Max amount	256 GB	ML110 & DL120: 256 GB ML150, DL160, & DL180: 512 GB	1.51 TB (LRDIMM) 768 GB (RDIMM)	DL560: 3 TB (LRDIMM/RDIMM) DL580: 6 TB (RDIMM)
Storage controller (standard)	B140i	B140i	B140i	DL560: B140i DL580: P830i
Models with HP Universal Media Bay	--	DL180	DL360 & DL380:	DL560
Networking controller (standard)	2x1 GbE embedded	2x1 GbE embedded	4x1 GbE embedded with FlexibleLOM slot (not embedded)	Choice of 4x1 GbE or 2x10 GbE HP FlexibleLOM slot (not embedded)

Table 1. Comparison of ProLiant Gen9 Rack and Tower Servers

	ProLiant 10 series	ProLiant 100 series	ProLiant 300 series	ProLiant 500 series
PS form factor	Entry level	ML110: Multi-output ML150: Common slot DL120, DL160, & DL180: entry level	ML350: Common Slot DL360 & DL380: Flex slot	Common Slot
ASHRAE operating class compliance [1]	A3	ML110, ML150 & DL120: A3 DL160 & DL180: A3 & A4	A3 & A4	A3 & A4

Note:

[1] Configuration dependent.

Processor technologies

ProLiant Gen9 rack and tower servers feature Intel Xeon processors. Table 2 shows the Xeon processors available with ProLiant Gen9 rack and tower servers.

Table 2. ProLiant Gen9 rack and tower server processor matrix.

	ProLiant 10-series	ProLiant 100-series	ProLiant 300-series	ProLiant 500-series
Processor type	Xeon E5-2600 v3	Xeon E5-2600 v3	Xeon E5-2600 v3	DL560: Xeon E5-4600 v3 DL580: Xeon E7-4800 v3 or E7-8800 v3
Socket type x number	Socket 2011-3 x2	ML110: Socket 2011-3 x1 ML150, DL120, DL180, DL160: Socket 2011-3 x2	Socket 2011-3 x2	Socket 2011-1 x4
Cores per processor	4/6/8/10/12	ML110: 4/6/8/10 ML150: 6/8/10/12 DL120: 4/6/8/10/12/14/16/18 DL160, DL180: 4/6/8/10/12	4/6/8/10/12/14/16/18	DL560: 6/10/12/14/16/18 DL580: 4/8/10/12/14/16/18

Each processor contains an integrated Northbridge that includes the memory controller and the PCIe 3.0 controller. The memory controller interfaces with HP DDR4 Smart Memory running up to 2133 MHz and works with registered DIMMs (RDIMMs) and, on select platforms, load-reduced DIMMs (LR-DIMMs). These processors provide a QPI bandwidth up to 9.6 GT/s and an L3 cache size of up to 45 MB (depending on processor model).

ProLiant Gen9 servers feature these Intel Xeon processor capabilities:

- Processor Internal Sensors and Thermal Control - Protection against over-temperature conditions.
- Cache parity/ECC - Protects cache data from accidental data corruption due to particle hits, etc.
- Legacy Error Mode - Corrupt data is contained before it is consumed to ensure data corruption does not occur.
- QPI Protocol Protection via Cycle Redundancy Check (CRC) - Automatically detects data errors using a checksum of either 8 bits or 16 bits.
- QPI Link Level Retry - Retransmits when a transient error is detected on the QPI link.

- PCIe Advanced Error Reporting – Enhanced PCIe reporting features such as finer granularity in defining the error type, ability to specify the severity of each uncorrectable error, error logging, and ability to identify the source of an error.
- Direct Media Interface link (DMI) – An x4 bi-directional chip-to-chip interconnect between the processor and chipset. The DMI link provides 2.0 GB/s of bandwidth in each direction (Upstream and Downstream).

Memory technologies

IT trends such as server virtualization, cloud computing, and high-performance computing place significant demands on server memory speed, capacity, and availability. These increasing demands define the system's reliability, performance, and overall power consumption to a much greater extent than before. Therefore, choosing the right memory is the key to ensure high reliability and performance, and to deliver a faster return on your IT investment.

ProLiant Gen9 servers feature HP DDR4 Memory portfolio from HP Standard Memory to the fastest and lower power-consuming HP SmartMemory. HP Advanced Memory Error Detection Technology enhances memory protection for ProLiant Gen9 servers.

HP DDR4 SmartMemory

HP DDR4 SmartMemory offers significant improvements over previous memory generations. HP DDR4 SmartMemory provides up to 2133 MT/s bandwidth¹ for up to a 14 percent increase² in throughput over DDR3 memory. In addition, HP DDR4 SmartMemory registered DIMMs (RDIMMs) are engineered to achieve up to 35 percent improved performance at 1.2 volts when compared to DDR3-1866 DIMMs running at 1.5 volts. For applications that required maximum memory capacity, HP SmartMemory Load Reduced DIMMs (LRDIMMs) reduce the electrical load to the memory controller allowing higher capacity memory to run in three DIMMs-per-channel configurations.

Unlike other third-party memory, HP SmartMemory authenticates whether memory has passed HP's rigorous qualification and testing to ensure that customers are getting the highest quality, genuine HP Qualified Server Memory. HP SmartMemory also features enhanced reporting through the HP Active Health System and HP iLO (see the "HP iLO Management Engine" section later in this document). Due to ProLiant Gen9 SmartMemory functionality, DDR4 and DDR3 memory is not interchangeable. HP SmartMemory is ideal for HP ProLiant Gen9 customers who are looking to extract all the memory performance, dependability, and power savings that ProLiant Gen9 servers are designed to deliver.

HP DDR4 Standard Memory

Supported on selected 10-Series and 100-Series ProLiant Gen9 servers, HP Standard Memory delivers the right balance of performance, reliability and efficiency, to meet the needs of less-memory-demanding applications, at the right total cost of ownership. HP Standard Memory is ideal for reliable and affordable solutions that don't require high memory capacities.

HP Advanced Memory Error Detection technology

Uncorrectable memory errors can cause applications and operating systems to crash, so they are costly in terms of downtime and repairs. The best way to prevent unnecessary DIMM replacements is to filter out superfluous errors and identify critical errors that can lead to a shutdown. You can no longer rely on simple error event counts on systems containing up to 14 trillion memory transistors. With HP Advanced Memory Error Detection Technology, we re-invented a precision system that pinpoints errors that cause downtime.

HP Advanced Memory Error Detection Technology seeks out specific defects that either cause performance degradation or significantly increase the probability of an uncorrectable (non-recoverable) memory condition. By improving the prediction of non-recoverable memory events, this technology prevents unnecessary DIMM replacements and increases server uptime.

ProLiant Gen9 servers include these advanced memory protection features:

- Advanced ECC / SDDC – Error Checking and Correcting combined with Single Device Data Correction ensures continued memory operation in the event of a single memory device failure. The system allows removal of a DRAM from the memory map if it exhibits a failure and recovers its data into a new device. SDDC works for both x4 and x8 DIMMs.
- Rank Sparring (Online Spare) – Dynamic fail-over to a spare DIMM rank or spare rank pair behind the same memory controller. No OS involvement. You cannot enable this feature concurrently with memory mirroring. HP offers the rank sparing rather than DIMM sparing as rank sparing uses less spare memory resulting in less overhead.
- Demand Scrubbing – Writes corrected data back to the memory once a correctable error is detected on a read transaction.
- Patrol Scrubbing – Proactively searches the system memory repairing correctable errors. Patrol and Demand scrubbing work together to prevent accumulation of correctable errors and reducing the likelihood of unplanned downtime.

¹ Depending on processor model installed.

² Based on Intel recommendation of running similar capacity non-HP DDR4 DIMMs at 1866MHz.

- **Failed DIMM Isolation** - Identifies a specific failing DIMM lockstep pair thereby enabling the user to replace only the failed DIMM pair. Identifies a single DIMM for correctable errors and DIMM pair for uncorrectable errors.
- **Memory Thermal Control** - Prevents DIMMs from overheating. Achieved by slowing down the memory access rate. The temperature is monitored by a DIMM sensor.
- **DIMM Address/Control Bus Parity Protection** - Methods to detect and protect command and address errors.

I/O Interconnect and convergence technologies

HP ProLiant Gen9 servers support PCI Express (PCIe), serial attached SCSI (SAS), serial ATA (SATA) I/O technologies, 1- and 10-Gb Ethernet, 10-Gb FlexFabric, 10 Gb Flex-10, 8 Gb Fibre Channel, and 4X DDR (20 Gb) InfiniBand. Beyond the I/O technology and performance characteristics described in this section, I/O convergence is an increasingly important factor in current and future data center infrastructure. HP Converged Infrastructure address the need for a common, virtualized network fabric. HP ProLiant Gen9 servers also support I/O convergence with FlexibleLOM adapters.

PCI Express technology

The PCI Express (PCIe) serial interface provides point-to-point connections between the chipset I/O controller hub and I/O devices. Each PCIe serial link consists of one or more dual-simplex lanes. Each lane contains a send pair and a receive pair to transmit data at the signaling rate in both directions simultaneously. ProLiant Gen9 servers provide PCIe 3.0 slots, which have a signaling rate of 2.5 Gb/s per direction per lane. After accounting for 20 percent serializing/deserializing encoding overhead, the resulting effective maximum bandwidth is 2 Gb/s (250 MB/s) per direction per lane. Therefore, an x4 link with 4 send and receive pairs has an effective bandwidth of 2 GB/s. An x8 link has an effective bandwidth of 4 GB/s. This flexibility allows slower devices to transmit on a single lane with a relatively small number of pins while faster devices can transmit on more lanes as required.

Serial-Attached SCSI (SAS) technology

SAS is a serial communication protocol for direct-attached storage devices such as SAS Small Form Factor (SFF) and Large Form Factor (LFF) disk drives. SAS is a point-to-point architecture in which each device connects directly to a SAS port rather than sharing a common bus as parallel SCSI devices do. Point-to-point links increase data throughput and improve the ability to locate and fix disk failures. More importantly, SAS architecture solves the parallel SCSI problems of clock skew and signal degradation at high signaling rates.

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 the 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 adapt to network changes in the future without using a standard PCIe slot. FlexibleLOM technology is available on ProLiant DL380 Gen9 and DL360 Gen9 Servers. For more information on FlexibleLOM technology refer to the technical brief [*Networking Innovations for HP ProLiant Gen9 Servers*](#).

Network and virtualization technologies

ProLiant Gen9 servers come standard with either a quad- or dual-port 1 GbE NIC embedded on the system board. The HP ProLiant DL380 Gen9 and HP ProLiant DL360 Gen9 Servers also accept FlexibleLOM adapters. These NICs and adapters offer enhanced functionality that increases server performance and networking efficiency.

IEEE 1588 Precision Time Protocol (PTP) compliance – HP 1 GbE and 10 GbE network adapters for ProLiant Gen9 servers are compliant with the IEEE 1588 Precision Time Protocol (PTP) standard, which provides precise timing and synchronization over Ethernet networks. When implemented, this ensures that a set of servers are all in lock-step with consistent time. This is important in environments where multiple systems may be executing transactions that need to be logged in the proper sequence regardless of which system makes the transaction. IEEE 1588 PTP compliance lets the servers offload the synchronization processes, thus relieving the processor of such tasks and reducing network bandwidth. Please note that all devices that will be handling traffic carrying the PTP information (for example, network switches) have to be IEEE 1588-compliant to participate in this scheme.

TCP/IP Offload Engine (TOE) – The increased bandwidth of Gigabit Ethernet networks increases demand for CPU cycles to manage the network protocol stack. This means that performance of even a fast CPU will degrade while simultaneously processing application instructions and transferring data to or from the network. Computers most susceptible to this problem are application servers, web servers, and file servers that have many of concurrent connections.

The ProLiant TOE for Windows speeds up network-intensive applications by offloading TCP/IP-related tasks from the processors onto the network adapter. TOE network adapters have on-board logic to process common and repetitive tasks

of TCP/IP network traffic. This effectively eliminates the need for the CPU to segment and reassemble network data packets. Eliminating this work significantly increases the application performance of servers attached to gigabit Ethernet networks. TOE is included on integrated Multifunction Gigabit Ethernet adapters and is supported on Microsoft® Windows® Server 2008 and later operating systems.

Receive-Side Scaling (RSS) - RSS balances incoming short-lived traffic across multiple processors while preserving ordered packet delivery. Additionally, RSS dynamically adjusts incoming traffic as the system load varies. As a result, any application with heavy network traffic running on a multi-processor server will benefit. RSS is independent of the number of connections, so it scales well. This makes RSS particularly valuable to web servers and file servers handling heavy loads of short-lived traffic. Windows Server 2012 supports RSS as part of the operating system.

iSCSI Acceleration - Accelerated iSCSI offloads the iSCSI function to the NIC rather than taxing the server CPU. Accelerated iSCSI is enabled by the HP ProLiant Essentials Accelerated iSCSI Pack that is used with certain embedded Multifunction NICs in Windows and Linux® environments.

iSCSI boot for Linux - iSCSI boot for Linux is available on the ProLiant 556FLR 10 Gb adapter. iSCSI boot allows the host server to boot from a remote OS image located on a SAN within a Red Hat or SUSE Linux environment. The host server uses an iSCSI firmware image (iSCSI boot option ROM), making the remote disk drive appear to be a local, bootable “C” drive. Administrators can configure the server to connect to and boot from the iSCSI target disk on the network. It then downloads the OS image from the iSCSI target disk. The HP iSCSI boot solution also includes scripts to significantly simplify the installation process. Adding an iSCSI HBA card is not required.

RDMA over Converged Ethernet (RoCE) -RoCE allows user or kernel space 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 virtual machine migrations. RoCE is available with the ProLiant 556FLR-SRP+ and 650FLR-SRP+ adapters.

Tunnel offload - 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. HP Tunnel Offloading increases I/O throughput, reduces CPU utilization, and lowers power consumption up to 122%³

HP ProLiant Smart Storage

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, HP has developed technologies that balances storage performance with ever-increasing processor and memory speeds.

HP Smart Array controllers

We’ve addressed the storage performance gap with solid state drives (SSD) and SSD-optimized Smart Array controllers. With spinning media, performance is improved by adding more spindles (or more drives). Compared to a 1000-spindle hard drive solution, we’ve been able to achieve maximum performance with less than 100 SSDs. A key to achieving this performance was to remove controller bottlenecks associated with improved SSD performance. We’ve removed those performance bottlenecks in Smart Array controllers for ProLiant Gen9 servers. Compared to previous generation controllers, the new Smart Array controller delivers more than four times the I/O rate for read operations and more than six times the IOP rate for database workloads.

The HP Smart Array B140i Controller embedded on the system board of ProLiant Gen9 servers (except the ProLiant DL580) is upgradeable with a HP Flexible Smart Array or Smart HBA on DL380 and DL360 Gen9 servers (without consuming a PCIe slot) and with a standup PCI adapter on all ProLiant Gen9 rack and tower servers. The new HP Smart Array controllers utilize the PCI Express 3.0 host interface and 12 Gb/s SAS storage interfaces. These controllers also provide Active Health Logging and Predictive Spare Activation, and use an embedded RAID-on-Chip (ROC). Optional HP Smart Array Controllers can accommodate a 2- or 4-GB Flash Backed Write Cache (FBWC) kit.

Table 3 compares the embedded and optional Smart Array controllers for ProLiant Gen9 rack and tower servers.

³ Testing was conducted by HP turning on or off offload for measurement of VXLAN bidirectional throughput, VXLAN Tx/Rx physical CPU effectiveness and host server power efficiency.

Table 3. Comparison of HP Smart Array controllers for ProLiant Gen9 rack and tower servers

	HP Smart Array Controller B140i (included [1])	HP Smart Array Controller P440ar (optional)	HP Smart Array Controller P440 (optional)	HP Smart Array Controller P441 (optional)	HP Smart Array Controller P840 (optional)
Form factor	Embedded on system board	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
Transfer protocol	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
Memory bus speed	N/A	DDR3-1866 MHz	DDR3-1866 MHz	DDR3-1866 MHz	DDR3-1866 MHz
Cache Memory options	N/A	2 GB FBWC	4 GB FBWC	4 GB FBWC	4 GB FBWC
Connectivity	10 internal	2 internal x4 Mini-SAS	1 internal x 8 Mini-SAS double-wide	2 external x4 Mini-SAS HD	2 internal x8 double-wide connectors
Max # of drives [2]	10	26 (with expander)	8 (no expander) 48 (two expanders)	200 (direct attached)	16 (no expander), 48 (two expanders)
RAID support	0, 1 & 10 (drive mirroring), 5	1 & 10 (drive mirroring), 1 & 10 (ADM), 5 (DDG), 50, 6 (ADG), 60		1 & 10 (drive mirroring), 1 & 10 (ADM), 5 (DDG), 50, 6 (ADG), 60	1 & 10 (drive mirroring), 1 & 10 (ADM), 5 (DDG), 50, 6 (ADG), 60
HP Secure Encryption	No	Optional	Optional	Optional	Optional
HP SmartCache	Optional	Optional	Optional	Optional	Standard

Notes:

[1] Except ProLiant DL580

[2] Dependent on server model. Optional HP 12G SAS Expander Card installs in ProLiant DL380, DL180, and ML350 only.

ADM = Advanced Data Mirroring

ADG = Advanced Data Guarding

DDG = Distributed Data Guarding

Data retention: FBWC and Smart Storage battery

The optional Smart Array Controllers accommodate an optional FBWC that provides read ahead caching and write back caching with indefinite write cache data retention in case of power outage. The FBWC is transportable, allowing data in the cache to be migrated to a new controller. Smart Array Controllers for ProLiant Gen9 servers feature a backup battery that is shared across all controllers (up to 16 devices) in a system. This design offers the following benefits:

- Cable-less backup power connection
- Supports much larger cache capacities
- Battery monitored by iLO
- Diagnostic data available in Active Health
- Longer backup time

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. HP 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

HP Smart Array Advanced Pack 2.0 features Advanced Data Mirroring (ADM). ADM uses additional drives for redundancy, but data are 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.

HP SmartCache

HP SmartCache utilizes SSDs for caching to accelerate workload performance. This solution uses HP 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. HP SmartCache performance outcomes are application dependent.

Dynamic Workload Acceleration

To optimize solid state media performance and eliminate controller bottlenecks, Smart Array controllers are optimized for SSDs with six times the performance of previous generation controllers. Recently, this technology helped HP 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.

HP Secure Encryption option

HP Secure Encryption is an HP 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. Key features of HP Secure Encryption include:

- Encrypts all data at rest (in the cache module and on the storage medium)
- Works with all HDDs and SSDs in the HP Smart Drive portfolio
- Easily scales with business growth; remote key management can be centralized for 1,000s of servers
- Helps you comply with industry standards and government regulations

HP Smart Host Bus Adapters

HP Smart Host Bus Adapters (HBAs) address the need for low-cost direct-attached storage, single-domain JBODs, tape drives, libraries, and shared storage arrays. The H-Series HBA supports 6 Gb/s SAS, SATA, or SSD. It also supports shared external storage and multi-LUN tape libraries or external tape. Table 4 lists the HP smart HBAs for ProLiant Gen9 servers.

Table 4. Comparison of HP Smart HBAs for ProLiant Gen9 rack and tower servers

	HP Smart HBA H240ar	HP Smart HBA H240	HP Smart HBA H241
Form factor	Flexible Smart SAS HBA (daughter card)	Low profile PCIe 3.0 x8 card	Low profile PCIe 3.0 x8 card
Transfer protocol	6 & 12 Gb/s SATA	6 & 12 Gb/s SATA	6 & 12 Gb/s SATA
Drive connectivity	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
Maximum capacity	90 TB (SAS or SATA)	144 TB (SAS or SATA)	576 TB (SAS or SATA)
RAID support	1 & 10 (drive mirroring), 5 (DDG)	1 & 10 (drive mirroring), 5 (DDG)	1 & 10 (drive mirroring), 5 (DDG)

Note: DDG = Distributed Data Guarding

HP drive technologies

HP 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.

SAS and SATA Small Form Factor hard drives

The SAS architecture enables system designs that deploy high-performance SAS and high-capacity SATA SFF and LFF drives. 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.

HP SmartDrive

HP ProLiant Gen9 servers use HP SmartDrives designed to improved drive density and serviceability. The drive's front bezel includes a blue backlight for locating a specific SmartDrive selected from within the storage software. An icon-based display reports the drive's status. A "do-not-remove" LED helps prevent a drive failure whenever anyone tries to remove the wrong drive. Other serviceability improvements include authentication, failure logging, and integration with the HP Active Health System.

HP Solid State Drives

HP Enterprise SSDs are suited to enterprise environments with highly random data under a variety of write-workload applications. The HP SAS and SATA SSDs provide significantly better random read and write I/O operations per second (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 HP SmartSSD Wear Gauge is a unique HP technology for monitoring the lifespan of solid state drives. SSDs have a limited write cycle lifetime and the HP Wear Gauge technology calculates how much life remains on your SSDs so you can plan for their replacement ahead of time.

M.2 SSD

HP ProLiant Gen9 rack and tower servers can accommodate the following M.2 SSD options:

- HP Dual 120GB Value Endurance Solid State M.2 Enablement Kit for ProLiant ML/DL Servers
- HP 120GB Value Endurance Solid State M.2 Enablement Kit for ProLiant ML/DL Servers

These kits install in PCIe slots and use the B140 SATA controller only.

HP PCIe Workload Accelerators

HP PCIe Workload Accelerators provide consistent, predictable, reliable, sustained high performance for all your business-critical applications. Built on NAND flash memory technology, HP PCIe Workload Accelerators communicate directly with your applications over the PCIe bus, boosting I/O and reducing latency to scale performance in line with your processing requirements. This means you can host your entire database on one or more workload accelerators for enhanced in-memory access and performance. Available in capacities from 400 GB to 6.4 TB, PCIe Workload Accelerators increase per server performance by eliminating I/O bottlenecks and decreasing the need for external HDD storage arrays (and their software layers). This reduces data center footprint along with the associated complexity resulting in significant management, maintenance, and power and cooling savings.

Select PCIe products (both 2.5-in. SSDs and add-in cards) feature Non-Volatile Memory Express (NVMe), an interface that taps the full potential of SSDs attached to the PCIe bus. The NVMe interface is designed specifically for the low-latency performance of SSDs. With a streamlined register and command set, NVMe significantly improves random and sequential access performance and provides a standards-based approach for broad adoption and interoperability. Key benefits of NVMe over SAS or SATA interfaces include reduced latency, increased Input/Output operations per second (IOPS), and lower power consumption.

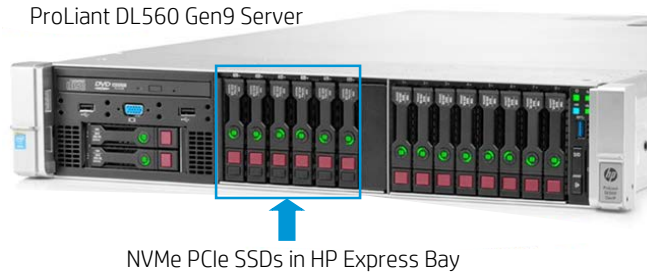
HP PCIe Workload Accelerators greatly increase performance for the following applications:

- Enterprise resource planning (ERP)
- Exchange
- SharePoint
- Business Intelligence and data warehousing
- Virtualization
- Multimedia
- Medical imaging

HP Express Bay

The ProLiant DL580, DL560, DL380, and DL360 Gen9 servers can be optionally configured with up to 1.6TB of 2.5-inch NVMe PCIe SSDs that offer increased bandwidth and reduced latency. Using the HP Express Bay Enablement kit option (Figure 2), you can add up to 6 drives that are front-panel accessible for hot add and orderly remove.

Figure 2. HP Universal Media Bay for the HP ProLiant DL560 Gen9 Server.



With the appropriate HP Express Bay Enablement Kit, the following ProLiant Gen9 servers can accommodate NVMe PCIe SSDs:

- ProLiant DL580: five NVMe PCIe SSD bays
- ProLiant DL560, DL380: six NVMe PCIe SSD bays
- ProLiant DL360: two NVMe PCIe SSD bays

You can choose from three types of NVMe SSDs:

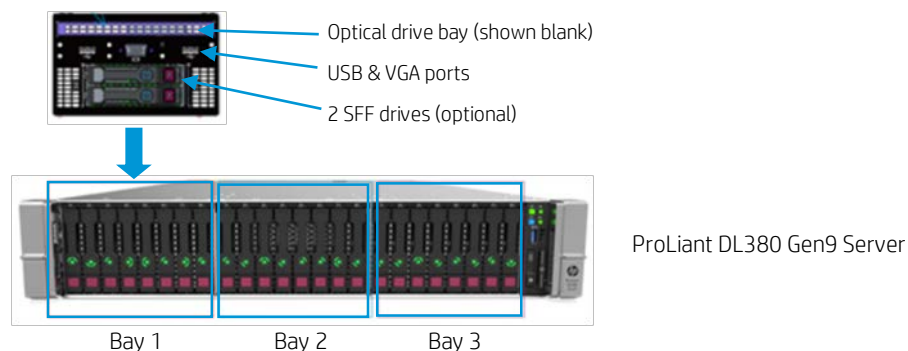
- HP NVMe PCIe Read-Intensive SSD: 400 GB up to 1.2 TB
 - Excellent performance
 - Target workloads: Read caching, social media, boot applications
- HP NVMe PCIe Write-Intensive SSD: 400 GB, 800 GB, and 1.6 TB
 - Excellent performance and endurance
 - Target workloads: OLTP, business intelligence, big data analysis
- HP NVMe PCIe Mixed Use SSD: 400 GB, 800 GB, and 1.6 TB
 - Balanced performance and endurance
 - Target workloads: Database, social media

HP Universal Media Bay

The HP Universal Media Bay adds functional flexibility to ProLiant DL380 Gen9 and DL360 Gen9 Servers. The Universal Media Bay kits allow you to add an optical disk drive bay, USB, and/or VGA ports to the server while providing two drive bays for SFF drives. The kit installs in a specific bay of the server (bay 1 in the DL380 Gen9 shown in Figure 3).

Figure 3. HP Universal Media Bay for the HP ProLiant DL380 Gen9 Server.

HP DL380 Gen9 2SFF Universal Media Bay kit



The following optional Universal Media kits are available:

For the ProLiant DL380 Gen9 Server:

- HP DL380 Gen9 2SFF Universal Media Bay Kit Front VGA and 2x USB:
- HP DL380 Gen9 2SFF Front/Rear SAS/SATA Kit
- HP Slim Optical Bay (SATA DVD-RW/ROM Optical Drive)

For the ProLiant DL360 Gen9 Server:

- HP DL360 Gen9 SFF DVD-RW/USB/VGA Universal Media Bay Kit
- HP DL360 Gen9 SFF USB/VGA Universal Media Bay Kit
- HP DL360 Gen9 LFF USB/VGA Universal Media Bay Kit

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 the amount of energy ProLiant Gen9 servers use.

HP Flexible Slot Power Supplies and Battery Backup Units

ProLiant DL360 and DL380 Gen9 servers feature HP Flexible Slot (Flex Slot) power supply unit (PSU) bays that accommodate HP Flex Slot Power Supplies and Flex Slot Battery Backup Units. The HP Flex Slot design represents a new generation of tool-less, hot-swappable components that use the cross-platform interchangeability model introduced with our Common Slot power supplies. For detailed information on Flex Slot Power Supply Units and Battery Backup Units refer to the white paper [*HP Flexible Slot Power Supply Unit and Flexible Slot Battery Backup Unit*](#).

HP Flex Slot Power Supply Units

HP Flex Slot Power Supply Units (PSUs) achieve the same degree of efficiency as Common Slot power supplies but use 25 percent less space, thus allowing more room for compute and I/O connectivity functions in the server chassis. Platinum Plus Flex Slot PSUs feature blue connectors that enable HP Power Discovery Services, which includes HP Intelligent Power Discovery (IPD) technology. IPD uses an embedded serial communication link to automatically discover newly deployed HP servers, map their power cords to the power source, verify power redundancy, and help ensure that all power sources are connected correctly. HP Flex Slot PSUs are 80PLUS certified and offer from 94 to 96 efficiency and are available in the following models:

- 500- and 800-watt models for 100-240 VAC input power
- 800- and 1400-watt models for 200-240 VAC input power

HP Flex Slot Battery Backup Units

HP Flex Slot Battery Backup Units (BBUs) offer an alternative to an uninterrupted power supply (UPS) for ensuring that power is not interrupted to the server. The HP Flex Slot BBU installs in a single Flex Slot PSU bay and provides power in the event of a temporary power outage (for instance, during a switchover from utility to generator power). The HP Flex Slot BBU can provide up to 750 watts for 60 seconds or up to 375 watts for about five minutes (actual amount of runtime will be determined by the load). Flex Slot BBUs integrate with 500 W or 800 W HP FlexSlot PSU configurations and, like Flex Slot PSUs, are managed through iLO.

HP Common Slot power supplies

HP Common Slot power supplies share a common electrical and mechanical design that allows for tool-less hot-swap installation into server and storage platforms with a Common Slot power supply bay. HP Common Slot power supplies are backward compatible with most HP ProLiant Gen8, G7, and G6 servers. The ability to use HP 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. HP Common Slot power supplies are qualified with specific HP products based on actual power output requirements.

HP 3D Sea of Sensors

HP 3D Sea of Sensors provides the data to precisely control the server fans and directly cool specific components while not overcooling other components. This significantly reduces fan power consumption per server. HP 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 HP Active Health System.

Power Provisioning tools

HP Power Provisioning tools include Dynamic Power Capping, Power Regulator for ProLiant, and the HP 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.

HP Power Regulator for ProLiant

HP Power Regulator for ProLiant is a hardware feature that enables ProLiant servers to dynamically control performance states of the system processors. Insight Control Power Management monitors and uses HP 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.

HP 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 HP 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 HP Insight Control and with iLO Federation Group Power Capping within HP iLO. HP iLO functionality of Group Power Capping requires an iLO Advanced or iLO Scale-Out license.

Power Regulator operates in HP Static Low Power Mode, HP Static High Performance Mode, HP Static High Performance Mode, HP Dynamic Power Savings Mode, and OS Control mode. You can find more information about Power Regulator in the ["Power efficiency and power management in HP ProLiant servers"](#) technology brief.

HP Power Advisor utility

The HP 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 HP 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 HP Power Advisor site at hp.com/us/en/products/servers/solutions.html?compURI=1439951.

Compliance with ASHRAE expanded operating ranges

The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) establishes temperature and humidity guidelines for data center operation. 2-socket ProLiant Gen9 rack and tower servers meet ASHRAE ambient temperature operating classes A3 and A4. These extended operating ranges may allow you to raise your data centers' operating temperature and/or use more efficient cooling strategies in your facility, significantly reducing energy consumption.

UEFI in system ROM

HP ProLiant Gen9 servers include the Unified Extensible Firmware Interface (UEFI) and are shipped with UEFI as the default boot mode. UEFI is a significant improvement over legacy BIOS and offers performance, functionality, security, and management capabilities not possible with legacy BIOS firmware. ProLiant Gen9 servers use an advanced version of UEFI that offers a number of features and benefits including:

- Unified pre-boot configuration environment (platform, NIC, and iLO configuration)
- Support for boot volumes greater than 2.2 TB using Globally Unique Identifier Partition Table (GPT) scheme
- HP UEFI Shell offering a programming API for:
 - Creating custom UEFI applications
 - Configuring UEFI with scripting such as HP RESTful API
- Improved interaction with option card
- Robust Secure Boot implementation
- Embedded UEFI Shell with programming API
- Configurable with HP RESTful API for scalable server configuration
- USB 3.0 stack

- Pre-operating system boot networking configuration:
 - HP Extended Network Stack
 - iSCSI Software Initiator
 - Boot from HTTP URL
- PXE boot for IPv6, IPv4 and PXE Multicast servers

All ProLiant Gen9 servers ship with UEFI as the default boot mode. ProLiant Gen9 servers can be re-configured for legacy BIOS operation if your existing environment requires it. The benefits UEFI brings to management are discussed in the following Management technologies section. For more information visit hp.com/go/proliant/uefi.

Management technologies

We provide a comprehensive set of management offerings purposely designed and packaged for small and large companies, and can meet your management needs at every stage of the server lifecycle with three types of server management solutions:

- Converged Management
- Embedded Management
- Support Management

In addition to the descriptions in the following sections, you can find additional information at hp.com/go/hpservermanagement.

Converged Management

Converged management refers to infrastructure management practices conducted primarily within the data center facility. We offer several solutions for conducting Converged management; HP OneView, HP Insight Control, and HP Systems Insight Manager.

HP OneView

HP offers HP OneView for data centers with a large number of devices that require 24x7 management, maximum uptime, and infrastructure management that spans servers, storage, and networking. This converged management platform provides powerful software-defined process templates for automating infrastructure configuration and provisioning, as well as for robust infrastructure health and monitoring. HP OneView integrates into existing enterprise management tools such as VMware vCenter Server and Microsoft System Center to streamline operations—saving you time and cost. Learn more at hp.com/go/oneview.

HP Insight Control and Systems Insight Manager

HP Insight Control and Systems Insight Manager (SIM) support the HP ProLiant server portfolio including Gen9. While HP OneView can coexist with HP Insight Control, Virtual Connect Enterprise Manager, and SIM, HP OneView is designed to replace these products. To learn more about Insight Control and SIM visit hp.com/go/servermanagement.

Embedded Management

A set of essential yet powerful server management capabilities are embedded on all HP servers. These management capabilities are designed to meet the needs of any organization, from small to enterprise IT environments. Embedded management provides embedded tools and system utilities that increase server administrator productivity. New features are available for HP ProLiant Gen9 only, unless noted, and include the following:

- **Unified Extensible Firmware Interface (UEFI)** – new firmware interface that simplifies server configuration, reduces boot time, enhances server security with Secure Boot and leverages HP RESTful API. All ProLiant Gen9 servers ship with UEFI as the default boot mode, but can be re-configured for legacy BIOS operation if your existing environment requires it.
- **HP RESTful Interface Tool** – Scripting utility for managing HP ProLiant Gen9 Servers. For more information visit hp.com/go/resttool
- **HP Smart Update Manager (HP SUM)** – utility enabled by iLO Federation delivers improved performance during discovery and deployment of firmware updates in iLO groups. New capabilities for HP SUM include Baseline enhancements such as validation, assigning baselines in guided update, dynamic filtering and the ability to download baselines from an http server and live logs to provide detailed information of target update process.

- **HP iLO** – iLO Federation Discovery is built in to every HP ProLiant Gen8 and Gen9 server to uniquely recognize numerous servers at once using multicast discovery methods supporting both IPv4 and IPv6 environment. With an iLO Advanced license, you gain full implementation of iLO Federation Management including: Group Firmware Update, Group Power Control, Group Power Capping, Group Configuration, Group Virtual Media, Group License Activation. Additional new iLO features for Gen9 servers only include:
 - HP RESTful API implementation into iLO's architecture⁴
 - iLO Reboot Switch – allows you to reset the iLO or HP ProLiant hardware via the UID button when iLO is not responding
 - Pre-Boot Health Summary – allows you to troubleshoot and view iLO diagnostic information through the server's external monitor prior to powering on
 - 1GB Embedded User Partition – accessible for additional utilization or storage with a 4GB iLO NAND installed in the server
 - Agentless data – now visible through the iLO Graphical User Interface (GUI).
- **Intelligent Provisioning** – Is an embedded utility available on the server that offers a simplified GUI for server provisioning and firmware updates.

To learn more, visit the webpages for [UEFI](#), [HP RESTful Interface Tool](#), [HP SUM](#), [HP iLO](#), or [Intelligent Provisioning](#).

Support Management

Taking a cue from the universal appeal of online banking, HP Insight Online enables you to see everything IT from anywhere at any time so you can work smarter and stay informed and in control of your IT infrastructure. HP Insight Online and related remote support tools are available at no additional cost to you, as part of your HP warranty or support agreement.

HP Insight Online provides automated support for your converged infrastructure of servers, storage and networking devices through a personalized cloud-based dashboard available anywhere, anytime to save you time and resources and reduce unplanned downtime. It provides easy access to IT health and support information for small environments that have little or no IT staff, where a trusted channel partner assists with server monitoring and support, and enterprises that want a global support view of their IT infrastructure. This is the ideal solution for providing 24x7 automated support and tracking device health and support status for faster problem resolution. In addition, you can use the HP Insight Online dashboard in the HP Support Center mobile app to remain up to date on what's happening with your IT environment, whether you're in the office or on the road. Learn more at hp.com/go/insightonline/info. For details about ProLiant Gen9 management, see the “[HP ProLiant Gen9 Server manageability innovations](#)” technical brief.

Data security technology with the Trusted Platform Module

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. Administrators can also use TPM to store platform measurements that help ensure that the platform remains trustworthy. ProLiant Gen9 servers support an optional TPM v1.2. A rivet supplied with the optional TPM v1.2 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 once it has been installed.

Quick Reference access with QR codes

All HP ProLiant Gen9 servers include an on-chassis Quick Response (QR) code (Figure 4) that provides access to mobile-friendly support for the particular ProLiant server. The QR code sticker is located either on the pull out tab located next to the iLO label or on top of the server chassis.

Figure 4. QR codes for the HP ProLiant DL380 and ML350 Gen9 Servers



⁴ Backwards compatible for iLO 4 in Gen8 and Gen9 servers.

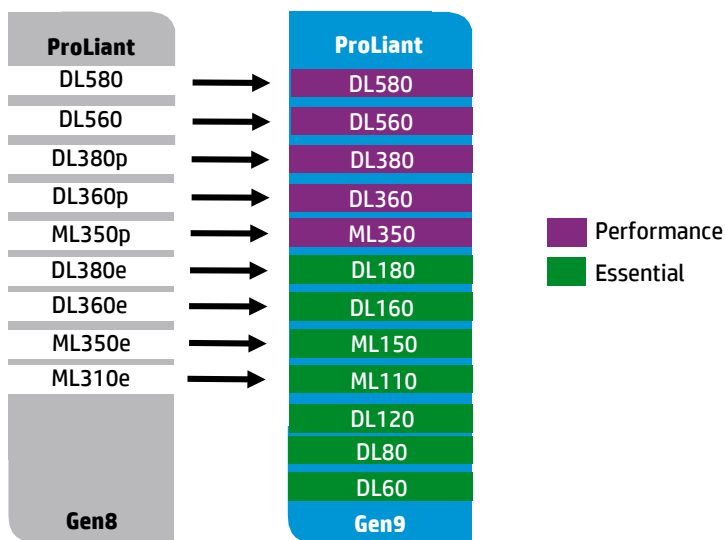
The QR code provided with each ProLiant server offers quick access to support information such as:

- Out-of-box setup, configuration, and installation information
- Troubleshooting and error message data
- Illustrated parts diagrams and spare parts lists

Conclusion

Incorporating our leading-edge memory, storage, networking, and management technologies with the latest Intel Xeon processors make ProLiant Gen9 servers *the* compute solutions for the new style of IT—service-oriented and software-defined. With the ability to reduce provisioning time from hours to seconds and offering right-sized and workload-optimized performance, ProLiant Gen9 rack and tower servers lower your TCO and bring value of service to your data center. Figure 5 shows the transition of previous generation rack mount ProLiant servers to current ProLiant Gen9 rack and tower servers and offers a suggested upgrade path of existing ProLiant inventory.

Figure 5. Model transition of previous generation servers to HP ProLiant Gen9 rack and tower servers



Resources, contacts, or additional links

HP ProLiant Gen9 servers

hp.com/go/proliant

HP Server Management

hp.com/us/en/products/servers/management/index.html?jumpid=reg_r1002_usen_c-001_title_r0004

HP ProLiant Gen9 Manageability Technology Brief

hp.com/V2/GetDocument.aspx?docname=4AA5-4527ENW&cc=us&lc=en

HP Smart Storage for HP ProLiant Gen9 Servers Technology Brief

hp.com/V2/GetDocument.aspx?docname=4AA5-4526ENW&cc=us&lc=en

Networking Innovations for HP ProLiant Gen9 Servers Technology Brief

hp.com/V2/GetDocument.aspx?docname=4AA5-4076ENW&cc=us&lc=en

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