Data sheet

HP Apollo 8000 System

Advancing the science of supercomputing

November 2014

The HP Apollo 8000 System is a high-performance computing solution that uses innovative warm-liquid cooling technology to fuel the future of science and technology—with a "green" answer to some of the industry's toughest challenges.

The possibilities are limitless

Supercomputing is being restricted by the very thing that enables it: technology
Supercomputers are the engines that drive the discoveries that truly impact all of our lives. The massive compute power they provide allows leading research institutions in government, academia, and industry to run the simulations and analytics that are behind the most amazing advances in science and technology.

But while the human imagination is limitless, the massive space and energy requirements of traditional supercomputers are becoming limiting factors on the growth of supercomputing power—and slowing the pace of innovation. The clock is always ticking to find the answer, find the cure, predict the next earthquake, and create the next new innovation. Therefore, high-performance computing (HPC) is always striving to find the answers faster to engineering, scientific, and data analysis problems at scale.

HP is passionate about driving technology to commercialization in the areas most important to our customers—and society
As a leader in HPC solutions, HP looks at emerging trends to understand where our industry—and our world—is headed. We invest in a forward-looking, ambitious research agenda for tomorrow, to fuel the next generation of HP products, services, and solutions, delivering breakthroughs that can transform current businesses and create new ones.

That innovation is what inspired HP to break through the barriers of traditional supercomputing to enable a high-density, energy-efficient, HPC solution that uses a groundbreaking warm-water liquid cooling system to deliver faster, more energy-efficient, and more sustainable infrastructure for research computing workloads than ever before.

So now you can change the world with your research—and your lower energy footprint.

Increase performance density, efficiency, and sustainability

Because liquid cooling is 1,000X more efficient than air cooling,[1] the HP Apollo 8000 System allows you to take advantage of higher performance components. We also brought the heat extraction closer to the processor, which further enhances computational performance capabilities. That allows extremely dense configurations that deliver hundreds of TeraFLOPS of compute power in a very compact space with up to 80 kW of power (4 x 30A 3ph 480VAC) supporting up to 144 servers per rack.

Liquid cooling not only enables higher-performance components, but also allows you to use the heat transferred to the water for facilities heat—reducing costs and your carbon footprint. When the National Renewable Energy Lab (NREL) deployed an HP Apollo 8000 System, they slashed their costs by $1 million USD a year, while putting their money where their values are.[1]

HP's new dry-disconnect server technology keeps components cool and dry. Other HP innovations include a power distribution system that exceeds ENERGY STAR® Platinum certification, and the HP Apollo 8000 intelligent Cooling Distribution Unit (iCDU) Rack that's more capable than competing solutions.

"For us, warm-water cooling was the key approach to making the efficiency targets work. As a cooling medium, liquids have about 1,000 times the efficiency of air. A juice glass full of water has the cooling capacity of a room full of air. And the pump energy needed to move that juice glass of water, to eject the heat from the system, is less than the fan energy needed to move that room full of air—much less."

– Steve Hammond, director of Computational Sciences, National Renewable Energy Labs

[1] HP case study, "National Renewable Energy Lab slashes data center power costs with HP servers," December 2013

HP Apollo 8000 System

System configuration

Multiple HP innovations make the HP Apollo 8000 System stand out from the competition. It leads the way in TeraFLOPS per rack for accelerated results. Its efficient liquid cooling is delivered without the risk, while paving the way to data center energy recycling and a more sustainable future.

- Innovation—Dry-disconnect server trays contain sealed heat pipes that cool server components while keeping them safe – the water is kept separated from the electrical/electronic components
- Innovation—The HVAC (High Voltage AC) power distribution system eliminates conversion steps and exceeds ENERGY STAR Platinum certification levels
- Innovation—The HP Apollo 8000 iCDU Rack maintains sub-atmospheric water pressure for operational resiliency and serviceability
- Innovation—Quick-connect, modular plumbing kit can be operational quickly as opposed to multiple days or weeks

Components at-a-glance

The HP Apollo 8000 System is available with a scalable starting configuration of one HP Apollo f8000 Rack and one HP Apollo 8000 iCDU Rack. This converged system has up to 144 x 2P servers per rack with plenty of accelerator, PCIe, and throughput options.

HP Apollo f8000 Rack	HP Apollo 8000 iCDU Rack	HP ProLiant XL730f Gen9 Server	HP ProLiant XL740f Gen9 Server	HP ProLiant XL750f Gen9 Server	HP InfiniBand Switch for Apollo 8000 system
• Standard rack footprint • Up to 144 servers/rack • Integrated 160 port 1GbE Ethernet switch for iLO, management and HP Advanced Power Manager traffic • Disaster recovery (DR) integrated fabric with simplified cabling • Utility module provides 80 kW of power • Eight hot-plug 10 kW power rectifier modules • Three-phase, high-voltage AC power for efficiency • Integrated liquid cooling with multi-level sensors for monitoring and intelligent rack isolation • HP Apollo 8000 System Manager provides IT and environmental rack management and monitoring	• Half-rack solution with 26U available in the top half of the rack • Avoids/limits the use of power-hungry chiller units • Reduces PUE and increases energy savings • Facility water intake, ASHRE-spec water • Vacuum pump maintains pressure for safe operation • Quick-connect plumbing kit for easy installation • Tri-loop technology maintains water pressure while isolating the facility and secondary water loop • Supports up to four HP Apollo f8000 Racks of IT • Available in N and N+N redundancy mode	• 2 x 2P servers per compute tray, Intel® Xeon® E5-2600 v3 series processors • Up to 256 GB per server HP DDR4 SmartMemory 2,133 MT/s • One SSD, up to 1.6 TB • One InfiniBand FDR port/server • One GbE NIC/server • No controllers • 1,200 W input power per tray • Component-level cooling with dry-disconnect server trays • Reusable energy providing additional savings to the overall energy bill • Heat sinks and jackets protect processors and memory, with heat pipes to ensure heat transfer • Hot-plug, independent server trays • HP Server Management and Support Management	• 1 x 2P servers per accelerator tray, Intel® Xeon® E5-2600 v3 series processors • Two Intel® Xeon Phi™ 7120D coprocessors • Up to 256 GB per server HP DDR4 SmartMemory 2,133 MT/s • One SSD, up to 1.6 TB • One InfiniBand FDR port/server • One GbE NIC/server • No controllers • 1,200 W input power per tray • Component-level cooling with dry-disconnect server trays • Reusable energy providing additional savings to the overall energy bill • Heat sinks and jackets protect processors and memory, with heat pipes to ensure heat transfer • Hot-plug, server trays • HP Server Management and Support Management	• 1 x 2P servers per accelerator tray, Intel® Xeon® E5-2600 v3 series processors • Two NVIDIA® Tesla® K40 XL GPUs • Up to 256 GB per server HP DDR4 SmartMemory 2,133 MT/s • One SSD, up to 1.6 TB • One InfiniBand FDR port/server • One GbE NIC/server • No controllers • 1,200 W input power per tray • Component-level cooling with dry-disconnect server trays • Reusable energy providing additional savings to the overall energy bill • Heat sinks and jackets protect processors and memory, with heat pipes to ensure heat transfer • Hot-plug, independent server trays • HP Server Management and Support Management	• 36-port InfiniBand FDR switch, each tray has 18 QSFP uplinks and 18 downlinks for server connectivity • 4–8 per rack based on configuration • Integrated in the rack for simplified cabling and network topology

HP Services

Site assessment, deployment, and support

HP Technology Services is ready to engage as you consider the HP Apollo 8000 System. HP Consulting Services can help you analyze and prioritize needs for power and cooling, as well as more detailed design and data center implementation planning. HP recommends Factory Express services to oversee the implementation of HP Apollo 8000 Systems from the HP factory floor to the data center floor. And our HP HPC specialists are ready to configure software solutions and any third-party integration needed. HP Apollo 8000 System Startup Service provides installation of HP Apollo f8000 racks, and HP Apollo 8000 iCDU racks. This service provides site readiness verification, installation planning and management, unpacking, and plug-in of the system with removal of packing materials, installation of a secondary water loop, power-up, and basic connectivity testing. Once the new HP Apollo 8000 System is in place, you can choose from a range of support services

HP Foundation Care Service, a set of reactive support levels, is composed of comprehensive hardware and software services aimed to help increase the availability of your IT infrastructure. HP technical resources work with your IT team to help you resolve hardware and software problems with HP and selected third-party products. The benefits of this service include - Escalation management, HP electronic remote support solution, Basic Software Support and Collaborative Call Management for non-HP software on eligible HP hardware products, Access to electronic support information and services.

HP Datacenter Care is a flexible, comprehensive, relationship-based approach to personalized support and management of heterogeneous data centers. With a structured framework of repeatable, tested, and globally available services, your team can leverage HP's experience supporting complex environments, global support partnerships, and technical expertise. You get exactly the services you need—when and where you need them—in a single agreement.

Flexible Capacity, a building block of Datacenter Care, offers smooth and cost-effective capacity growth—with the headroom for peak processing periods such as quarter or year-end processing. Our utility concept gives customers a detailed view of the expenses associated with your IT infrastructure, allowing you to achieve greater IT flexibility and manage customers' costs. In this way, HP can help increase agility with compute resources that are ready to react quickly to support new business opportunities—without the delay of procuring needed capacity. Customers can have a fully configured environment ready to tap into on demand and increase or decrease capacity, quickly and easily – to pay only for the capacity the customers uses.

HP Apollo 6000 and 8000 Systems Financing

Having access to technology on terms that align to your business needs is critical, and HP Financial Services is uniquely positioned to help accelerate your move to the data center of the future with a broad portfolio of flexible investment and transition solutions. Maximize your current data center environment, and access the latest high-performance computing technology when you need it. HP Financial Services offer:

- Simple transition from existing technology to HP Apollo 6000 and 8000 Systems

- Dual usage of existing and new equipment to ease the transition

- Flexible payment plans to quickly access HP Apollo 6000 and 8000 Systems more economically

- Removal of existing technology and recovery of remaining value to help support the transition to new HP Apollo 6000 and 8000 Systems

- Technology refresh approach to allow for future scalability and upgrades

- Expert support for secure data removal from legacy equipment

- Flexible terms to meet business needs

- Available globally where HP Financial Services conducts business[2]

[2] Financing and service offerings available through Hewlett-Packard Financial Services Company and its subsidiaries and affiliates (collectively HPFSC) in certain countries and is subject to credit approval and execution of standard HPFSC documentation. Rates and terms are based on customer's credit rating, offering types, services, and/or equipment type and options. Not all customers may qualify. Not all services or offers are available in all countries. Other restrictions may apply. HPFSC reserves the right to change or cancel this program at any time without notice.

Technical specifications

HP Apollo f8000 Rack

Server	Each rack supports up to 72 HP ProLiant XL730f Gen9 Server trays (two 2P servers per tray)
Networking	Each rack supports a total of eight integrated HP Apollo 8000 InfiniBand switches Each rack ships standard with a 160 port integrated HP Apollo 8000 1GbE Ethernet switch
Power	80 kW input power per rack ships standard with N+1 or N+N redundancy support depending on configuration of the servers **Input:** 380–415 VAC for international standards and 480 VAC for North American standards (4 x 30A power cords per rack)
Management	HP Apollo 8000 System Manager
Typical configuration	72 HP ProLiant XL730f Gen9 Server trays and eight HP InfiniBand switches, associated underfloor plumbing kit and utility module (includes HP Apollo 8000 Rack Manager, 2 x 40 KW input power shelves)
Weight	4,700 pounds (or 2,132 kg) max 2,914 pounds (1,322 kg) max with no server trays
Dimensions (WxDxH)	24 in x 56.18 in x 94 in (607 mm x 1427 mm x 2,382 mm)

HP Apollo 8000 iCDU Rack

Cooling	An iCDU rack supports a maximum of 320 kW or up to four HP Apollo f8000 racks
Power	**Input:** 380–415 VAC for international standards and 480 VAC for NA standards (1 x 30A power cord per rack)
Management	HP Apollo 8000 System Manager
Redundancy	Supports N, N+N secondary water loop redundancy
Configuration	Each iCDU rack ships with one CDU at the bottom of the rack and associated rack plumbing kit. Also the iCDU rack is configurable to add 22U of IT(server, storage, network switches) in the top half of the rack. Secondary plumbing kit is ordered on for every three racks (f8000 and iCDU) in the solution Optional IT equipment may be added to the top half of the iCDU provided power and cooling requirements for additional IT are supplied
IT equipment	26U of standard 19" rack space for network switches or servers
Weight	2,188 pounds (993 kg) with no hose kits or IT equipment installed
Dimensions (WxDxH)	24 in x 57 in x 94 in (607 mm x 1427 mm x 2,382 mm)

Technical specifications (continued)

	HP ProLiant XL730f Gen9 Server	HP ProLiant XL740f Gen9 Server	HP ProLiant XL750f Gen9 Server
Server	Each HP ProLiant XL730f Gen9 Server comes standard with two 2P servers Each HP ProLiant XL740f Gen9 Server and XL750f Gen9 Server comes standard with one 2P server and two accelerators		
CPU	Intel Xeon E5-2600 series: E5-2695v3, E5-2690v3, E5-2680v3, E5-2670v3, and E5-2683v3		
Memory	16 DIMMs per server, max 256 GB HP DDR4 SmartMemory 2,133 MT/s		
Network	Integrated NIC: Single port 1 GbE per server InfiniBand Adaptor Kit: Single ConnectX-3 Pro InfiniBand FDR port per server		
Storage	One small form factor (SFF) SSD per server Supports 80 GB, 120 GB, 480 GB, and 1.6 TB SSD		
Boot	SSD and network		
Minimum configuration	Two CPUs per server, single InfiniBand FDR adaptor, two DIMMs per CPU (up to eight DIMMs max)		
Accelerators	The HP ProLiant XL740f Gen9 Server supports two Intel® Xeon Phi™ 7120D coprocessors. The HP ProLiant XL750f Gen9 Server supports two NVIDIA® Tesla® K40 XL GPUs		
Power	Max of 1,200 W of HVDC to 12V conversion per ProLiant XL730f, XL740f or XL750f Gen9 Server tray		
Management	HP Insight Cluster Management Utility (optional) HP Insight Online Embedded Management – dedicated iLO network support		
OS	RHEL, SLES, and CentOS		
System ROM	UEFI, Legacy BIOS		
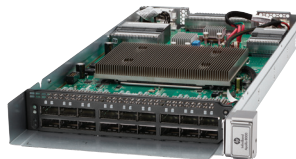
HP InfiniBand Switch for Apollo 8000

Switch type	Mellanox 36 port QDR/FDR10/FDR integrated leaf module
Ports	Each tray has 18 QSFP uplinks and 18 downlinks for server connectivity
Speed	Up to 56 GB/s InfiniBand FDR per port
Cabling	Front cabled uplinks with rear cabled server connectivity
Form factor	1U half-width tray
Power	Maximum 250 W per switch tray (Preliminary estimates)
Management	Embedded

Customize your IT lifecycle management, from acquisition of new IT, management of existing assets, and removal of unneeded equipment. hp.com/go/hpfinancialservices

HP Apollo 8000 management

HP Apollo 8000 System Manager

HP Apollo 8000 System Manager is an integrated infrastructure solution to manage and monitor the system. You get the efficient power management with detailed and aggregate power control and a centralized management "at a glance" view of the entire infrastructure. You can zoom into components for additional monitoring. HP Apollo 8000 System Manager provides a comprehensive ecosystem for IT and environment control.

HP Insight Cluster Management Utility (CMU)

An efficient and robust utility for the management of HPC and hyperscale clusters, HP Insight CMU is an efficient and easy-to-use tool for cluster administration. HP Insight CMU is used at some of the largest HP cluster deployments, supporting multiple Top 500 sites, where it is not only valued for its capability to install, modify, and update images rapidly but also for its ability to identify and isolate performance issues.

HP Insight Online

Simplified and comprehensive IT support management for your converged infrastructure of servers, storage, and networking devices via a personalized online and mobile dashboard. HP Insight Online 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 is a smart choice for enterprises that want a global support view of their IT infrastructure. This is the ideal solution for providing 24x7 automated support, access to device information, easy contract and warranty management and other support-related information required for faster problem resolution.

Embedded Management

A set of essential yet powerful server management capabilities are embedded on all HP servers. These capabilities, such as HP Integrated Lights Out (HP iLO), are considered "on system" management—designed to meet the needs of any organization, from enterprise to smaller IT environments. In addition to embedded offerings like HP iLO, Embedded Management includes other products and tools such as UEFI, Intelligent Provisioning, HP Smart Update Manager (HP SUM), Service Pack for ProLiant (SPP), HP RESTful Interface Tool, Scripting Toolkit for Windows and Linux, and HP Scripting Tools for Windows PowerShell, which are available to all HP ProLiant server customers.

The HP Apollo 8000 System in action

National Renewable Energy Lab slashes power requirements with HP

NREL researchers are focused on a future built around clean energy. That's why they partnered with HP to build an HP Apollo 8000 System for the lab's new HPC data center, which was designed to be one of the world's most energy-efficient data centers. It provides an astounding amount of compute power while breaking new ground in energy-efficient computing with a liquid cooling system developed by HP. And the data center is designed to capture the "waste heat" from computing systems so it can be used to heat facilities on the NREL campus.

"Strong partnerships between our national laboratories and America's private industry, academia, and entrepreneurs will help reduce the effects of climate change, increase the production of clean energy, and accelerate the development of new technologies."

– Ernest Moniz, U.S. Energy Secretary[6]

Resources

Building a more sustainable world

Make it matter

Why HP for Supercomputing

HP has a consistent track record of redefining the server market to meet the next wave of computing requirements. We are the only company with IP across all three of the technology areas (servers, storage, and networking) needed to address the challenges of high-density computing. As a result:

- HP holds the number one position of entries on the Green500 supercomputers list with 195[3]
- HP holds the number one position of entries in the Top 500 supercomputers list with 196[4]
- HP is number one in the HPC market, according to IDC[5]
- The HP Apollo 8000 System, called "Peregrine," designed for NREL, has petascale computing capability (1.2 quadrillion calculations per second peak performance), representing the world's largest computing capability dedicated solely to renewable energy and energy-efficiency research[6]

Get started on the data center of the future, today
If your research requires advanced supercomputing technology to solve the greatest challenges of our day, don't delay. Contact your authorized HP representative to see how we can build the engine that drives your next great advancement.

Learn more at
hp.com/go/apollo

[3] green500.org
[4] top500.org
[5] IDC: careers.idg.com/www/pr.nsf/ByID/MYAR-9HJMPN
[6] energy.gov/articles/energy-secretary-moniz-dedicates-clean-energy-research-center-new-supercomputer

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