

Data sheet

# HP Apollo 8000 System



Advancing the science of supercomputing



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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,<sup>1</sup> 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 480AC) 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.<sup>1</sup>

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

<sup>1</sup>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 dry
- Innovation—The HVAC power distribution system eliminates most conversion steps to exceed Energy Star Platinum certification levels
- Innovation—The HP Apollo 8000 iCDU Rack maintains sub-atmospheric 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 Server	HP Infiniband Switch for HP Apollo 8000 System
<ul style="list-style-type: none"> <li>• Standard rack footprint</li> <li>• Up to 144 servers/rack</li> <li>• Disaster recovery (DR) integrated fabric with simplified cabling</li> <li>• Utility module provides 80 kW of power input</li> <li>• Eight hot-plug 10 kW power rectifiers</li> <li>• Hot-plug 10 kW power rectifiers</li> <li>• Three-phase, high-voltage AC power for efficiency</li> <li>• Integrated liquid cooling with multi-level sensors for monitoring and intelligent rack isolation</li> <li>• HP Apollo 8000 System Manager provides environmental rack monitoring and power management, along with HP Integrated Lights-out (iLO) and HP Advanced Power Manager</li> </ul>	<ul style="list-style-type: none"> <li>• Dense, half-rack solution with 26U available in the top half of the rack</li> <li>• Avoids/limits the use of power hungry-chiller units</li> <li>• Reduces PUE and increases energy savings</li> <li>• Facility water in-take, ASHRAE-spec water</li> <li>• Vacuum pump maintains pressure, so liquid stays in place</li> <li>• Quick-connect plumbing kit for easy installation</li> <li>• Tri-loop technology maintains water pressure while isolating the facility and secondary water loop</li> <li>• Supports up to 4 HP Apollo f8000 Racks of IT</li> </ul>	<ul style="list-style-type: none"> <li>• 2 x 2P servers per compute tray</li> <li>• Up to 256 GB memory/server</li> <li>• Up to 1 SSD 480 GB</li> <li>• 1 FDR IB port/server</li> <li>• 1 GbE NIC/server</li> <li>• 1,200W input power per tray</li> <li>• Component-level cooling with dry-disconnect server trays</li> <li>• Reusable energy providing additional savings to the overall energy bill</li> <li>• Heat sinks and jackets protect processors and memory, with heat pipes to ensure heat transfer</li> <li>• Hot-plug, independent server trays</li> <li>• HP Integrated Lights-Out (iLO) Management Engine</li> </ul>	<ul style="list-style-type: none"> <li>• 36-port FDR Infiniband switch, each tray has 18 QSFP uplinks and 18 downlinks for node connectivity</li> <li>• 4–8 per rack based on configuration</li> <li>• Integrated in the rack for simplified cabling and network topology</li> </ul>

## 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 provide any third-party integration needed. Once the new HP Apollo 8000 System is in place, HP gives you easy access to expertise for routine hardware replacements and the ability to get assistance fast if a more complex situation arises.

- **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.
- **HP Financing** for HP Apollo 6000 and 8000 Systems—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 plan to quickly access HP Apollo 6000 and 8000 Systems more economically
  - Removal of existing technology and recover 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<sup>2</sup>

<sup>2</sup> 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**

<b>Server</b>	Each rack supports up to 72 HP ProLiant XL730f Server trays (2 nodes per tray)
<b>Networking</b>	Each rack supports a total of 8 HP InfiniBand switches
<b>Power</b>	80 kW input power per rack ships standard with N+1 or N+N redundancy support depending on configuration of the servers <b>Input:</b> 380-415VAC for international standards and 480VAC for North American standards (4x30A power cords per rack)
<b>Management</b>	HP Apollo 8000 System Manager HP iLO Management Engine (iLO 4 v2.00) Rack level iLO network consolidation
<b>Typical configuration</b>	72 HP ProLiant XL730f Server trays and 8 HP InfiniBand switches, 16 Ethernet SFP+ cable kits, associated rack plumbing kit and utility module (includes HP Apollo 8000 System Manager, 2x40KW power shelves)
<b>Weight</b>	4700 lbs (or 2132kg) Max 2914 lbs (or 1322kg) Max with no server trays
<b>Dimensions (WxDxH)</b>	24 in x 56.18 in x 94 in (607mm or 1427mm or 2382mm)



**HP Apollo 8000 iCDU Rack**

<b>Cooling</b>	An iCDU rack supports a maximum of 320 kW or up to 4 HP Apollo f8000 Racks
<b>Power</b>	<b>Input:</b> 380-415VAC for Intl standards & 480VAC for NA standards (1x30A power cord per rack)
<b>Management</b>	HP Apollo 8000 System Manager
<b>Redundancy</b>	Supports N, N+N redundancy at launch
<b>Configuration</b>	<ul style="list-style-type: none"> <li>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 48-port HP 5900 Ethernet switches.</li> <li>Secondary plumbing kit is ordered one for every 3 racks (f8000 and iCDU) in the solution.</li> <li>Optional IT equipment may be added to the top half of iCDU provided power and cooling requirements for additional IT are supplied.</li> </ul>
<b>IT equipment</b>	26U of standard 19" rack space for network switches or server nodes
<b>Weight</b>	2188 lbs (or 993kg) with no hose kits or IT equip. installed
<b>Dimensions (WxDxH)</b>	24 in x 56.18 in x 94 in (607mm or 1427mm or 2382mm)

## Technical specifications (continued)



**HP ProLiant XL730f Server**

<b>Server</b>	Each XL730f tray supports two dual socket x86 servers
<b>CPU</b>	Support for future Intel® Xeon® processor E5-2600 v3 product families
<b>Memory</b>	16 DIMMS total per server or max 256GB memory per server DDR4 support on future Intel® Xeon® processor E5-2600 v3 product family
<b>Network</b>	Integrated NIC: Single port 1GbE per server IB Adaptor Kit: Single ConnectX-3 Pro FDR InfiniBand port per server
<b>Storage</b>	1 Small form factor SSD per server Supports 80GB/120GB SSD
<b>Boot</b>	SSD and network
<b>Minimum configuration</b>	2 CPUs per server, single FDR InfiniBand adaptor, 2 DIMMs per CPU (up to 8 DIMMS max)
<b>Power</b>	Max of 1200W of HVDC to 12V conversion per ProLiant XL730f Server tray
<b>Management</b>	<ul style="list-style-type: none"> <li>• HP Apollo 8000 System Manager</li> <li>• HP iLO Management Engine (iLO 4) - dedicated iLO network support</li> <li>• HP Advanced Power Manager</li> <li>• HP Insight Cluster Management Utility</li> </ul>
<b>OS</b>	RHEL, SLES, CentOS



**HP InfiniBand Switch for Apollo 8000**

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

## HP server management software

### HP Apollo 8000 System Manager

With HP Apollo 8000 System Manager, you can see and manage shared infrastructure power, and environmental controls, from a single console. Save by avoiding spend on serial concentrators, adaptors, cables, and switches. Flex to meet workload demands with dynamic power allocation and capping.

### 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 Integrated Light-Out (iLO) Management Engine

The HP iLO Management Engine with Integrated Lifecycle Management provides new levels of performance and quality of service. Monitoring the health of HPC solutions usually requires running monitoring software on the systems, stealing cycles from primary computational tasks. With Active Health and Agentless Management, all the monitoring is performed on the iLO Management Engine, allowing extensive monitoring without impacting performance.

## 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<sup>6</sup>

## Resources

### Building a more sustainable world

#### Make it matter

Customize your IT lifecycle management, from acquisition of new IT, management of existing assets, and removal of unneeded equipment. [hp.com/go/hpfinancialservices](http://hp.com/go/hpfinancialservices)

## 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 who has intellectual property 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<sup>3</sup>
- HP holds the number one position of entries in the Top 500 supercomputers list with 196<sup>4</sup>
- HP is number one in the HPC market, according to IDC<sup>5</sup>
- The 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<sup>6</sup>

### 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](http://hp.com/go/apollo)

<sup>3</sup>[green500.org](http://green500.org)

<sup>4</sup>[top500.org](http://top500.org)

<sup>5</sup>IDC: [careers.idg.com/www/pr.nsf/ByID/MYAR-9HJMPN](http://careers.idg.com/www/pr.nsf/ByID/MYAR-9HJMPN)

<sup>6</sup>[energy.gov/articles/energy-secretary-moniz-dedicates-clean-energy-research-center-new-supercomputer](http://energy.gov/articles/energy-secretary-moniz-dedicates-clean-energy-research-center-new-supercomputer)

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