QuickSpecs

Overview

HPE Cray EX Supercomputer

The HPE Cray EX supercomputer is a liquid cooled blade-based, high-density clustered computer system designed from the ground up to deliver the utmost in performance, scale, and density. The basic building block of the HPE Cray EX Supercomputer is the Liquid Cooled cabinet. The cabinet is a sealed unit, uses closed-loop cooling technology, and does not exhaust heated air into the data center. Direct attached liquid cooled cold plates provide for efficient heat removal from high power devices including processors, GPUs, and switches via an auxiliary cooling distribution unit (CDU).

HPE Cray EX Supercomputer - Closed and With Trim

Standard Features

HPE Cray EX4000 Detail

A single cabinet can accommodate up to 64 compute blade slots within 8 compute chassis. The cabinet is not configured with any cooling fans. All cooling needs for the cabinet are provided by direct liquid cooling and the CDU. This approach to cooling provides greater efficiency for the rack-level cooling, decreases power costs associated with cooling (no blowers) and utilizes a single water source per CDU

One cabinet supports the following:

- 8 compute chassis
- 4 power shelves with a maximum of 8 rectifiers per shelf- 36 total 15kW rectifiers per cabinet
- 4 PDUs (1 per power shelf)
- 4 power input whips (3-phase)
- Maximum of 64 quad-blade compute blades
- Maximum of 64 HPE Slingshot switch blades

**Single Cabinet – Doors Closed Without CDU**

Standard Features

Compute Chassis

The compute chassis is a mechanical assembly that provides power, cooling, system control, and network fabric for up to 8 compute blade slots. 8 chassis are installed in the 48U cabinet.

The features of the compute chassis are as follows:
- 8 compute blade slots
- 8 HPE Slingshot switch blade slots
- One power/signal midplane
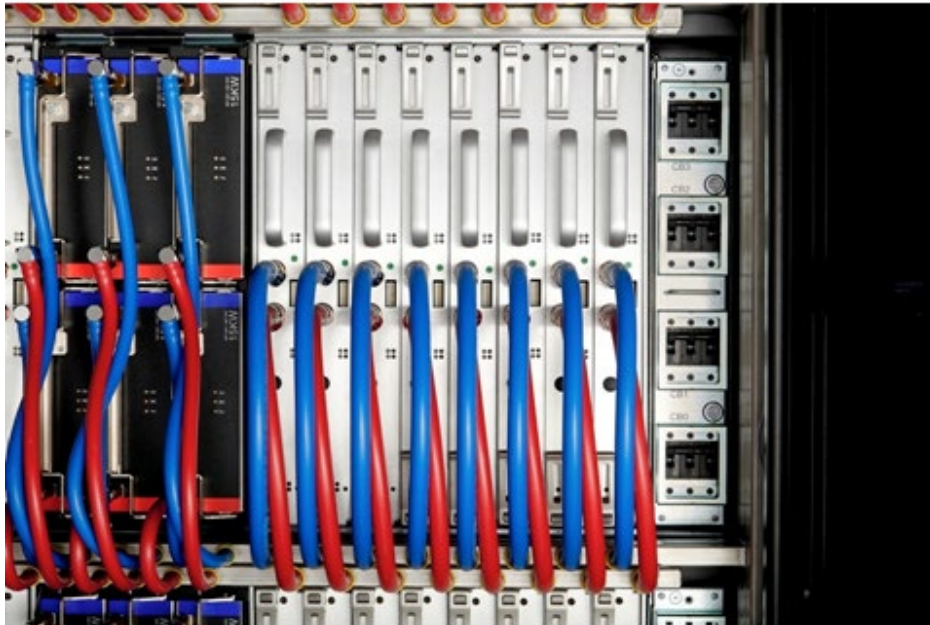
Compute Blades

Blades have three basic sections: computation, memory, and I/O and consume one blade slot in the compute chassis. The following blade is designed for the HPE Cray EX Supercomputer

HPE Cray EX425

The features of this compute blade are as follows:
- 2 boards per blade. Each board contains two 2-socket nodes (total of 4 nodes per blade).
- Support for the full 2nd Gen AMD EPYC™ 7002 or 3rd Gen AMD EPYC™ 7003 series processor stack
- 8 DIMMs per socket (1DPC)
- Up to 64 GB DIMMs at up to 3200 MT/s
- Up to 8 HPE Slingshot injection ports per blade
- 2 Board Management Controllers (BMC) per blade
- Cooled with cold plate

Standard Features

HPE Cray EX235n
The features of this compute blade are as follows:
- 2 boards per blade. Each board contains a 4-socket A100 and 1-socket CPU nodes (total of 2 nodes per blade).
- Support for the full AMD 3rd Gen AMD EPYC™ 7003 series processor stack
- 8 DIMMs per socket (1DPC)
- Up to 64 GB DIMMs at up to 3200 MT/s
- Up to 8 HPE Slingshot injection ports per blade
- 2 Board Management Controllers (BMC) per blade
- Cooled with cold plate

HPE Cray EX235a
The features of this compute blade are as follows:
- 2 boards per blade. Each board contains 4x AMD Instinct™ MI-Next Series accelerators and 1-socket CPU nodes (total of 2 nodes per blade).
- Support for the 3rd Gen AMD EPYC™ processor
- 8 DIMMs per socket (1DPC)
- Up to 64 GB DIMMs at up to 3200 MT/s
- Up to 8 HPE Slingshot injection ports per blade
- 2 Board Management Controllers (BMC) per blade
- Cooled with cold plate

Switch Chassis
The switches are in the switch chassis and mounted to the rear of the compute chassis. The purpose of the switch chassis is to provide a structure for orthogonally mounting the switch blades to the compute chassis. There is no backplane connecting the switches to the compute blades. Each compute blade directly connects to one or more switch blades in the switch chassis enabling a cableless connection. The switch chassis supports a maximum of eight switch blades.
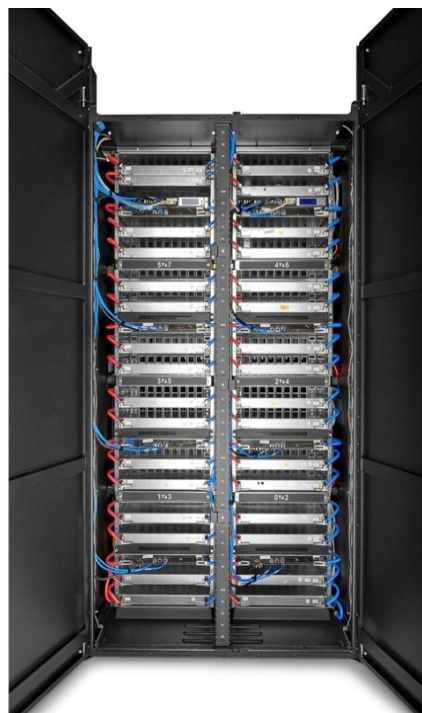
Compute Cabinet Rear View with Doors Open

Standard Features

HPE Slingshot switch blade
The following switch blade types are supported

The HPE Slingshot Switch blade is a 64 port, 200Gb/s switch designed for the switch chassis. Switch blades are inserted into the rear of the cabinet and provide the high-speed network interface for the compute blades. Each switch blade connects to all eight compute blades through orthogonal connectors and provides fabric connections through its faceplate to expand the network.

Each switch blade has 8 local connectors, with two ports per connector for a total of 16 downlink ports to the eight compute blades. Each switch blade also has 24 QSFP-DD connectors with two ports per connector for a total of 48 gl copper or optical ports connecting to other switch blades over the high-speed fabric. A typical configuration for the HPE Cray EX425 is two switch blades in the switch chassis to support all 8 compute blades consisting of 32 nodes. This provides support for the 4 nodes on the compute blade via the two port NIC Mezzanine card.

The following mezzanine card type is supported
Dual port Ethernet with Mellanox ConnectX-5 ASIC

The HPE Slingshot-10 mezzanine card is a two port NIC design. Each 100Gb/s Ethernet NIC port connects to a compute processor via a x16 PCIe Gen3 channel.
An L0 cable connects each NIC mezzanine card to a connector on the back of the compute blade.

A compute or GPU blade may support one to eight NIC mezzanine cards depending on the design. Additional injection bandwidth to the compute blade can increase by adding NIC mezzanine cards if the blade supports it.

The HPE Slingshot-10 NIC supports the Libfabrics interface for communicating to the network fabric.

Topology
The all-to-all Dragonfly Ethernet topology is supported in the HPE Cray EX SuperComputer: Dragonfly provides a lower cost and highly scalable alternative to traditional Fat Tree topologies. It leverages the use of high speed copper cables and reduces more expensive optical connections by up to 50%. In a dragonfly topology, every switch is connected to every other switch in a typical group size of 16 switches..

The below list provides a high level description of the Dragonfly topology including a summary of its capabilities.

Dragonfly
- A 16 switch group can scale up to 37,120 nodes or 145 cabinets.
- A 32 switch group can scale up to 131,584 nodes or 257 cabinets.
- Low diameter network with no more than 3 switch hops between any two nodes in the network, even at scale.
- Most switch links are in the same cabinet and use low cost QSFP-DD copper cabling. Group to group links typically use QSFP-DD fiber.
- Configurable global bandwidth from ranging from ~25% to 100%.
- Built-in congestion management and adaptive routing at scale

Standard Features

CDU (Cooling Distribution Unit)

The cooling distribution unit (CDU) is a liquid-to-liquid heat exchanger that is used to remove heat from HPE Cray EX Supercomputer. The CDU uses a secondary loop to circulate a heat transfer liquid to the cold sinks. The heat captured in the secondary loop is transferred to the facilities primary loop via a liquid-to-liquid heat exchanger.

The CDU is designed to circulate and control the heat transfer fluid to the manifolds that are in each chassis in the cabinet. The CDU is rated for 1.6MW of cooling. One CDU supports a maximum of four cabinets

The CDU consists of a cabinet that includes a heat exchanger, circulating pumps, control valve, sensors, controller, valves, and piping. The CDU monitors room conditions and prevents condensation by maintaining the secondary loop at a temperature above the room's dew point.

All functions, such as switching pumps (if applicable), controlling water temperature, etc., are managed by the controller using user defined settings.

CDU Side View with no Doors or Skins

Standard Features

Software Stack
HPE Cray EX supercomputers are complete solutions with software and hardware that are tightly integrated and performance-tuned to offer the best system performance while bringing new standard in flexibility, manageability, and resiliency to supercomputing.

Cray supercomputer software stacks address the needs of both system administrators, developers, and end-users.

Administrative Software
HPE Cray supercomputer users now have the option to choose either HPE Cray System Management or HPE Performance Cluster Manager.

HPE Cray System Management - a built-for-scale system management solution offering administrators all functionalities they need to keep the HPE Cray EX system healthy, utilized to the maximum and accommodating wide range of workload requirements via –aaS experience. The software is built to manage systems which can scale to Exascale deployments featuring:
- Comprehensive monitoring and management of all aspects of the system: CPU/GPU, network (integrated HPE Slingshot Fabric Manager), storage as well as power management and monitoring combined with provisioning for operational efficiency.
- Partitioning and batch or container orchestration enable customers to run a variety of HPC/AI/HPDA workloads the way that makes the best use of their system without logistical constraints.
- REST APIs & standard protocols enable full interoperability with existing monitoring, management, and automation toolsets.

HPE Performance Cluster Manager - a comprehensive, flexible HPC system management solution that enables fast setup, provisioning and monitoring including the following features

- Hardware discovery and Linux operating system installation for compute and service nodes
- Inventory management
- Telemetry data collection and analysis
- Alert monitoring and component diagnosis
- Power resource monitoring and management
- Software image management **Developer Software**

HPE Cray Programming Environment – is a fully integrated software development suite offering programmers comprehensive set of tools for developing, porting, debugging, and tuning of their applications so they can shorten application development time and accelerate their performance.

The programming environment is designed to make porting of existing applications easier with minimal recording and changes to the existing programming models to simplify transition to the new hardware architectures and configurations, such as HPE Cray EX systems.

Standard Features

Operating System

HPE Cray OS is a compute operating system based on SLES with enhancements. The enhancements provide customers with capabilities specific to supercomputing and high-performance computing fully supported by HPE Pointnext. These modifications don't alter the ability to run standard Linux applications, but rather enhance it for performance, scale, and reliability. We integrate and test these materials together and package releases.

Overall

While HPE Cray System Management and HPE Cray Operating System are designed to support HPE Cray EX systems with HPE Slingshot, HPE Cray Programming Environment product also supports other HPE and HPE Cray HPC systems (using InfiniBand interconnect).

The software stack is supported by HPE Pointnext Services.

Features

HPE Cray EX Supercomputer	
Operating system	• HPE Cray Operating System or RedHat RHEL (HPE Performance Cluster Manager only)
System Management and Fabric software	• HPE Cray System Management or HPE Performance Cluster Manager • HPE Slingshot Network Manager
Workload Management and Orchestration	• Altair® PBS Professional • Slurm Workload Manager • Containers: Singularity & Docker

Software and Application Development Tools:	**HPE Cray Programming Environment**
	• **Development**
	  — Compiling environment
	  — Communication Libraries: HPE Cray MPI, SHMEM
	  — Scientific Libraries: LAPACK, ScaLAPACK, BLAS, libsci, IRT, FFTW 3.0
	  — I/O Libraries: NETCDF, HDF5
	  — 3rd party programming environments:
	    o AMD ROCm and AOCC
	    o NVIDIA HPC SDK
	    o GNU Compilers
	
	• **Performance analysis tools**
	  — Tools for performance analysis and optimization – versions for both experienced and novice users
	  — Code parallelization assistant for application optimization via code restructuring
	  — Visualization tool for quick assessment of severity of issues
	  — Debuggers: GDB for HPC, Valgrind for HPC, tools for stack trace analysis & abnormal termination processing
	  — 3rd party debugger support: Arm® Forge, TotalView™ by Perforce

DL/AI Tools:	• **Deep learning plugin**

Service and Support

Product warranty
HPE offers a 13-month warranty on all HPE Cray-branded hardware components that begins at the time of shipment and provides replacement or repair of failed hardware at HPE's discretion. This warranty provides only the most basic customer hardware support and is designed for highly skilled customers that intend to maintain their own systems. This HPE limited warranty does not provide any support or warranty obligation for software, even if sold, delivered, or installed by HPE.

Installation
The HPE Cray EX system requires the following installation services:
- Pre-installation activities and solution implementation:
  HPE and the Customer determine all installation activities that must be completed prior to System installation. The Customer agrees to complete all of the pre-installation activities required. This includes HPE site engineering work onsite as may be described in the HPE Cray Site Preparation Guide.

  Solution Implementation: upon completion of the pre-installation activities, HPE will provide the software components as set forth in the applicable system purchase agreement or bill of materials. Any additional software installation or configuration will need to be documented separately and will incur additional charges. This configuration service does not include any customer specific configuration, customization or testing unless otherwise specified.
- System testing and performance validation:

The HPE installation personnel will conduct tests to verify the health and performance of the System. The tests are not intended to demonstrate application performance; the tests verify that the system infrastructure is working properly and delivering the intended performance level. HPE manufacturing tests and diagnostics will be used by installation personnel while onsite to validate that all hardware is functional, meeting the same performance and functional specifications as tested at the factory. Any additional testing that is required should be specified in a separate mutually agreed writing.

Hardware Maintenance Service Features
The HPE Cray EX system benefits of HPE's highest level of support for high-performance compute 'HPE Cray Advanced Support' that may include HPE presence onsite.
- This service level offers customers access to the HPE Cray customer portal. Case logging is available 24x7 by telephone or via this customer portal.
- There is a choice of two maintenance coverage windows: 9x5 or 24x7. Onsite response time options are NBD, 4 hours, 2 hours, or 1 hour. When an issue is reported, an HPE technical representative will arrive onsite within the response time window to identify and begin resolving the issue.
- HPE provides critical spare parts to reduce any downtime associated with failures or maintenance. Critical spare parts may be located either onsite or at professionally managed regional spare part depots that provide rapid transportation of spare parts to customer sites. Customers may elect to supplement the HPE-owned spare parts inventory by purchasing additional spare parts.
- HPE Cray EX customers have access to the support snapshot analyzer that collects, analyzes, and reports support information for HPE air cooled and liquid cooled HPC, and Cray ClusterStor systems.
- HPE Remote Support via MyRoom, providing remote access and support to customers while still allowing customers full session control. Capabilities range from a customer having full control of a remote screen-sharing session to the HPE Pointnext Services team having the ability to log in securely as needed to resolve issues and perform administrative functions.
- This service level offers customers access to the HPE Cray customer portal. Case logging is available 24x7 by HPE Cray EX customers are assigned a customer care manager who is familiar with their environment and able to assist with issues and escalations. This person provides quarterly reports and reviews of open issues and upcoming activities, such as larger maintenance upgrades, updates, system expansions, etc.

Technical Specifications

Software Support Features

Support for HPE developed software includes the following features:

- Access to self-help resources on customer portal
    - Ability to open and submit a support case
    - Access to HPE knowledge articles
    - Ability to download:
        o Software releases and updates, including BIOS and FW
        o Software Patches
- Notification of key operational items through the field notice (FN) process
- Assistance from HPE Pointnext Services to resolve issues within the service level coverage window for the hardware contract; assistance includes:
    - Triage to investigate/analyze issues
    - Confirmation whether the issue is hardware or software

Confirmation if the issue is related to an HPE-supported product or a third-party-supported product. If the issue is with a HPE-supported product, HPE Pointnext Services may provide configuration recommendations, possible work arounds, and directions to install a later version or patch, and/or submit a bug to get the issue fixed. For HPE products, HPE reserves the right to determine whether and how an issue will be resolved.

Customized Software

Support is provided for products sold by HPE and with a valid HPE Pointnext Services support agreement. Support for third-party products without a related HPE Pointnext Services support agreement requires the user to contact the third-party vendor for assistance. If customers modify HPE-delivered software without authorization from HPE, any issues resulting from the unapproved modifications fall outside of the standard support service agreement and HPE is not responsible for any resulting defects, damage, failure, performance degradation, or issues of any kind, or correction or remedy of same. HPE may require the user to remove custom modifications to confirm that a modification is not the source of the issue. Customers may request that HPE Pointnext Services assist in making modifications to a product. HPE Pointnext Services will do its best to implement the request via a billable statement of work (SOW).

API and CLI Support

Support is available for HPE published APIs. Unpublished APIs are not eligible for support. Documentation outlining published API best practices and limitations is available at **pubs.cray.com**, accessible either directly or through the HPE Cray customer portal. HPE will assist in determining if the API is working correctly, if the documentation is incorrect, or if the issue is an enhancement request.

HPE Application Programming Interface (API) and Command Line Interface (CLI) features allow the flexibility to configure and customize your system to optimize operations in your environment. These tools have the ability to significantly alter your system operations. If not properly tested and implemented in a controlled manner, they can introduce significant problems in your environment. When using these features or otherwise modifying or altering APIs, customers take on the responsibility to resolve or mitigate any issues they have introduced into the system.

HPE Pointnext Services is not available to provide support to resolve issues that arise from the use of CLIs or APIs in a form not identical to those published by HPE.

Customer Training

Training courses are taught by HPE system experts and combine lectures with hands-on labs to enhance understanding and retention. The courses cover all aspects of using and maintaining an HPE system, from system administration to application development, porting, and optimization. A full listing of the standard HPE Cray training courses, along with their descriptions, can be found at **http://www.cray.com/support/training/schedule.**

Subject to separate ordering arrangement, classes are scheduled on regular cycles at the HPE training facilities and can be scheduled for onsite delivery. HPE also offers customized training courses and can provide quotes for these courses based on the customer's needs.

Technical Specifications

HPE Cray EX Supercomputer (cabinet)

Dimensions with overhead cable trays	98 x 46.5 x 68.5 in (H x W x D) 2489 x 1181 x 1740 mm (H x W x D)
Weight: (Maximum)	Up to 8000 lbs. (3629kg)
Floor Loading (Flat Base)	362 lbs./sq ft (1767 kg/qs m) (Operational)
Compute blade chassis	8 compute blade chassiss per cabinet with integrated compute trans, switches, and power Up to 5 + 1 redundant 15kW power supplies per compute blade chassis
Cooling	Closed-loop airflow with direct liquid cooling for high wattage components and room neutral up to 32°C data center supply water.
Power Requirements (Max)	Up to 300KVA with 480V Up to 250KVA with 400V

Compute Blade Options – (HPE Cray EX425)

Form factor	single-slot blade for the HPE Cray EX425 compute chassis assembly
Processors	AMD 2nd Gen AMD EPYC™ 7002 series and 3rd Gen AMD EPYC™ 7003 series
Compute blade	Four 2-socket CPU nodes
Memory/blade	Up to 1024 GB per node, 16 DIMM slots (8 per CPU socket) per node
Memory technology	16, 32, and 64 GB DDR4 3200 MT/s ECC Registered DIMMs
Local storage	none
Fabric options	HPE Slingshot (1 or 2 injection ports per node)

Compute Blade Options – (HPE Cray EX235n)

Form factor	single-slot blade for the HPE Cray EX235 compute chassis assembly
Processors	AMD 3rd Gen AMD EPYC™ 7003 series
Compute blade	Two 4-socket A100 GPUs x 1-socket CPU nodes
Memory/blade	Up to 512 GB per node, 8 DIMM slots per node
Memory technology	16, 32, and 64 GB DDR4 3200 MT/s ECC Registered DIMMs
Local storage	none
Fabric options	HPE Slingshot (2 or 4 injection ports per node)

Compute Blade Options – (HPE Cray EX235a)

Form factor	single-slot blade for the HPE Cray EX235 compute chassis assembly
Processors	3rd Gen EPYC™ processor
Compute blade	Two 4x AMD Instinct™ MI-Next Series accelerators x 1-socket CPU nodes.
Memory/blade	Up to 512 GB per node, 8 DIMM slots per node
Memory technology	16, 32, and 64 GB DDR4 3200 MT/s ECC Registered DIMMs
Local storage	Two M.2 NVME SSD per node
Fabric options	HPE Slingshot (4 injection ports per node)

Integrated HPE Slingshot Switch Blade

Ethernet Ports	64 Ethernet ports (16 Host; 48 QSFP-DD ports)
Port capability	100/200 Gb/s per port
Switch fabric capability	12.8Tb/s
Messages/s capability	1.2B/s

Summary of Changes

Date	Version History	Action	Description of Change
04-Oct-2021	Version 7	Changed	Standard Features section was updated
07-Sep-2021	Version 6	Changed	Standard Features section was updated
06-Jul-2021	Version 5	Changed	Updated Software Development Tools. Standard Features and Technical Specifications sections were updated.
17-May-2021	Version 4	Changed	Standard Features section was updated
06-Apr-2021	Version 3	Changed	Overview, Standard Features and Technical Specifications sections were updated.
05-Oct-2020	Version 2	Changed	Service and Support section was updated.
03-Aug-2020	Version 1	New	New QuickSpecs

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