NEXT-GENERATION SUPERCOMPUTING ARCHITECTURE
OVERVIEW

Our first exascale-class architecture, the Cray® Shasta™ system takes a revolutionary approach to supercomputing. If you need exaflop performance and scale, it delivers. But more than speed, it delivers the capabilities and productivity that today’s questions demand.

Data growth, digital transformation, and converging high-performance computing and artificial intelligence workloads are giving rise to new, increasingly complex questions. And in doing so, they’re transforming every industry and field of inquiry from large to small. Addressing these new realities facing our customers meant completely rethinking supercomputing.

The Cray Shasta supercomputing system is our answer. It’s an entirely new design created to address today’s diversifying needs. Hardware and software innovations tackle system bottlenecks, manageability, and job completion issues that emerge or grow when core counts increase, compute node architectures proliferate, and workflows expand to incorporate AI at scale. It eliminates the distinction between clusters and supercomputers with a single new system architecture, enabling a choice of computational infrastructure without trade-offs.

Meet the next era of supercomputing. Revolutionary capabilities that will power discovery and innovation for years to come.
BEYOND HIGH-PERFORMANCE COMPUTING

SUPERCOMPUTING REDESIGNED

COMPUTE, STORAGE, NETWORK, AND SOFTWARE RETHOUGHT AND RE-ARCHITECTED
Why Supercomputing is Changing

Supercomputing is changing because your questions are. Today, answering questions requires fusing modeling and simulation workloads with analytics, AI, and Internet of things to create one business-critical workflow. High-performance computing (HPC) systems must be able to handle these massive, converged workloads. And it has led to a supercomputing sea change.

With the imperative to navigate increasingly diverse, complex workloads, the next generation of supercomputers will be characterized by exascale performance, data-centric workloads, and diversification of processor architectures.

The Cray Shasta delivers application HPC and AI performance at scale. Designed to provide an optimal solution for tens to hundreds of thousands of nodes, its consistent, predictable, and reliable performance ensures high productivity on large-scale workflows.

With an impressive management toolset and native Ethernet compatibility, improved and straightforward productivity for new cloud-like applications and converged HPC and workloads is readily achievable. Direct connection to data center storage and resources enables delivering the I/O bandwidth that today’s AI applications demand.
FLEXIBLE HARDWARE ARCHITECTURE

Cray® Shasta™ hardware architecture supports multiple processor architectures and accelerator options. Additionally, it is architected for forward compatibility with next-generation blades and servers. Choose from two basic packaging options:

1) Cray-designed cabinetry supporting direct liquid cooling of all components in a highly dense bladed configuration.

2) A 19” standard data center air-cooled rack for smaller configurations or where liquid cooling is not an option.

Both packaging solutions run the full suite of Cray Shasta software and are built around the new Cray® Slingshot™ interconnect technology. Customers can choose either or both packaging configurations to meet their individual requirements for density, performance, and efficiency and know they are getting the full functionality of the Cray Shasta platform. Liquid-cooled configurations support processors up to 500W, and highly dense configurations of up to 512 processors per cabinet including switches.

BREAKTHROUGH INTERCONNECT

The Cray Slingshot interconnect is fundamental to the Cray Shasta systems revolutionary design. It delivers a high-performing interconnect solution built on high radix, 64-port switches which enable scaling to hundreds of thousands of nodes with only three hops in a Dragonfly topology. Advanced congestion management features reduce congestion effects significantly as compared to alternative interconnect technologies. Ethernet support enables direct access to data center resources and native support for IP-based cloud technologies.
**REDESIGNED SOFTWARE STACK**

The Cray Shasta software platform couples the productivity of cloud and data center interoperability with the power of supercomputing to create a new platform for the next era of computing.

Get the ease and flexibility of cloud computing through an environment which supports microservices-based composability for rapid innovation of new workflows across processor architectures. Then, seamlessly scale from development in the cloud to production on a supercomputer.

The Cray Shasta software stack supports Cray’s legendary package of HPC-optimized programming tools, Linux OS, and scalable analytics suite. The Cray Linux Environment suite of high-performance software runs large, complex applications and scales efficiently to more than 500,000 processor cores.

Many ISV applications are available “out of the box.” And Cray® Urika® AI and analytics software suites deliver a robust set of tools including Apache® Spark™, TensorFlow™, Cray Graph Engine, Python with distributed Dask, PyTorch, Jupyter Notebooks and more.

**INTEGRATED STORAGE SOLUTION**

The Cray® ClusterStor® E1000 high-performance storage solution maximizes I/O performance with minimum cost and overhead. Choose from all SSD for fastest I/O performance, all HDD for best price/GB, and hybrid for a customized balance of both. The ClusterStor E1000 solution is workflow-aware, providing the right data at the right time through workflow-accelerating data services including placement tiering, parallel data movers, scheduled tiering, and transparent tiering. A flash-optimized Lustre® file system and Cray support completes the solution.

**FLEXIBILITY AND TCO**

Designed for a decade or more of work, the Cray Shasta system eliminates the need for frequent, expensive upgrades. You can incorporate any supported silicon processing choice — or a heterogeneous mix — with a single management and application development infrastructure. Flex from single to multi-socket nodes, GPUs, FPGAs, and other options as they emerge such as AI-specialized accelerators. The Cray-developed Shasta software stack ensures continuous robust tools and support for future management and development requirements.

**CRAY SHASTA LIQUID-COOLED CABINETRY**

For greatest density and efficiency, liquid-cooled cabinetry supports direct liquid cooling of all components in a highly dense bladed configuration. These cabinets contain eight chassis, each of which support up to eight compute and eight switch blades. Orthogonal orientation of compute to switch blades enables cableless connection. A Chassis Management Module connects internally to compute and switch blade management devices and externally to a non-compute system running the Shasta Management System.

**CRAY SHASTA AIR-COOLED CABINETRY**

The air-cooled solution is a standard 19” rack configuration for data centers or smaller systems without liquid cooling. The current compute platform is the S3815 4 AMD® EPYC® 7002 nodes in a 2U compute server.
# Cray Shasta Specifications

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<th>C7815 Compute Blade</th>
<th>S3815 Compute Server</th>
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<tbody>
<tr>
<td><strong>Processors</strong></td>
<td>AMD® EPYC® 7002 Series dual processor node (4 nodes per compute blade)</td>
<td>AMD® EPYC® 7002 Series CPU Dual Processor Node</td>
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<tr>
<td><strong>Memory</strong></td>
<td>8 DDR4 channels per socket; 1 DIMM per channel; up to 1024 GB per node Memory bandwidth: up to 400 GB/s per node</td>
<td>8 DDR4 channels per socket; 1 DIMM per channel, up to 1024 GB per node Memory bandwidth: up to 400 GB/s per node</td>
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<tr>
<td><strong>Interconnect</strong></td>
<td>1 or 2 Slingshot high-speed connections per node High-radix 64-port switch blade provides 12.8 Tb/s of bandwidth; each port operates at 200 Gb/s per direction Dragonfly interconnect: low-latency, high-bandwidth topology</td>
<td>1 or 2 Slingshot connections per node via x16 PCIe Gen 4 NIC High-radix 64-port TOR switch provides 12.8 Tb/s of bandwidth; each port operates at 200 Gb/s per direction Dragonfly interconnect: low-latency, high-bandwidth topology</td>
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<tr>
<td><strong>System Chassis</strong></td>
<td>Cray liquid-cooled cabinetry supporting up to 256 compute nodes per cabinet</td>
<td>19” 2U Chassis with 4 AMD EPYC 7002 Dual Processor Servers</td>
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<td><strong>Reliability Features</strong></td>
<td>Integrated Cray Hardware Supervisory System (HSS) Independent, out-of-band management network Link level retry and low latency FEC (forward error correction) on Slingshot Redundant power supplies; redundant voltage regulator modules Hot swap power supplies and compute blades Integrated pressure and temperature sensors Redundant, micro Services based system management software Analytics-ready telemetry data Node health check software</td>
<td>Onboard system management controller Independent, out-of-band management network Link level retry and low latency FEC (forward error correction) on Slingshot Redundant, hot swap power supplies Redundant, micro-services based system management software Analytics-ready telemetry data Node health check software</td>
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## Liquid Cooled Cabinet

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<th><strong>Power</strong></th>
<th>Support up to 300kVA Support for 480 VAC and 400 VAC computer rooms</th>
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<tr>
<td><strong>Cooling</strong></td>
<td>Direct liquid cooling, up to ASHRAE W4 warm water support</td>
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<tr>
<td><strong>Dimensions (Cabinets)</strong></td>
<td>1.2m x 1.7m x 2.5m installed height</td>
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<tr>
<td><strong>Weight (Operational)</strong></td>
<td>CPUs: 3,204 kg (1,668 kg/sq m; 1,178 kg/sq m with base) GPUs: 3,842 kg (2,000 kg/sq m; 1,397 kg/sq m with base - future)</td>
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