Introducing the next generation of affordable and productive massively parallel processing (MPP) computing – the Cray XT6m™ supercomputer. Building on the reliability and scalability of the Cray XT6™ supercomputer and using the same proven petascale technologies, the Cray XT6m system is optimized to support scalable application workloads in the midrange high performance computing (HPC) market, where applications require between 700 and 13,000 cores of processing power.
## Cray XT6m Specifications

### CPU
- Eight or 12-core 64-bit AMD Opteron 6100 series processors; up to 192 per cabinet

### Cache
- 64K L1 instruction cache, 64K L1 data cache, 512 KB L2 cache per processor core, 12 MB shared L3 cache

### Cores
- 1,536 or 2,304 processor cores per system cabinet

### Peak Performance
- 12.2 to 20.2 Teraflops per system cabinet

### Main Memory
- 32 GB or 64 GB registered ECC DDR3 SDRAM per compute node

### Memory Bandwidth
- 85.3 GB/sec per compute node

### Interconnect
- 1 Cray SeaStar2+ routing and communications ASIC per compute node
- 4 switch ports per Cray SeaStar2+ chip, 9.6 GB/sec each (38.4 GB/sec switching capacity per Cray SeaStar2+ chip)
- 2D torus interconnect

### External I/O Interface
- Gigabit Ethernet
- 10 Gigabit Ethernet
- Fibre Channel (FC)
- InfiniBand

### Disk Storage
- Full line of FC-attached disk arrays with support for FC and SATA disk drives

### File System
- Lustre, Data Virtualization Service (DVS) allows support for NFS, external Lustre and other file systems

### System Administration
- Cray System Management Workstation (SMW)
- Graphical and command line system administration
- Single-system view for system administration
- PBS Professional™ job management system
- Adaptive Computing Moab™ job management system
- System software rollback capability

### Reliability Features (Hardware)
- Cray Hardware Supervisory System (HSS) with independent 100 Mb/s management fabric between all system blades and cabinet-level controllers
- More than 50 measurement points monitored per Cray XT6m system blade
- Full ECC protection in the Cray SeaStar2+ chip
- Redundant power supplies; redundant voltage regulator modules (VRMs)
- Redundant paths to all system RAID
- Variable-speed axial turbofan with integrated pressure and temperature sensors

### Reliability Features (Software)
- HSS system monitors operation of all operating system kernels
- Lustre file system object storage target failover; Lustre metadata server failover
- Software failover for critical system services including system database, system logger and batch subsystems
- NodeKARE™ - Node Knowledge and REconfiguration

### Operating System
- Cray Linux Environment: components include SUSE Linux™, HSS and SMW software
- Extreme Scalability Mode (ESM) and Cluster Compatibility Mode (CCM)

### Message Passing Libraries
- MPI 2.0, Cray SHMEM, other standard MPI libraries using CCM

### Compilers
- PGI® Compilers, Cray Compiler Environment, Pathscale: support for Fortran 77, 90, 95; C/C++, UPC, Co-Array Fortran

### Power
- 45 - 54.1 kW (45.9 - 55.2 kVA) per cabinet, depending on configuration
- Circuit requirements: 3 phase wye, 100 AMP at 480/277 and 125 AMP at 400/230 (3 phase, neutral, and ground)

### Cooling Requirement
- Air-cooled, air flow: 3,000 cfm (1.41 m3/s); intake: bottom; exhaust: top
- Optional ECOphlex liquid cooling

### Dimensions (Cabinet)
- H 93 in. (2,045 mm) x W 22.50 in. (572 mm) x D 56.75 in. (1,441 mm)

### Weight (Maximum)
- 1,600 lbs. per cabinet (725 kg) air cooled; 2,000 lbs. per cabinet (907 kg) liquid cooled

### Acoustical Noise Level
- 75 dba at 3.3 ft (1.0 m)

### Regulatory Compliance
- UL 60950-1, CAN/CSA – C 22.2 No. 60950-1, CE mark, RoHS, WEEE

### Safety
- EN 61000-3-2, EN 61000-3-3, Statskontoret 26.2 Category 1
**Cray XT6m Supercomputer**

Engineered to meet the demanding needs of capability-class HPC applications, each feature and function is selected in order to enable larger datasets, faster solutions and a greater return on investment. Designed to support the most challenging HPC workloads in a cost effective midrange system, the Cray XT6m supercomputer delivers scalable power for the toughest computing challenges.

**Scalable Performance**
The Cray XT6m system incorporates the same Cray SeaStar2+™ interconnect found in Cray’s petascale systems which provides superior interconnect, bandwidth, upgradeability and manageability while remaining competitively priced with commodity clusters.

**Price, Performance and Upgradeability**
The Cray XT6m system provides affordable petascale technologies for truly scalable performance in a fully upgradeable infrastructure that will conserve this HPC investment for years to come.

**Reliable and Easy to Manage - Cray Linux Environment™**
The flexible, scalable and performance-optimized Cray Linux Environment (CLE) makes it easier for a wide variety of applications to benefit from superior scalability. This environment enables use of a wide range of open source tools and streamlined porting of a broad set of Independent Software Vendor (ISV) applications.

**Optimized Architecture**
The Cray XT6m system utilizes a 2-dimensional (2D) torus architecture, optimized for superior application performance between 700 and 13,000 processing cores. It incorporates two types of dedicated nodes — compute nodes and service nodes. Compute nodes are designed to run parallel MPI and/or OpenMP tasks with maximum efficiency. Each compute node is composed of two AMD Opteron™ microprocessors (eight or 12-core) and direct attached memory, coupled with a dedicated communications resource. Service nodes are designed to provide scalable system and I/O connectivity and can serve as login nodes from which applications are compiled and launched. This design eliminates the scheduling complexities and asymmetric performance problems associated with common cluster designs. It also ensures that performance is uniform across distributed memory processes — an absolute requirement for scalable algorithms.

The Cray XT6m supercomputer incorporates a high-bandwidth, low-latency interconnect based on the Cray SeaStar2+ chip. All the nodes in a Cray XT6m system are directly connected in a 2D torus topology, eliminating the inherent inefficiencies of systems that use external switches. The Cray XT6m design allows for easy expandability and is upgradable to future high performance Cray interconnect technologies. As the backbone of the Cray XT6m supercomputer, this powerful interconnect carries all message passing and I/O traffic for the system.

Designed to optimize for MPI message passing, the Cray SeaStar2+ chip combines communications processing and high-speed routing on a single device. Each communications chip is composed of a HyperTransport™ link, a Direct Memory Access (DMA) engine, a communications and management processor, a high-speed interconnect router and a service port.

The interconnect router in the Cray SeaStar2+ chip provides four high-speed network links which connect to four neighbors in the 2D
torus. The peak bidirectional bandwidth of each link is 9.6 GB/s with sustained bandwidth in excess of 6 GB/s.

Each port is configured with an independent router table, ensuring contention-free access for packets. The router is designed with a reliable link-level protocol with error correction and retransmission, ensuring that message passing traffic reliably reaches its destination without the costly timeout and retry mechanism used in typical clusters. The Cray SeaStar communication protocol is connectionless, thus eliminating the need to create and cache queue structures between communicating node pairs. This enables full application scalability to large node counts, even on challenging applications which stress irregular communication patterns.

CLE3 also includes Cluster Compatibility Mode (CCM). CCM allows the running of most parallel ISV applications out-of-the-box, without recompilation or re-linking and allows for the use of various versions of MPI (MPICH™, Platform MPI™, etc.). At job submission, the compute nodes are configured with CCM to run a more cluster compatible compute node Linux OS, complete with the necessary services to ensure application compatibility. When the application is finished, all nodes are returned to their native ESM state.

Jobs are submitted to the Cray XT6m supercomputer through batch programs such as Altair PBS Professional™ or Adaptive Computing Moab™, which are tightly integrated with the system scheduler, interactively using the Cray XT6m job launch command. The system provides accounting for parallel jobs as single entities with aggregated resource usage.

Each Cray XT6m supercomputer includes a fully integrated Cray Programming Environment with tools designed to enhance programmer productivity, and application scalability and performance. This feature-rich, easy-to-use programming environment facilitates the development of scalable applications. Parallel programming models supported include MPI, Cray SHMEM™, UPC, Co-Array Fortran, and OpenMP. The MPI implementation is compliant with the MPI 2.0 standard and is optimized to take advantage of the scalable interconnect in the Cray XT6m system.

CrayPAT with Cray Apprentice2™, Cray’s performance analysis tools, allow users to analyze resource utilization throughout their code at scale and eliminate bottlenecks and load-imbalance issues.

The Cray XT6m supercomputer can utilize a wide variety of high performance compilers and libraries, including PGI®, Pathscale™ and the Cray Compiler Environment with support for optimized C, C++, and Fortran90, UPC and Co-Array Fortran, as well as high-performance optimized math libraries of BLAS, FFTs, LAPACK, ScaLAPACK, SuperLU, and Cray Scientific Libraries.

Efficient System Administration

Cray XT6m systems are built for reliability and installed systems typically have greater than 99% availability. Key to this reliability are Cray’s integrated Hardware Supervisory System (HSS) and innovations in CLE3, including our exclusive NodeKARE™ (Node Knowledge and Reconfiguration) functionality.

Cray XT6m integrates hardware and software components to provide system monitoring, fault identification and recovery. An independent system with its own control processors and supervisory network, the HSS monitors and manages all of the major hardware and software components in the Cray XT6m system. In addition to providing recovery services in the event of a hardware or software failure, HSS controls power-up, power-down and boot sequences, manages the interconnect and displays the machine state to the system administrator.

CLE3 features NodeKARE. Should a user’s program terminate abnormally, NodeKARE automatically runs diagnostics on all compute nodes involved in the application removing any unhealthy nodes from the compute pool. This ensures that subsequent jobs are allocated only healthy nodes and run reliably to completion.
Higher Efficiency, Lower Operating Cost

Cray’s high efficiency cabinets with optional ECOphlex cooling provide innovative power, cooling and packaging with superior energy efficiency, lowering data center cooling requirements and the total cost of ownership.

High Performance, Parallel I/O

The Cray XT6m I/O subsystem scales to meet the bandwidth needs of even the most data-intensive applications. The I/O architecture consists of storage arrays connected to I/O nodes which reside on the high-speed interconnect. The Lustre® file system manages the striping of file operations across these arrays. This highly scalable I/O architecture allows customers to configure the Cray XT6m supercomputer with the desired bandwidth by selecting the appropriate number of arrays and service nodes. Additionally, the Cray Data Virtualization Service (DVS), an integrated feature in CLE, allows for the projection of various other file systems (including NFS, GPFS™, Panasas® and StorNext®) to the compute and login nodes on the Cray XT6m system.

Superior Energy Efficiency, Lower Operating Costs

Recognizing the growing need to reduce energy usage and control operating costs, the Cray XT6m supercomputer employs innovative packaging technologies and an efficient power conversion train that reduces energy use and total cost of ownership.

Cray XT6m systems provide state-of-the-art datacenter flexibility. Each system can be air- or liquid-cooled. In an air-cooled configuration, a single, high efficiency ducted turbine fan draws cold air straight from its source - the floor - and efficiently cools the processors on the blades, which are uniquely positioned for optimal airflow. This design offers unparalleled processor density, using less air per watt than other air-cooled configurations.

The optional Cray ECOphlex™ (PHase-change Liquid EXchange) technology can dramatically reduce the operating costs associated with cooling and provide flexibility in data center design and implementation. Each high efficiency cabinet can be configured with in-line phase-change evaporator coils which effectively extract virtually all the heat imparted to the airstream as it passes through the cabinet. Coolant is re-condensed in a Heat Exchange Unit (HEU) which is connected to the building chilled water supply. Because a flexible range of building water temperatures is permitted, a modern data center using ECOphlex technology can operate chillers and air handlers much less often, reducing electrical cost. In many climates, cooling towers alone are all that is needed to keep a system fitted with ECOphlex operating at full capacity during much of the year.

Cray XT6m compute blades are designed for maximum power efficiency, with only the necessary components needed for massively parallel processing – processors, memory and interconnect. The 400/480VAC power supplies in each cabinet connect directly from the power grid without transformer and power distribution unit loss, further contributing to reduced energy usage and lower cost of ownership.

Cray XT6m supercomputers allow for easy, flexible upgrade options which lower the overall cost of ownership and increase the competitive lifespan of systems. Like all Cray XT™ systems, the Cray XT6m supercomputer can be upgraded or expanded to take advantage of new technologies. Cray XT6m system owners are well positioned to take advantage of next-generation compute processors, I/O technologies and interconnects as they become available, without replacing the entire system.

Scalable Compute Nodes

Each Cray XT6m blade includes four compute nodes for high scalability in a small footprint – up to 96 processor cores per blade or 2,304 processor cores per cabinet. Each compute node is composed of two AMD Opteron processors (eight or 12-core), each coupled with its own memory and dedicated Cray SeaStar communication ASIC. Each compute node is designed to efficiently run up to eight MPI tasks, or alternately can be programmed to run OpenMP within a compute node and MPI between nodes.

The AMD processor’s on-chip and highly associative data cache supports aggressive out-of-order execution. The integrated memory controller eliminates the need for separate Northbridge memory chip, and provides a high-bandwidth path to local memory – 85.3 GB/sec per dual-socket compute node. This design brings a significant performance advantage to algorithms that stress local memory bandwidth and provides significant head room to accommodate future processor upgrades. HyperTransport technology enables a 6.4 GB/sec direct connection between the compute node and the Cray SeaStar interconnect, removing the PCI bottleneck inherent in commodity networks.

Each Cray XT6m node can be configured with 32 GB or 64 GB DDR3 memory. Memory on compute nodes is registered and memory controllers provide for the additional protection of x4 device correction, ensuring highly reliable memory performance while retaining the upgradeability, serviceability and flexibility of a socketed component.