
CRAY J916
JUST
RIGHT
FOR
YOU

CRAY SUPER

WHEN
YOU THINK OF A
SUPERCOMPUTER, YOU MOST
LIKELY ENVISION A MULTI-MILLION
DOLLAR NUMBER CRUNCHER LOCKED
AWAY IN A CUSTOM COMPUTING
ENVIRONMENT

THAT'S JUST NO LONGER

THE CRAY J916 SYSTEM—JUST RIGHT FOR YOU

The CRAY J916 system is the latest air-cooled supercomputer from Cray Research. With prices beginning at $225 thousand in the United States, the CRAY J916 system is a cost-effective throughput supercomputer that can make a real difference to the bottom line of your business.

When it comes to performance on real applications, CRAY J916 systems provide the highest throughput in their price range with up to 16 CPUs and large central memories. Because it's binary compatible with our more powerful supercomputers, the CRAY J916 system runs the most widely used scientific and engineering applications—FAST, without modification.

The CRAY J916 is the third-generation of Cray Research products designed to provide supercomputing capabilities at a low cost of ownership. With up to 12 times the performance at the same price points as previous systems, the CRAY J916 system is ideal for budget-conscious departments and organizations.

The CRAY J916 system is just right for you in ways you never thought a supercomputer could be. For example, it doesn't require a computer room environment or special power or cooling arrangements. And with its open software environment, it integrates easily into your existing distributed computing network.

At Cray Research, we understand that you want to concentrate on the tasks at hand, not on how to squeeze performance from your computational tools. With the built-in production supercomputing environment of the CRAY J916 system, you get the fastest possible solutions to critical problems without being a systems expert.

After all, it's not just a computer. The CRAY J916 supercomputer goes beyond the sum of today's enabling software and hardware technologies. With cost-effective, sustained performance, the CRAY J916 system lets you tap the potential of your distributed computing environment.

THE CASE

Just Right For Your Departmental Budget

The CRAY J916 system just might shatter your conception of what a supercomputer costs to acquire, operate, and maintain. At prices starting at $225 thousand in the United States, the CRAY J916 system delivers more performance for the money than any previous Cray Research system.

In fact, for less than $60 thousand per CPU, you'll get access to the same kind of stellar productivity that Cray Research customers have enjoyed for years. That's because the CRAY J916 system delivers truly scalable multiprocessing throughput to augment the capabilities of your entire departmental network.

But CRAY J916 affordability goes beyond the purchase price. Because it's air cooled and uses standard 50/60 Hz, 200-240 V power, you can install it easily just about anywhere in the world. The system's modular design makes memory, processor, and I/O upgrades easy and affordable, too. And because Cray Research's UNICOS operating system is bundled with every CRAY J916 system, you get access to new operating system releases without costly upgrade fees.

The Applications Advantage

To help our customers capitalize on their supercomputing investments, Cray Research supports a wide variety of application software available from the leading commercial application vendors. By working closely with the top vendors, we ensure that the most widely used application software is continually enhanced to take advantage of the latest features of our hardware and software systems. Industry-leading software used in structural analysis, fluid dynamics, chemical modeling, seismic data processing, and other areas of industrial R&D and manufacturing has been optimized for the CRAY J916 architecture. The following pages present just a few of the many and diverse science and engineering problems solved routinely on Cray Research systems using readily available commercial software packages.

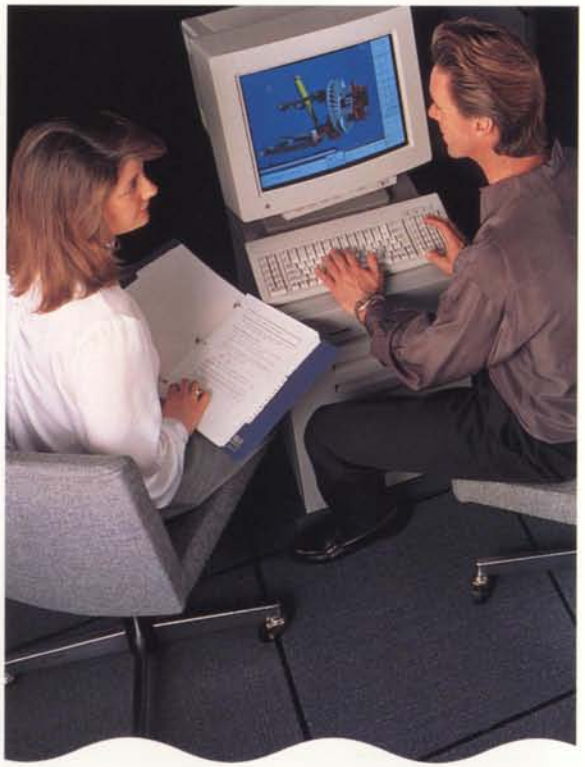
Just Right For Your Applications

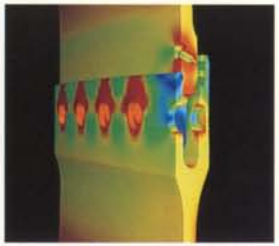
Sustained applications performance and sustained throughput are what the CRAY J916 system is all about. The CRAY J916 system provides the fastest solutions in its price range for computationally intensive problems because it runs the full suite of applications already optimized for our more powerful supercomputers.

The CRAY J916 system has the memory and I/O bandwidth needed to sustain parallel workload throughput. And, as problem size and complexity increase, optimized applications let you take full advantage of CRAY J916 parallel vector processing capabilities.

Within its standards-based implementations, Cray Research software transparently delivers scalable applications performance. Our industry-leading compilers automatically parallelize, vectorize, and scalar-optimize standard code to deliver maximum value from your supercomputer resources.

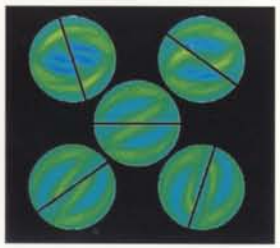
Cray Research applications experts bring performance straight to your bottom line with their years of hands-on experience solving complex, industry-specific problems like yours. This dedicated team works closely with leading application software developers, leading research institutions, and customers to ensure that you have access to optimal supercomputer-level performance.





Left, Space Shuttle solid rocket motor factory joint pressure simulation. EnSight (formerly called MPGS) postprocessing of ANSYS results showing displacements and equivalent stresses. Red indicates highest stress values.

Right, concentration fields of the transport of two chemical species, shown at various intersections of an inline static mixer's helical mixing elements as the mechanism has passed through various rotations. The simulations were conducted with FLUENT software.



Just Right For Your Departmental Environment

You may be surprised at how well the CRAY J916 system fits into your departmental computing environment. And that's not just because it is easy to install and has full networking capabilities. The CRAY J916 system gives you the interoperability and productivity advantages of an open supercomputing software environment.

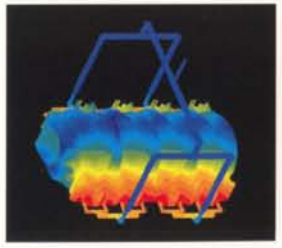
Open supercomputing is built on a foundation of industry standards that provides a familiar operating environment and ensures interoperability across heterogeneous systems on your network. As a result, Cray Research systems can be networked to function as extensions of your desktop environment.

At the center of the open supercomputing environment is UNICOS, an industrial strength, POSIX-compliant operating system based on UNIX system software. Enhanced with heterogeneous networking capabilities, UNICOS also complies with high performance implementations of industry standard languages (Fortran 90, Standard C, and C++) as well as the following networking and distributed computing standards:

- Communications protocols: TCP/IP and ISO/OSI
- Distributed client/server computing: ONC, OSF/DCE
- Distributed data: NFS, OSF/DFS
- Distributed batch processing: NQS, NQX
- Distributed programming: PVM parallel virtual machine message passing
- Media connections: Ethernet, HIPPI, FDDI and ATM
- Windowing and visualization: X Window System, MOTIF, Distributed GL

To provide transparent access to distributed data across local and wide area networks, Cray Research offers sophisticated, standards-based data management and hierarchical storage management solutions.

To guard the confidentiality of your data, the same UNICOS functionality that has received a U.S. Department of Defense B1 "Trusted Network Component" security rating is available on the CRAY J916 system. This functionality provides security between UNICOS systems and other trusted systems on a secure network. Additional network security and authentication protection are provided by Kerberos and OSF/DCE.



Left, a MOLDFLOW filling analysis for an automotive intake manifold, showing the temperature of the plastic at the time the mold is filled.

Right, simulation of an automobile instrument cluster bezel. As a result of the simulation using MOLDFLOW software, warpage of the part was reduced by 50 percent.

Just Right For Your Production Computing Needs

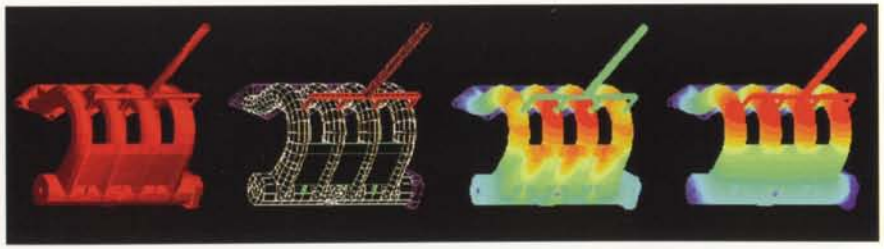
The CRAY J916 system and UNICOS operating system were designed with real-world production computing needs in mind. This should come as no surprise given Cray Research's years of experience delivering high-performance multiprocessing UNIX as part of a powerful production-quality software environment. Since our supercomputers are relied on for mission-critical solutions, we've built "mainframe-like" features into UNICOS for job scheduling, accounting, reliability, load balancing, tape management, and hierarchical storage management.

Because performance is key to efficient production computing, UNICOS includes numerous unique capabilities that enable it to tap the performance of the CRAY J916 system:

- Multithreading provides scalable operating system efficiency for multiple CPUs.
- High performance I/O capabilities such as flexible file, asynchronous and raw (no buffering) I/O maximize throughput on a wide range of programs.
- Automatic parallel processing support (Autotasking) and multitasking provide efficient parallel applications performance on multiple CPUs.
- Fully automatic optimizing compiling systems maximize performance on standard code (Fortran CF90, Standard C, and C++)
- The industry's highest-performing math libraries enable you to access hardware performance features transparently.
- High Performance Parallel Interface (HIPPI) and Fiber Distributed Data Interface (FDDI) networking capabilities enable data transmission speeds of up to 100 Mbytes/s.

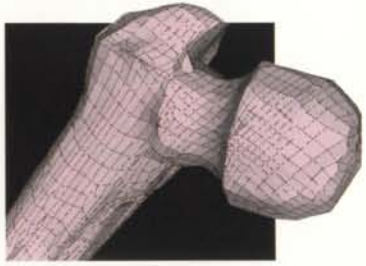
Because the CRAY J916 system is a valuable resource with high usage demands, we've made it easy to manage and administer. Our sophisticated resource management software helps schedule user jobs, provides useful accounting information, and balances workload distribution within the system and across your network.

Cray Research understands the importance of reliability, serviceability, and data availability. The CRAY J916 hardware is so robust you can service it yourself with minimal training. To protect work in progress in case of system or network interruptions, the UNICOS operating system provides advanced resilience features like automatic checkpoint/restart for batch jobs and interactive session recovery.



Left, MOLDFLOW warpage analysis of a Kia Motors four-cylinder engine intake manifold.

Right, mesh of a human femur model containing 14,887 elements, used for analysis with the ABAQUS analysis program, and generated with the Hexar mesh-generation software.



The Right Configurations For Your Workload

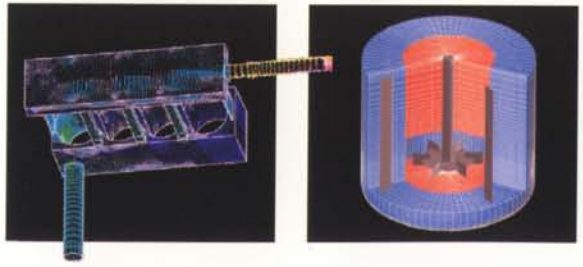
Your computing resources must be able to grow and adapt to your changing workload. That's why we built the CRAY J916 system with field-upgradable processing, memory, and I/O capacities.

The complete CRAY J916 system takes up less than 12 ft^2 (1.1 m^2) of floor space and includes memory, CPUs, I/O subsystems, and room for up to 90 Gbytes of disk storage options. To provide additional storage capacity, up to three additional peripheral cabinets, each with 90 Gbytes of disk storage, can be added to the base configuration.

To provide maximum connectivity, the CRAY J916 system is equipped with 1 to 16 VME-64 I/O subsystems with up to 1.6 Gbytes/s of total I/O bandwidth. This industry standard design allows you to access a wide range of price and performance disk products, third-party peripherals, FDDI and Ethernet networks, and I/O

Configurations

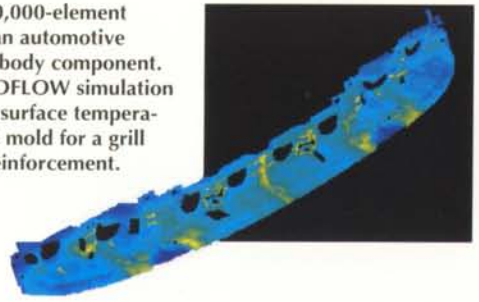
Model	CPUs	Total Memory (Gbytes)	VME-64 IOSs	Peripheral Expansion Cabinets	Peak Performance (GFLOPS)
CRAY J916	4 - 16	0.25 - 4	1 - 16	1 - 4	0.8 - 3.2



Far left, four-cylinder engine block test rig modeled with the STAR-CD fluid dynamics software package.

Left, chemical mixer vessel modeled with the STAR-CD software.

Right, a 10,000-element model of an automotive structural body component. This MOLDFLOW simulation shows the surface temperature of the mold for a grill opening reinforcement.



devices from vendors such as E-Systems, Metrum, and Storage Technology. For hierarchical storage management (HSM), the system supports Cray Research's Data Migration Facility. And connecting to your existing small computer system interface (SCSI) peripherals is easy, too, because the CRAY J916 system has easily accessible SCSI bulk head connectors.

The CRAY J916 High Performance Parallel Interface (HIPPI) provides high performance connectivity to HIPPI-based peripherals and for high-speed network connectivity applications such as Parallel Virtual Machine (PVM). This high performance connectivity also greatly assists the transfer of large files to other Cray Research systems. The CRAY J916 system can be configured with up to four 100-Mbyte/s HIPPI-to-memory channels.

Product Specifications

CPU

Technology	CMOS
Clock period	Approx. 10 ns
Number of CPUs	4 - 16
CPUs per processor module	4
Peak performance	Approaching 200 MFLOPS per CPU

Memory

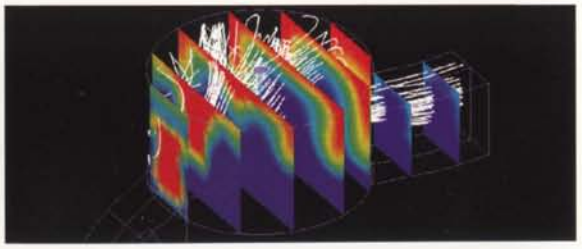
Technology	70 ns CMOS DRAM
Memory size	0.25 - 4 Gbytes (64 - 512 Mwords)
Total memory bandwidth	25.6 Gbytes/s

VME-64 IOS

Number of IOSs	1 - 16
I/O bandwidth	1.6 Gbytes/s (0.8 Gbytes/s full duplex)
HIPPI to memory channels	1 channel pair per processor module @100 Mbytes/s per channel

Physical characteristics (mainframe cabinet with one attached I/O cabinet)

Weight (max.)	1400 lbs (635 kg)
Footprint area	12 ft^2 (1.1 m^2)
Max. power consumption	8 kW (8 kVA)
Operating temperature	55 - 85 °F (13 - 29 °C)



Left, image of concentration of fresh charge and velocity streamlines during the scavenging process in a two-stroke engine, generated with the CRI/*Turbo*Kiva software package.

Right, flame front and velocity field at auto-ignition in a Nissan Motor Company indirect injection diesel engine, generated by CRI/*Turbo*Kiva.

A Versatile Platform for Capacity and Capability Computing

The CRAY J916 system is a true multiprocessor system that provides scalable applications performance. Individual CPUs can simultaneously process separate programs or different portions of a single program automatically.

These capabilities allow the CRAY J916 system to operate equally well as a throughput server or as a time-to-solution server.

As a throughput server, the multiple CPUs and low parallel overhead of the CRAY J916 system provide high efficiency on multiple job workloads. To reduce your time to solution on individual jobs, tightly integrated CRAY J916 CPUs can be pooled together using our state-of-the-art multiprocessing software.

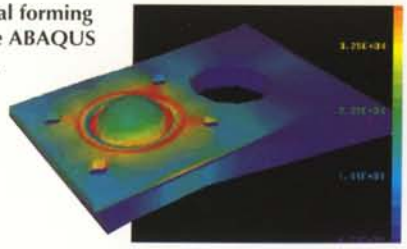
Parallel Processing

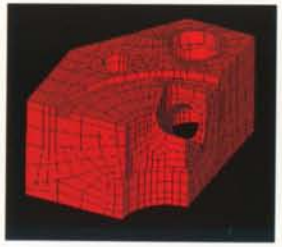
Low parallel overhead delivers significant speedups

A key to utilizing multiple CPUs effectively is to minimize parallel overhead, and that's just what the UNICOS operating system and compiling systems do behind the scenes. In applications where more than 80 percent of the computations can be performed in parallel, low parallel overhead produces speedups very close to the maximum theoretical speedup on multiple Cray Research CPUs.

As model sizes increase, it becomes more important to perform as many computations in parallel as possible. Doing so utilizes your multiple-CPU platform efficiently and allows memory-intensive jobs to complete and exit the system more quickly.

Simulation of metal forming produced with the ABAQUS software package.





Left, cylinder head model with 192,000 degrees of freedom and 2400 RMS wavefront, analyzed with the ABAQUS software package.

Right, stereochemical model of the transition structure for endo trapping of the bicyclo-[2.1.0]pent-2-yl radical by H_2S, calculated with the Gaussian 92 quantum chemistry program.

Increasing Throughput With The SuperCluster Environment

Multiple CRAY J916 systems can be connected using the Cray SuperCluster Environment to extend throughput capacity. In clustered configurations, CRAY J916 systems have access to a shared file system (SFS) that provides high-speed file sharing between any Cray Research systems running UNICOS. In addition, the SuperCluster Environment provides automatic workload distribution and load balancing across heterogeneous systems on a network.

Efficient Vector Processing and Scalar Cache Deliver Significant Speedups

Cray Research pioneered vector processing—a version of the Single Instruction Multiple Data (SIMD) parallel processing technique that can produce tremendous speedups on scientific and engineering codes. Unlike scalar processing, which requires a separate instruction cycle for each operation, vector processing requires only one instruction to carry out all calculations on an entire list of operands.

While not all codes are fully vectorizable, the CRAY J916 design allows considerable overlapping of many computations (including vector, scalar, and parallel processing). You don't have to worry about how best to use these features because our ANSI standard Fortran and C compilers provide you with transparent access to system performance.

Each CPU in the CRAY J916 system has a cache for increased scalar performance. This cache complements the system's shared memory bandwidth critical for efficient and fast vector performance. This combination of vector and scalar capabilities delivers top performance on the widest range of applications.

The CRAY J916 System—Just Right For You

The CRAY J916 system is just right for your departmental budget and production computing needs. By providing cost-effective, sustained applications throughput, the CRAY J916 system brings true supercomputing capabilities within reach.

CRAY J916

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