

You are challenged to turn your
best ideas into better solutions.
Now the power to make a difference
is more accessible than ever before.

The CRAY Y-MP4E Supercomputer System



CRAY
RESEARCH, INC.

Introducing the CRAY Y-MP4E Supercomputer System

For over 15 years, top scientists and engineers have been using Cray Research supercomputers to turn their best ideas into better solutions. To bring this capability to more users than ever before, Cray Research offers the CRAY Y-MP4E system — an affordable, easy-to-use supercomputing tool to bridge the gap between inspiration and innovation.

Outstanding performance and functionality

At Cray Research, we offer a total supercomputing solution. Because the CRAY Y-MP4E supercomputer works in concert with Cray Research software, applications, and customer networks, it can solve problems that can't be attempted on any other computer system.

The CRAY Y-MP4E system offers unmatched performance with two or four CPUs and 32 or 64 million words of central memory. To provide the highest possible performance for a full spectrum of applications, the system features a balanced architecture and all new I/O and SSD technology. Its large, fast memories are matched with up to four CPUs working in parallel. This architecture provides sustained performance of over one billion floating-point operations per second (over 1 GFLOPS) on a variety of applications. In fact, more codes and applications run at GFLOPS speed on CRAY Y-MP systems than on any other system.

The CRAY Y-MP4E system offers unmatched functionality with performance-oriented, feature-rich software products that enhance its capabilities. Cray Research provides the most complete body of software available on any supercomputer. In addition, Cray Research systems are unsurpassed in their ability to connect to computer hardware from other vendors.

Compatibility and broad supercomputing experience

The CRAY Y-MP4E system is fully compatible with other members of the CRAY Y-MP supercomputer family. Like other family members, it runs UNICOS, a powerful UNIX-based operating system optimized for maximum performance on production workloads. With outstanding functionality, performance, and ease of use, UNICOS is the most powerful and feature-rich operating system available for supercomputers.

To deliver the power of the CRAY Y-MP4E system, Cray Research offers over 15 years of experience supporting supercomputer customers. Cray Research was the first supercomputer vendor to offer a UNIX-based operating system, parallel processing, vectorization, Autotasking software, and sustainable GFLOPS performance. At Cray Research, we put this experience to work for you to help you get the most from your CRAY Y-MP4E computer system.

The CRAY Y-MP4E system

Affordable, unmatched performance

Using new technologies, the CRAY Y-MP4E computer system sets a new price/performance standard for mid-range CRAY Y-MP systems. It is less costly to operate and maintain than the original CRAY Y-MP system and is easier to install because of its simplified power and cooling.

When it comes to real-world applications, no other computer system available today exceeds the performance of the CRAY Y-MP4E system, except for Cray Research's largest CRAY Y-MP8 supercomputers. For example, the CRAY Y-MP4E system is one of the only supercomputers capable of solving the global 10-day forecast model at the European Center for Medium Range Weather Forecasts (ECMWF) in less than three hours. In addition, the CRAY Y-MP4E system provides outstanding functionality with MSC/NASTRAN. With its gather/scatter addressing and large fast memory, the power of the CRAY Y-MP is easily coupled with advanced algorithms developed by MSC, allowing it to attack full body

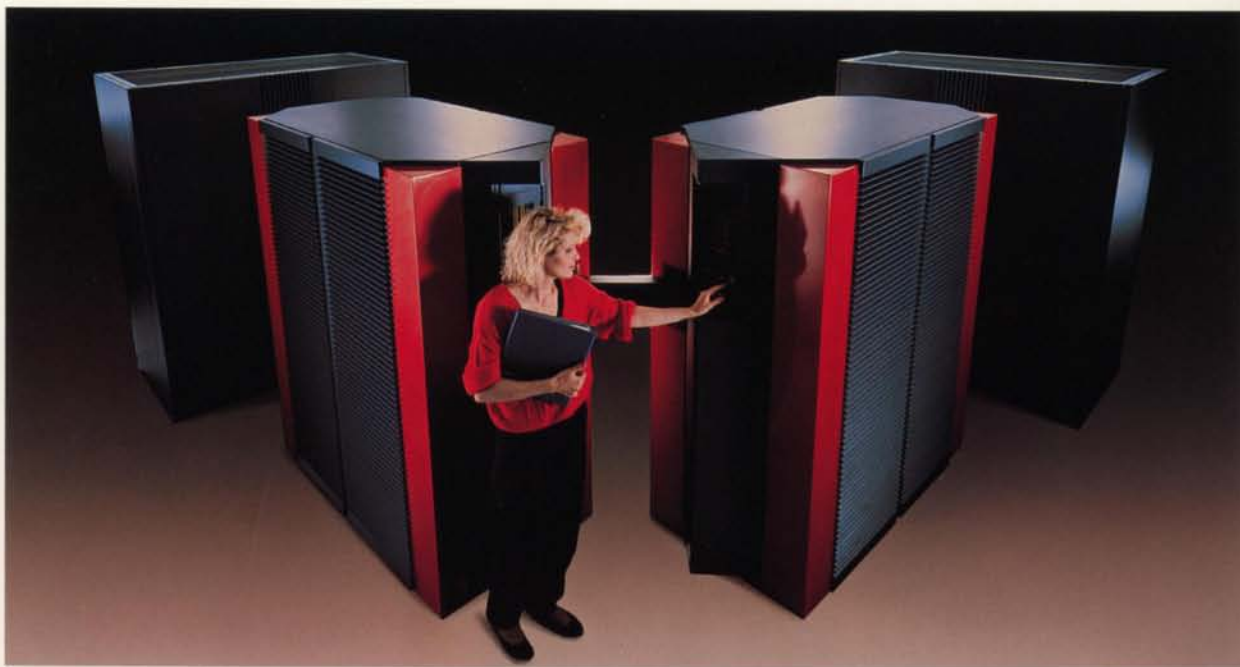
automobile dynamics problems with unprecedented accuracy and efficiency.

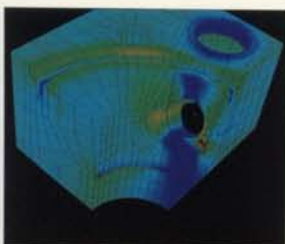
Configurations to fit present needs, with room to grow

The CRAY Y-MP4E computer system is field upgradable. The standard configuration CRAY Y-MP4E system includes two CPUs, 32 Mwords of central memory, and one I/O cluster. Upgrade options include additional CPUs, I/O clusters, central memory, and an optional SSD solid-state storage device.

Physical description

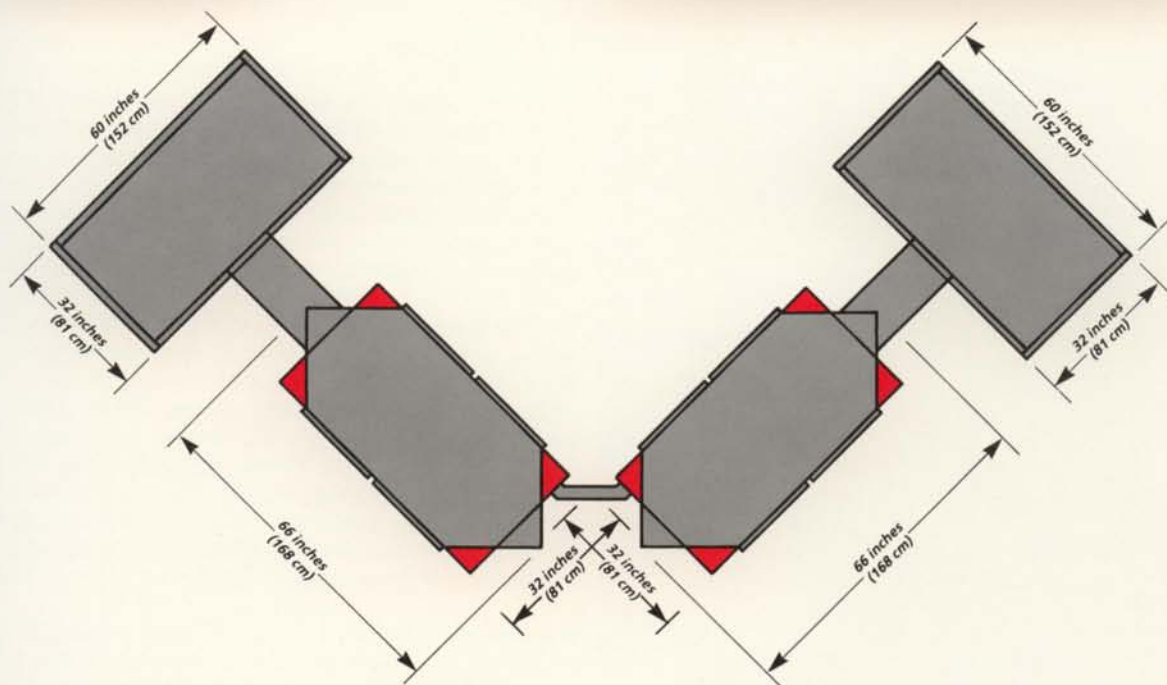
The CRAY Y-MP4E system comprises a mainframe chassis, an IOS/SSD chassis, and two cooling units. The mainframe and the IOS/SSD chassis measure 32 inches wide by 66 inches deep by 68.5 inches high (81 cm x 168 cm x 174 cm). Each cooling unit measures 60 inches wide by 32 inches deep by 72 inches high (152 cm x 81 cm x 183 cm).





Left, head of a pressure vessel. Colors signify stresses due to pressure and preload.

Right, three-dimensional view of the predicted vortex lattice wake structure modeling the complete wake surface of an H-34 helicopter rotor.



CRAY Y-MP4E system highlights

- ☐ Up to four processors
- ☐ 6-nanosecond clock cycle
- ☐ Very Large Scale Integration (VLSI) gate-array circuits
- ☐ Flexible hardware chaining for vector operations
- ☐ Gather/scatter and compressed index vector support
- ☐ Flexible processor clustering for multitasking applications
- ☐ Four parallel memory ports per processor
- ☐ Liquid cooling system
- ☐ Dedicated registers for efficient interprocessor communication and control
- ☐ SECED memory protection
- ☐ Large, fast central memories
- ☐ Optional SSD

CRAY Y-MP4E system configurations

Model	CPUs	Central memory (Mwords)	IOCs	Optional SSD (Mwords)
CRAY Y-MP4E/232	2	32	1 - 3	128, 256, or 512
CRAY Y-MP4E/264	2	64	1 - 3	128, 256, or 512
CRAY Y-MP4E/432	4	32	1 - 3	128, 256, or 512
CRAY Y-MP4E/464	4	64	1 - 3	128, 256, or 512

New technologies

IOS highlights

- ☐ Up to three I/O clusters
- ☐ Up to 16 channel adapters per cluster
- ☐ Support for high-performance disk drives
- ☐ Support for high-performance online tapes
- ☐ 200 Mbyte/sec internal channels
- ☐ Support for high-speed and low-speed networks
- ☐ Support for the ANSI standard HIPPI channel
- ☐ Aggregate I/O bandwidth exceeding 2000 Mbytes/sec to peripheral devices and the SSD

SSD highlights

- ☐ Up to 512 Mwords
- ☐ Reliable VLSI technology
- ☐ One or two 1000 Mbyte/sec channels to the mainframe
- ☐ SECDED memory protection
- ☐ Up to three 200 Mbyte/sec channels to the IOS

I/O Subsystem

To further enhance its performance, the CRAY Y-MP4E system uses the new Input/Output Subsystem (IOS) technology introduced with the CRAY Y-MP2E system. With support for high-performance DD-60 disk drives, the new IOS allows users to access over half a terabyte of data at twice the transfer rate of previous CRAY Y-MP systems.

The IOS is an integral part of the CRAY Y-MP4E design, acting as the mainframe's data distribution point. The IOS allows the central memory of the CRAY Y-MP4E system to communicate at high speeds with networks and peripherals. The IOS comprises one to three I/O clusters (IOCs), providing up to 50 percent more I/O capacity than the CRAY Y-MP2E system. Each IOC supports up to 16 channel adapters for connection to disk storage units, tape units, and communications networks.

The new I/O technology is extremely versatile; it provides customers with a flexible framework that can grow with their I/O and peripheral needs. The standard configuration of the CRAY Y-MP4E system includes one I/O cluster with eight channel adapters. Additional I/O clusters and channel adapters can easily be configured at customer sites.

To increase the CRAY Y-MP4E production workload capacity, the CRAY Y-MP4E system has an aggregate I/O bandwidth of over 2000 Mbytes/sec to peripheral devices and the SSD. This large bandwidth allows users to access more peripheral devices and perform more simultaneous activities.

The CRAY Y-MP4E system supports 1000 Mbyte/sec and 200 Mbyte/sec channels that provide high I/O bandwidth. The 1000 Mbyte/sec channels transfer data between central memory and the SSD. The 200 Mbyte/sec, full-duplex channels transfer data between central memory and the IOS or between the IOS and an optional SSD.

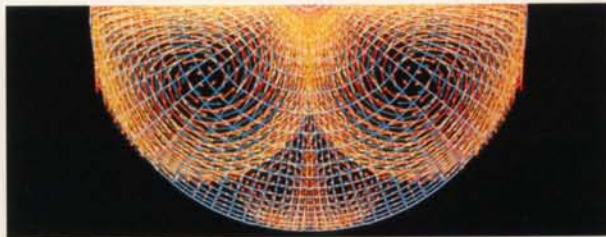
All new SSD technology

The CRAY Y-MP4E system offers all new SSD technology that provides high-speed, reliable data storage at a significantly lower cost than previous SSD systems.



Left, film material simulation. Modeling materials processing operations helps manufacturers apply their production resources more efficiently.

Right, surface tension driven flow field within a weld pool.





Fuel injection in a direct injection diesel engine during cold start.

Using VLSI chips and increased system integration, the SSD is available with up to 512 Mwords of data capacity. These large storage capacities allow users to solve larger problems and increase I/O throughput.

The optional SSD is a very fast random-access device used for large prestaged or intermediate files that are generated and manipulated repeatedly by user programs. The SSD also can be used for swapping programs and for holding commonly accessed libraries and other frequently accessed programs, thereby improving overall system performance.

The CRAY Y-MP4E system communicates with the SSD through one or two 1000 Mbyte/sec channels. The SSD is connected to the IOS through up to three 200 Mbyte/sec channels. These connections enable data to be transferred directly between an IOS and the SSD without passing through central memory, thereby increasing overall performance.

Disk drives

Cray Research offers fast, reliable mass storage devices that give users access to more data at faster rates than was possible with previous disk drives. The CRAY Y-MP4E system supports all current Cray Research disk storage devices including the DD-60 and DD-61 disk storage units.

The DD-60 disk drive offers outstanding performance and large storage capacities when matched with the I/O capability of the CRAY Y-MP4E supercomputers. With the capability to support over half a terabyte of disk storage, the CRAY Y-MP4E system gives users high-speed access to more data than was possible with previous CRAY Y-MP systems.

The DD-60 provides users with access to large amounts of data using highly reliable, 8-inch disk technology. The DD-60 is a 24 Mbyte/sec disk drive with a sustained transfer rate of 20 Mbytes/sec. With up to 200 Mbyte/sec full-duplex bandwidth from an I/O cluster to/from central memory, an I/O cluster configured with 16 disk channel adapters and 16 DD-60 disk drives can deliver up to 320 Mbyte/sec performance (up to 200 Mbytes/sec in each direction). Up to eight DD-60 disk drives can be connected to each disk channel adapter in the IOS.



Two DE-60 disk cabinets, each containing up to eight DD-60 or DD-61 disk drives.

The DD-61 disk drive delivers large storage capacities at a low cost. The DD-61 provides users with access to large amounts of data using highly reliable, 8-inch disk technology that helps give the DD-61 a lower cost per Mbyte, a small footprint, and low power consumption. The DD-61 is a 3 Mbyte/sec disk drive with a sustained transfer rate of 2.6 Mbytes/sec. Up to eight DD-61 disk drives can be connected to each disk channel adapter in the IOS.

Software

Performance-oriented, feature-rich software

Cray Research provides the most complete body of performance-oriented system software available on any supercomputer system. As part of a total system solution, Cray Research software enables users to focus on their work, not the system's requirements. This advantage is evident in the UNICOS operating system, the world's first UNIX-based supercomputer operating system, and in the CF77 compiling system, the industry-leading autovectorizing and Autotasking compiler with the world's most complete Fortran development environment.

UNICOS operating system

The CRAY Y-MP4E computer system runs the UNICOS operating system, the most powerful and feature-rich UNIX-based operating system available to supercomputer users. Based on the UNIX System V operating system

with Berkeley extensions, UNICOS is an interactive and batch operating system that offers a number of advantages including high performance, functionality, portability, and connectivity.

UNICOS features hundreds of programmer years of optimizations that deliver very high performance on production workloads. Together with the powerful CRAY Y-MP4E computer hardware and Autotasking software, this performance not only provides fast turnaround on individual jobs, but also high throughput for a varied workload through sophisticated job scheduling capabilities.

UNICOS combines all the inherent strengths of UNIX, such as a familiar user interface, with production-oriented features including high-performance I/O, optimal memory bandwidth utilization, multiprocessing support, ANSI/IBM tape support, resource control, sophisticated job scheduling, and batch processing.

UNICOS highlights

Functionality

- ☐ Batch processing
- ☐ Multi-level security
- ☐ Tape support
- ☐ Resource management
- ☐ Accounting
- ☐ Recovery
- ☐ Networking

Performance

- ☐ Autotasking features
- ☐ Efficient I/O
- ☐ File system extensions
- ☐ SSD cache
- ☐ High-performance, optimized C and scientific libraries

Ease of use

- ☐ Advanced program development tools
- ☐ X Window System support
- ☐ Performance analysis tools

Compilers

Cray Research offers the most powerful compilers in the industry including the CF77 compiling system, Cray Standard C, Cray Ada, Cray Allegro Common Lisp, and Pascal. The CF77 compiling system was the first Fortran compiler in the industry with the functionality required for automatic parallel processing, automatic vectorization, and scalar optimization. These compiling features require little or no code modification by the user.

The CF77 compiling system ensures portability with full compliance to ANSI standard 3.9-1978. The flexibility of CF77 allows it to accept many nonstandard constructs written for IBM, DEC, CDC, and other vendors' compilers.

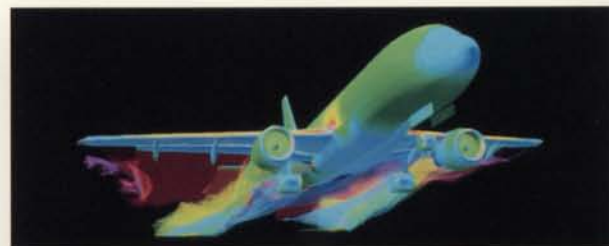
The CF77 compiling system compiles Fortran77 programs into executable code modules that take full advantage of the CRAY Y-MP4E vector and multiprocessing capabilities. For those codes that are not highly vectorizable, CF77 ensures the best possible execution time by providing scalar optimization for the CRAY Y-MP4E system.

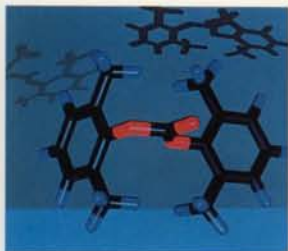
Because supercomputing applications written in the C language are becoming increasingly popular, Cray Research offers the highest-performance ANSI standard C compiler in the industry. The Cray Standard C compiler



Left, temperature contours in canned food (meatball surrounded by liquid broth) undergoing sterilization. Modeling can improve process designs and reduce energy costs.

Right, airliner in ground effect. Image shows surface pressure distribution and wakes behind the aircraft.





Far left, polycarbonate monomer simulated on a CRAY Y-MP supercomputer.



Left, air velocity distribution in a passenger car indirect injection diesel engine.



Right, syringe rubber stopper. Image shows the component geometry.

can be used to create portable, highly optimized code with performance comparable to Fortran programs. Like CF77, the Cray Standard C compiler takes full advantage of the CRAY Y-MP4E performance capabilities with support for automatic vectorization, scalar optimization, and microtasking.

Autotasking

The CF77 compiling system includes Autotasking features that can dramatically improve performance on the CRAY Y-MP4E system. The Autotasking feature divides a program into discrete tasks that can be performed concurrently on all processors in the CRAY Y-MP4E system. In addition, the Autotasking features include a convenient, powerful set of directives that allow programmers to fine-tune their code for even better performance.

UNICOS Storage System

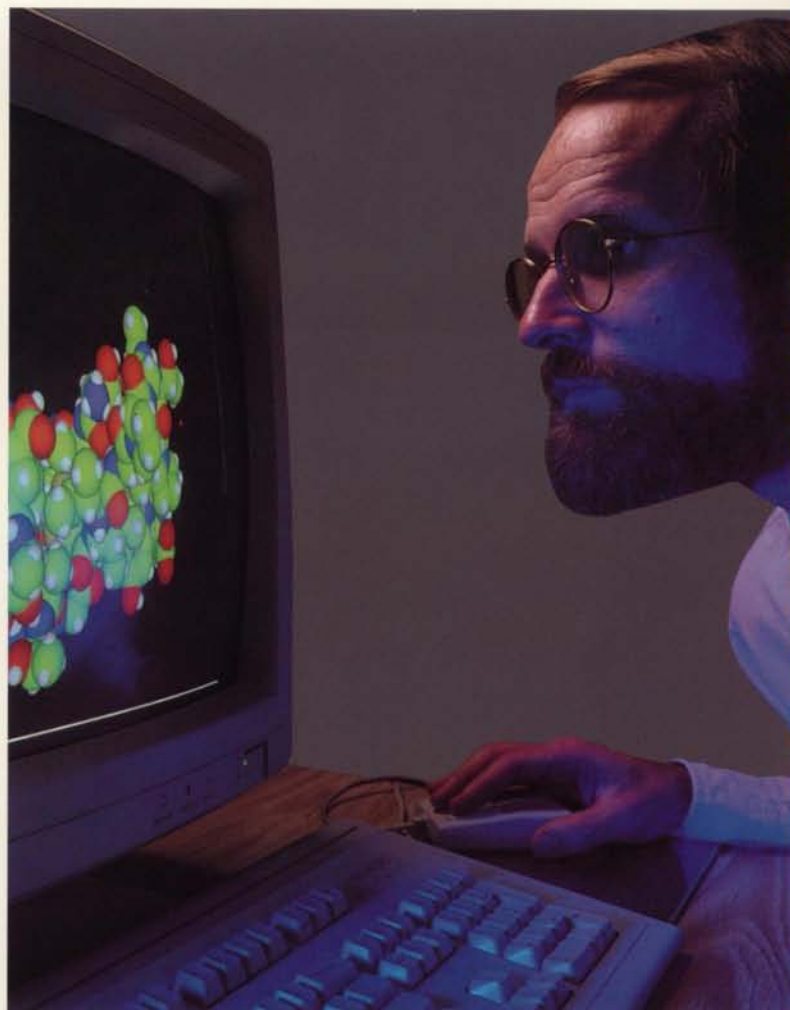
The UNICOS Storage System is the world's first high-performance UNIX-based file server. With the UNICOS Storage System, the CRAY Y-MP4E system enables users to process large workloads while addressing the file storage needs of their network. The UNICOS Storage System provides transparent data access, file access capabilities, system administration, and automated storage capabilities.

Using the UNICOS Storage System, the CRAY Y-MP4E file server can satisfy requests from multiple supercomputers over gigabit networks while also providing service to smaller systems, workstations, and personal computers. When used as a file server, the CRAY Y-MP4E system can also simultaneously perform scientific processing.

Applications

Cray Research supports leading-edge applications for nearly every scientific and engineering discipline including over 600 of the most widely used third-party application programs. These applications are used by diverse industries to accelerate product development, increase productivity, and solve basic research problems. Applications are available for industries such as aerospace, automotive, chemistry, electronics, energy, and petroleum.

To augment its applications support efforts, Cray Research has developed the Multipurpose Graphics System (MPGS) and the UniChem computational chemistry environment. The MPGS system is an interactive menu-driven engineering visualization package for use on Cray Research computer systems. UniChem is an easy-to-use supercomputing environment for computational chemistry simulation that enables researchers to explore complex chemical systems at a new level of detail from their desktops.



Network supercomputing

Delivering supercomputing power to your desktop

To bring the benefits of supercomputing to more users than ever before, Cray Research is dedicated to making its systems accessible through Network Supercomputing. Because Cray Research supercomputers support industry standards and a variety of proprietary interfaces from other vendors, they can easily be integrated into heterogeneous computing environments.

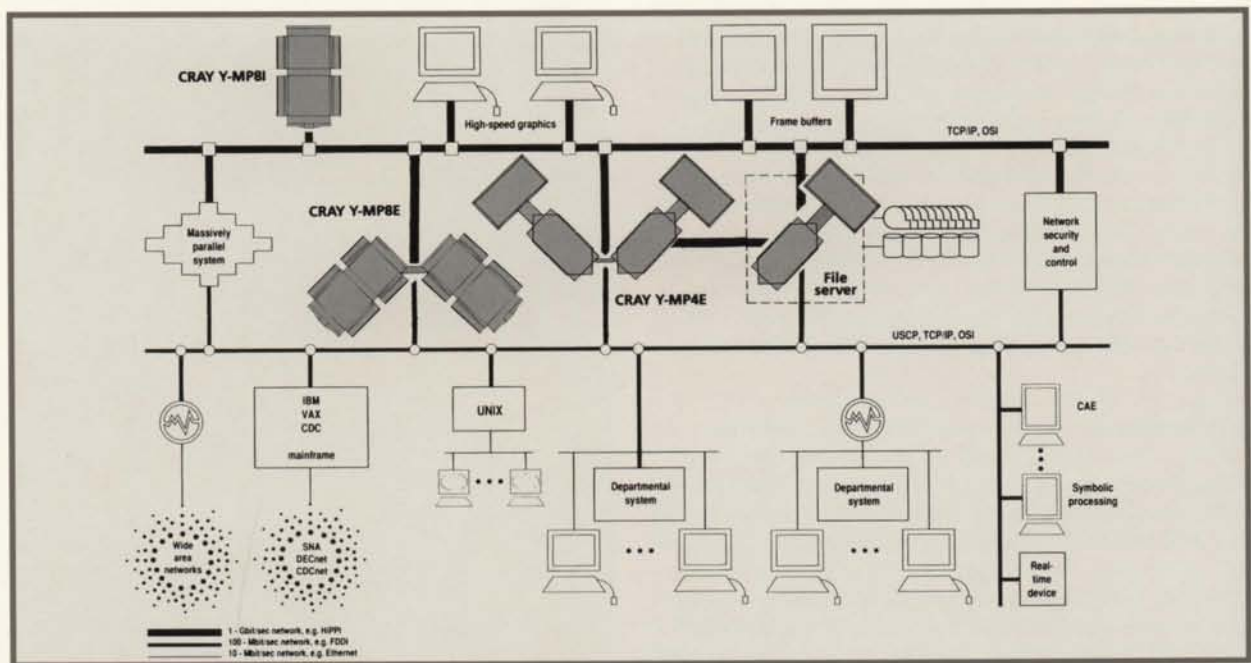
The array of communication products and protocols supported by Cray Research allow applications to be distributed within your network. Thus, other systems on your network may perform data handling, graphic display, and other functions, while the CRAY Y-MP4E system handles what it does best: large simulations that enable researchers to solve problems that formerly were impractical or impossible to solve.

Through the implementation of emerging and de facto networking standards, Cray Research provides connec-

tivity to most UNIX-based mainframes, minicomputers, and workstations. These standards include the TCP/IP networking protocol and applications, the X Window System, the Network File System, the Open Systems Interconnection (OSI) of the International Standards Organization (ISO), the Fiber Distributed Data Interface (FDDI), as well as other networking standards.

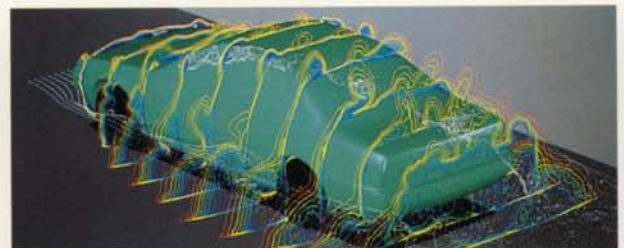
Cray Research also provides station software products that offer access to proprietary protocol implementations (such as SNA, DECnet, and CDCNET) through network gateways. Standard Cray station software is available for the following systems: IBM MVS and VM, CDC NOS, NOS/VE, DEC VAX/VMS, and a variety of computers and workstations running the UNIX operating system. Station software for Unisys and Honeywell Bull systems is available from third-party vendors.

Network Supercomputing increases user productivity by providing optimal workload distribution. The result is a combination of flexibility and computing power unparalleled in the computer industry.



Left, airflow around ascending space shuttle. The image was generated using Cray Research's Multipurpose Graphic System, and includes a complete shuttle, tank, and solid rocket booster.

Right, airflow around passenger vehicle.



Real supercomputing power within reach

The CRAY Y-MP4E computer system makes supercomputing affordable to a broad range of users by costing less to acquire, install, operate, and maintain. The following features give it a low cost of ownership:

- ☐ It can be air cooled and thus does not require any special site plumbing; it requires only a standard computer room environment with commercial air conditioning capacity. The CRAY Y-MP4E system also can be water cooled at the customer's option.
- ☐ Its electrical power system uses commercially available power and does not require a motor generator set.
- ☐ It has a limited number of connections, making installation quick and easy.
- ☐ Its high reliability and enhanced maintenance features make possible low cost, on-call hardware maintenance options.

Low maintenance costs

Cray Research offers an increasingly wide range of maintenance options, from round-the-clock, on-site coverage to on-call hardware service options that make the CRAY Y-MP4E less costly to maintain than previous CRAY Y-MP4 systems. A discount is offered for customers allowing remote access.

Maximized system availability

The CRAY Y-MP4E supercomputers provide high system reliability while maintaining high performance. Higher-density integrated circuits and an overall increase in component integration increases reliability by reducing the number of components and connections.

System quality begins with a design process that integrates quality and reliability into every system component. All components undergo strict inspection and checkout prior to assembly. Prior to shipment, your CRAY Y-MP4E computer system undergoes rigorous operational and reliability tests.

To assure high system availability, Cray Research has developed advanced system support tools including the new System Maintenance and Remote Test Environment (SMARTE), which provides continuous error detection and isolation. SMARTE schedules all on-line diagnostic activity, automatically reports errors, and provides a common X Window System interface to all online diagnostics, concurrent maintenance tools, and expert systems analysis.

Supercomputing power made more affordable

The CRAY Y-MP4E system offers outstanding performance and functionality at a lower cost of ownership. As with all CRAY Y-MP systems, it excels in a wide range of applications and allows users to solve problems that cannot be attempted on other computer systems. Backed by Cray Research's unmatched experience with total supercomputing solutions, the CRAY Y-MP4E system gives you the power to bridge the gap between inspiration and innovation.

For more information on the CRAY Y-MP4E supercomputer, contact your local Cray Research representative.



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The product specifications contained in this brochure and the availability of the products are subject to change without notice. For the latest information, contact your Cray Research representative.