

You are challenged to solve problems that stand  
in the way of a better future. Your success  
depends on having the best possible tool to bridge  
the gap between inspiration and innovation.

## The CRAY Y-MP8 Supercomputer Systems



**CRAY**  
RESEARCH, INC.



# Introducing the CRAY Y-MP8 Supercomputer Systems

At Cray Research, we offer much more than just fast hardware — we offer a total supercomputing solution that allows you to rise to the challenges of your work. With you in control, Cray Research hardware, software, applications, and networks work in concert to turn your best ideas into better solutions.

Now, Cray Research has greatly enhanced the heart of its total system solution with the new CRAY Y-MP8 products — innovative, easy-to-use supercomputing tools that give you the power to make a difference.

## The best gets better

The new CRAY Y-MP8 supercomputers set new standards for high-performance computing with outstanding functionality, reliability, and I/O capabilities, all at a lower cost than previous CRAY Y-MP8 systems. With a wide range of options and new technologies, the new CRAY Y-MP8 systems provide an outstanding level of price, performance, and productivity.

With all new I/O and SSD technology, the CRAY Y-MP8 systems offer the highest sustained performance for a full spectrum of applications. The CRAY Y-MP8 models use a balanced system architecture with large, fast memories matched and tuned with up to eight CPUs working in parallel. This architecture provides sustained performance of over 2 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 vendor's systems. With this performance at your fingertips, you can tackle problems previously thought intractable.

As part of a total supercomputing solution, the CRAY Y-MP8 systems enable a higher level of productivity for scientists and engineers. Not only can these systems solve larger problems than before, but a greater number of problems as well. But productivity doesn't stop there. Cray Research has focused on making its systems simple to use and operate with familiar user interfaces. This approach to supercomputing eliminates obstacles between you and the problems you need to solve.

## A tradition of performance and reliability

The original CRAY Y-MP8 computer system, with its multiple processors and vectorization capabilities, shattered all performance records. The new CRAY Y-MP8 models build on these strengths with expanded I/O and secondary storage capacity, innovative packaging, and an overall increase in integration on the component level.

The CRAY Y-MP8 models combine a wide range of computational power and memory capacity with a balanced architecture that allows for efficient parallel and vector processing. All of the best features of the CRAY Y-MP series of computers — such as gather/scatter and compressed index vector instructions, flexible hardware chaining, and dedicated registers for interprocessor communication and control — have been retained or enhanced in the CRAY Y-MP8 models.

The CRAY Y-MP8 models can process a varied workload mix and still maintain optimal performance. While competitors offer fast solutions for only certain types of problems, the balanced architecture of the CRAY Y-MP8 systems offer the highest possible performance on scalar, short vector, and long vector problems. Because the real problems that make up a production workload consist of a varied mix of codes, the CRAY Y-MP8 systems offer the best overall performance solution.

The CRAY Y-MP8 systems are available in two frame configurations: the dual-chassis CRAY Y-MP8E, and the single-chassis CRAY Y-MP8I (integrated) system. The CRAY Y-MP8E is available with four to eight CPUs and up to 256 Mwords of central memory in one chassis and an I/O Subsystem (IOS) and optional SSD Solid-state Storage Device in the second chassis. The CRAY Y-MP8I integrates up to eight CPUs, an IOS, an optional SSD, and up to 128 Mwords of central memory, all in the same chassis.



## The CRAY Y-MP8E system

### The most powerful Cray Research system ever

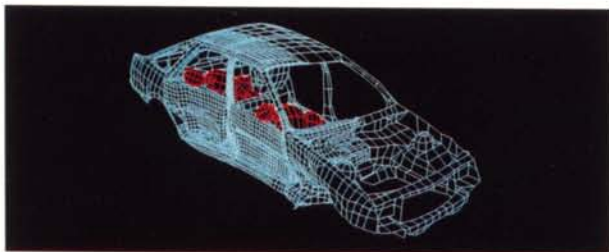
The CRAY Y-MP8E system is the most powerful, general-purpose supercomputer available. With up to eight processors, the CRAY Y-MP8E system offers the largest central memory, SSD, and I/O capacity ever available on CRAY Y-MP supercomputers.

The CRAY Y-MP8E system offers an unprecedented level of computing power and throughput. With up to 256 million 64-bit words of directly addressable central memory and 2 Gigawords of SSD capacity, the CRAY Y-MP8E system allows you to solve previously intractable problems.

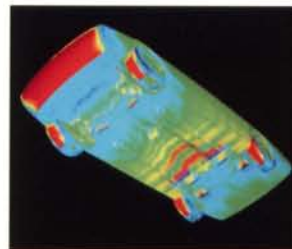
In order to run efficiently, a high-speed supercomputer requires a vast amount of input/output data. The CRAY Y-MP8E system offers the most powerful and versatile I/O capabilities in the industry. The IOS comprises one to eight I/O clusters (IOCs), which allow more data to be accessed at faster rates with support for high-performance DD-60 disk drives. Each IOC supports up to 16 channel adapters for connection to disk storage units, tape units, and communications connections.

The CRAY Y-MP8E system offers an optional integrated SSD. The SSD provides very-high-speed secondary memory of up to 2,048 Mwords (2 Gigawords) at a lower cost per





Left, side impact with crash dummies. Image depicts passengers in a side collision.

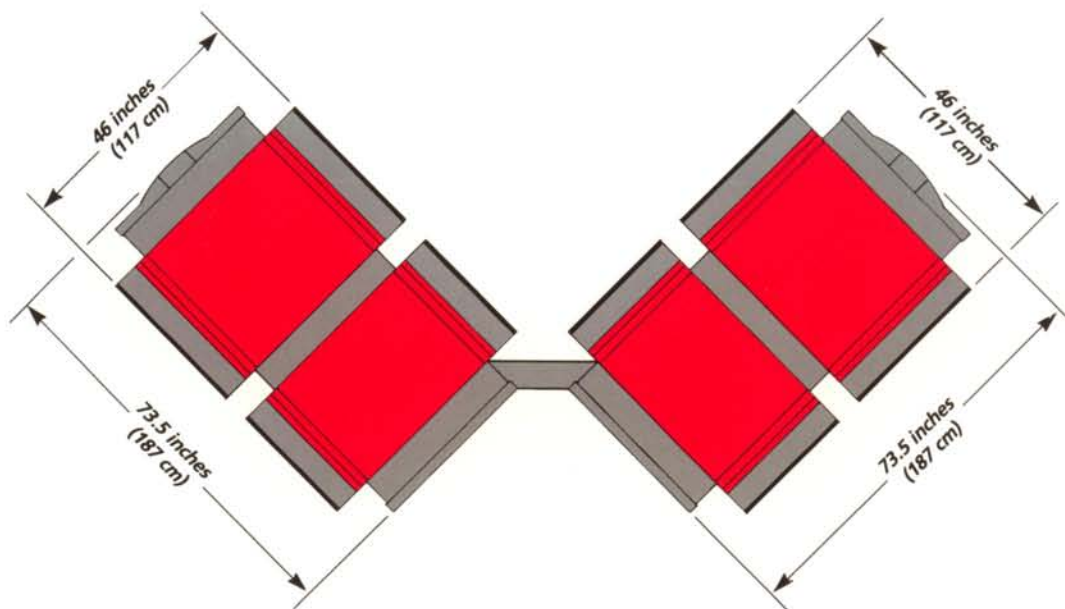


Right, airflow around the Nissan Cefiro. Image shows pressure on the underside of the vehicle.

Mword than with previous SSDs. With support for up to four 1000-Mbyte/sec channels to the SSD, the CRAY Y-MP8E system provides rapid access to this massive storage capacity, which allows you to tackle larger problems.

The CRAY Y-MP8E computer system is field upgradable. The standard CRAY Y-MP8E system includes four CPUs, 128 Mwords of central memory, and one IOC. Upgrade options include additional central processing units, IOCs, central memory, and an SSD.

The CRAY Y-MP8E system comprises two rectangular cabinets. The mainframe cabinet contains the CPUs and central memory. The second cabinet contains the IOS and optional SSD. Each cabinet measures 46 inches wide by 73.5 inches deep by 76.25 inches high (117 cm x 187 cm x 194 cm).



#### CRAY Y-MP8E system configurations

| Model            | CPUs | Central memory (Mwords) | IOCs | Optional SSD (Mwords) |
|------------------|------|-------------------------|------|-----------------------|
| CRAY Y-MP8E/4128 | 4    | 128                     | 1-8  | 512, 1024, or 2048    |
| CRAY Y-MP8E/4256 | 4    | 256                     | 1-8  | 512, 1024, or 2048    |
| CRAY Y-MP8E/8128 | 8    | 128                     | 1-8  | 512, 1024, or 2048    |
| CRAY Y-MP8E/8256 | 8    | 256                     | 1-8  | 512, 1024, or 2048    |



## The CRAY Y-MP8I system

### High-end supercomputing made more affordable

The CRAY Y-MP8I system redefines the cost of full-scale supercomputing by providing the performance of up to eight CPUs with an IOS and optional SSD all in the same cabinet. By offering the performance capability of previous CRAY Y-MP8 systems at a significantly lower price, the CRAY Y-MP8I system gives you more computing for your money. This outstanding price/performance ratio makes high-end supercomputing available to a broader range of users.

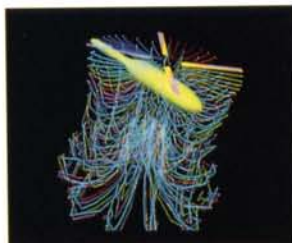
The CRAY Y-MP8I offers powerful supercomputing capabilities with up to 128 Mwords of central memory. The CRAY Y-MP8I system requires less floor space, less support equipment, and costs less to operate and maintain than previous CRAY Y-MP8 models. Its cost-effectiveness is further enhanced with support for lower cost/Mbyte DD-60 and DD-61 disk drives.

The CRAY Y-MP8I integrated I/O Subsystem provides improved performance and reliability. The IOS includes up to four I/O clusters (IOCs), which allow more data to be accessed at faster rates than with previous CRAY Y-MP8 systems. Each IOC supports up to 16 channel adapters for connection to disk storage units, tape units, and communications products.

The CRAY Y-MP8I system can be configured with an optional integrated SSD. The SSD provides very-high-speed secondary memory of 256 or 512 Mwords at a lower cost

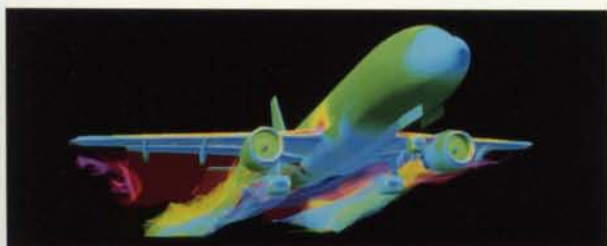


*Helicopter in hover. Image shows pressure distribution on the surface and wake roll-up underneath a helicopter in hover.*



*Jet engine turbofan.*





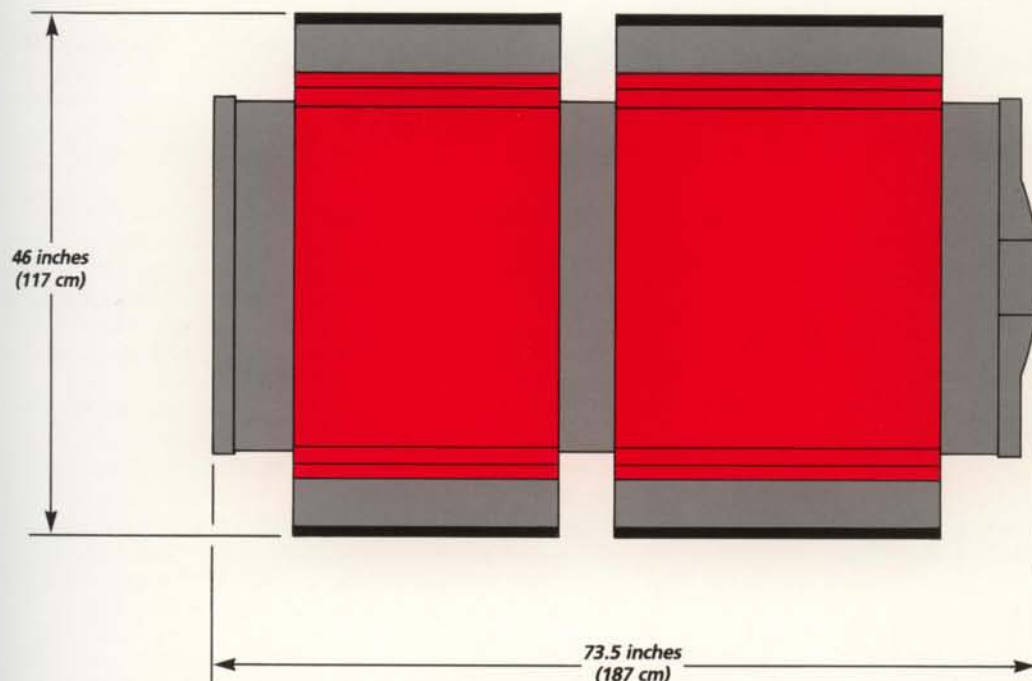
*Airliner in ground effect. Image shows surface pressure distribution and wakes behind the aircraft.*

per Mword. This large storage capacity allows you to address larger problems that require extensive I/O and out-of-memory solution techniques.

The CRAY Y-MP8I computer system offers excellent practical upgradability, allowing it to grow with your needs. The standard CRAY Y-MP8I system includes four CPUs, 64 Mwords of central memory, and one IOC. Upgrade

options include additional central processing units, IOCs, central memory, and an SSD.

The rectangular CRAY Y-MP8I cabinet contains the CPU, memory, IOS, and optional SSD modules as well as power supplies, power distribution unit, and coolant hoses. The cabinet measures 46 inches wide by 73.5 inches deep by 76.25 inches high (117 cm x 187 cm x 194 cm).



#### CRAY Y-MP8I system configurations

| Model            | CPUs | Central memory (Mwords) | IOCs | Optional SSD (Mwords) |
|------------------|------|-------------------------|------|-----------------------|
| CRAY Y-MP8I/464  | 4    | 64                      | 1-4  | 256 or 512            |
| CRAY Y-MP8I/4128 | 4    | 128                     | 1-4  | 256 or 512            |
| CRAY Y-MP8I/864  | 8    | 64                      | 1-4  | 256 or 512            |
| CRAY Y-MP8I/8128 | 8    | 128                     | 1-4  | 256 or 512            |



# New technologies

## I/O subsystem

The CRAY Y-MP8 models use the all new I/O Subsystem (IOS) that provides improved performance, versatility, and reliability. The IOS is an integral part of the CRAY Y-MP8 design, acting as the mainframe's data distribution point. The IOS allows the central memory of the CRAY Y-MP8 system to communicate at high speeds with networks and peripherals such as disk drives.

To increase the CRAY Y-MP8 production workload capacity, the new I/O technology offers increased I/O bandwidth. This increased bandwidth allows you to connect to more peripheral devices and perform more simultaneous activities. The IOS consists of up to 4 (CRAY Y-MP8I system) or 8 (CRAY Y-MP8E system) I/O clusters, each with up to 16 channel adapters.

### IOS highlights

- ☐ Up to 4 (CRAY Y-MP8I) or 8 (CRAY Y-MP8E) 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 and 6 Mbyte/sec internal channels
- ☐ Support for the ANSI standard HIPPI channel

### SSD highlights

- ☐ Up to 512 Mwords (CRAY Y-MP8I) or 2 Gwords (CRAY Y-MP8E) capacity
- ☐ Reliable VLSI technology
- ☐ Up to four 1000 Mbyte/sec channels to mainframe
- ☐ SECDED memory protection
- ☐ Up to four (CRAY Y-MP8I) or eight (CRAY Y-MP8E) 200 Mbyte/sec channels to IOS

The CRAY Y-MP8 systems support the following internal channel types to provide improved I/O bandwidth:

- ☐ 200 Mbyte/sec, full-duplex channels, which transfer data between central memory and the IOS or between the IOS and an optional SSD
- ☐ 6 Mbyte/sec channels, which pass control information between central memory and the IOS

The new I/O technology provides customers with a flexible framework that can grow with their I/O and peripheral needs. The standard configuration of the CRAY Y-MP8 models includes one I/O cluster with eight channel adapters. Additional I/O clusters and channel adapters can easily be configured in the field.

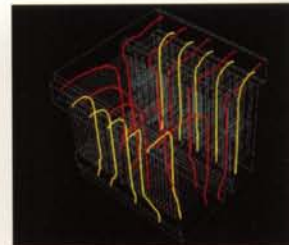
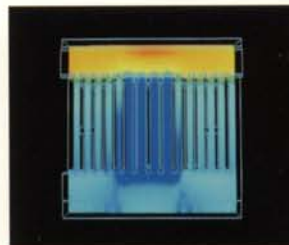
## SSD Solid-state Storage Device

The CRAY Y-MP8 models offer all new SSD technology that provides reliable storage capacity at a lower cost per Mword. Using VLSI chips and increased system integration, the SSD is available with up to 512 Mwords (CRAY Y-MP8I) or 2 Gigawords (CRAY Y-MP8E). These large storage capacities allow you to solve larger problems.

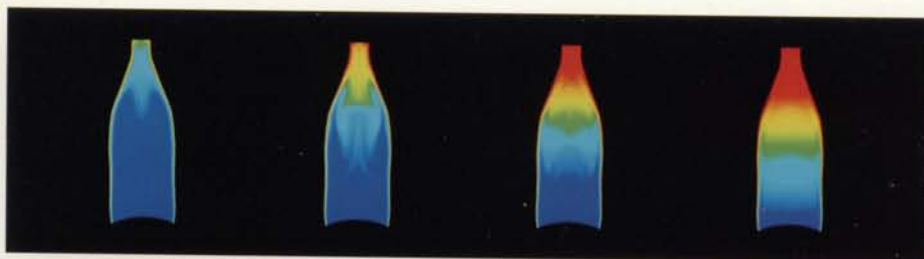
The optional SSD is a very fast random-access device used for large prestaged or intermediate files that are generated and manipulated repeatedly by user programs. The SSD also can be used for swapping programs and for holding commonly accessed libraries and other frequently accessed programs, thereby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

*Right, injection molding of a VT131 keyboard insert.*

*Far right, airflow through a computer cabinet.*







*Beer pasteurization. Images show fluid temperature pattern as cold beer is heated by hot water on the outside of the bottle.*

The CRAY Y-MP8 systems communicate with the SSD through up to four 1000 Mbyte/sec channels, which provide a maximum aggregate transfer rate of up to 4000 Mbytes/sec. The SSD is connected to the IOS through up to eight 200 Mbyte/sec channels (CRAY Y-MP8E system). 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 provide large storage capacities in a small space. The CRAY Y-MP8 models support 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-MP8 models. With the capability to support over a terabyte of disk storage, the CRAY Y-MP8E gives you high-speed access to over six times more data than was possible with previous CRAY Y-MP8 systems.

The DD-60 provides you 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 Mbytes/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 (maximum of 200 Mbytes/sec in each direction). Up to eight DD-60 disk drives can be connected serially to each DCA-2 channel adapter in the IOS.

The DD-61 disk drive delivers large storage capacities at a low cost. The DD-61 provides you with access to large amounts of data using highly reliable, 8-inch disk technology that gives 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 serially to each DCA-2 channel adapter in the integrated CRAY Y-MP8 I/O Subsystem.



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



# Software



## Performance-oriented, feature-rich software

Because hardware performance depends heavily on software performance, Cray Research emphasizes performance-oriented, feature-rich software products that enhance the hardware capabilities of the CRAY Y-MP8 models. Cray Research provides the most complete body of system software available on any supercomputer system. In addition, Cray Research systems are unsurpassed in their ability to connect to computer hardware from other vendors.

As part of a total system solution, Cray Research software enables you to focus on your work, not the system's requirements. This approach is evident in the UNICOS operating system and in the CF77 compiling system, the industry-leading autovectorizing and Autotasking compiler with the world's highest performance Fortran development environment.

## UNICOS operating system

The CRAY Y-MP8 computer systems run UNICOS, 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 performance, functionality, portability, and connectivity.

Together with the powerful CRAY Y-MP8 computing engine, UNICOS is optimized to deliver very high performance on your production workloads. This performance not only gives you quick turnarounds on individual jobs, but also incredibly fast 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, multiprocessing support, ANSI/IBM tape support, resource control, sophisticated job scheduling, and batch processing.

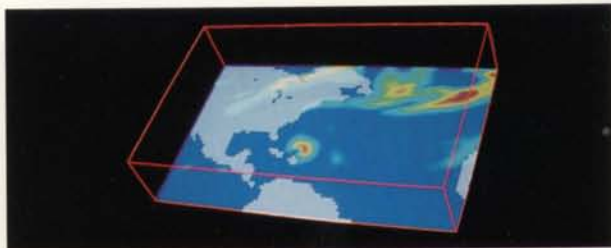
## Compilers

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.

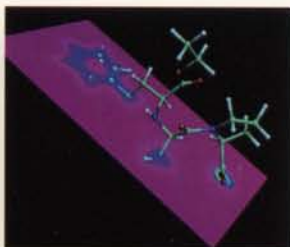
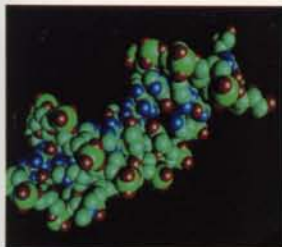


Left, blood flow in a blood vessel bifurcation flow field.

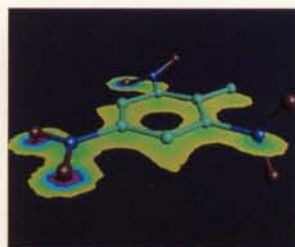
Right, wind speeds of Hurricane Hugo. Image shows high (red) and low (blue) wind speeds two days before landfall in South Carolina.







*Three-dimensional molecular models created with the UniChem computational chemistry environment.*



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 the ANSI standard 3.9-1978. The flexibility of CF77 allows it to accept many nonstandard constructs written for other vendors' compilers.

The CF77 compiling system compiles Fortran77 programs into executable code modules that take full advantage of the CRAY Y-MP8 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-MP8 system.

Because supercomputing applications written in the C language are becoming increasingly popular, Cray Research offers a high performance C compiler. The Cray Standard C compiler 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-MP8 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 CRAY Y-MP8 systems. The Autotasking feature divides a program into discrete tasks that can be performed concurrently on up to eight processors on the CRAY Y-MP8 systems. In addition, the Autotasking features include a convenient, powerful set of directives that allow a programmer to fine-tune the code for even better performance.

### **Applications**

Cray Research supports leading-edge applications for nearly every scientific and engineering discipline including over 600 third-party application programs. Applications are available for industries such as aerospace, automotive, chemistry,

electronics, energy, and petroleum. These applications are used by diverse industries to accelerate product development, increase productivity, and solve basic research problems.

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 visualization package for use in a distributed environment between workstations and Cray Research computer systems. The MPGS system enables engineers to visualize the results from many applications including computational fluid dynamics, structural analysis, electromagnetics, thermodynamics, and petroleum engineering.

The MPGS system is the first advanced-graphics visualization tool that uses distributed processing to support supercomputer applications. Memory and CPU-intensive tasks are processed on the Cray Research system, while the user interface and local graphics manipulations are processed on the graphics workstation. This workload distribution ensures the efficient use of both computer systems.

UniChem is an easy-to-use supercomputing environment for computational chemistry simulation. UniChem software links the power and networking capabilities of Cray Research supercomputers with the convenience and visualization capabilities of workstations. It enables researchers to explore complex chemical systems at a new level of detail from their desktops.

UniChem provides a single, interactive interface for a variety of powerful quantum mechanics programs. With UniChem, researchers can easily apply advanced theoretical methods to understand complex molecular systems such as drug molecules, proteins, agrochemicals, polymers, catalysts, and advanced materials.



# Network supercomputing

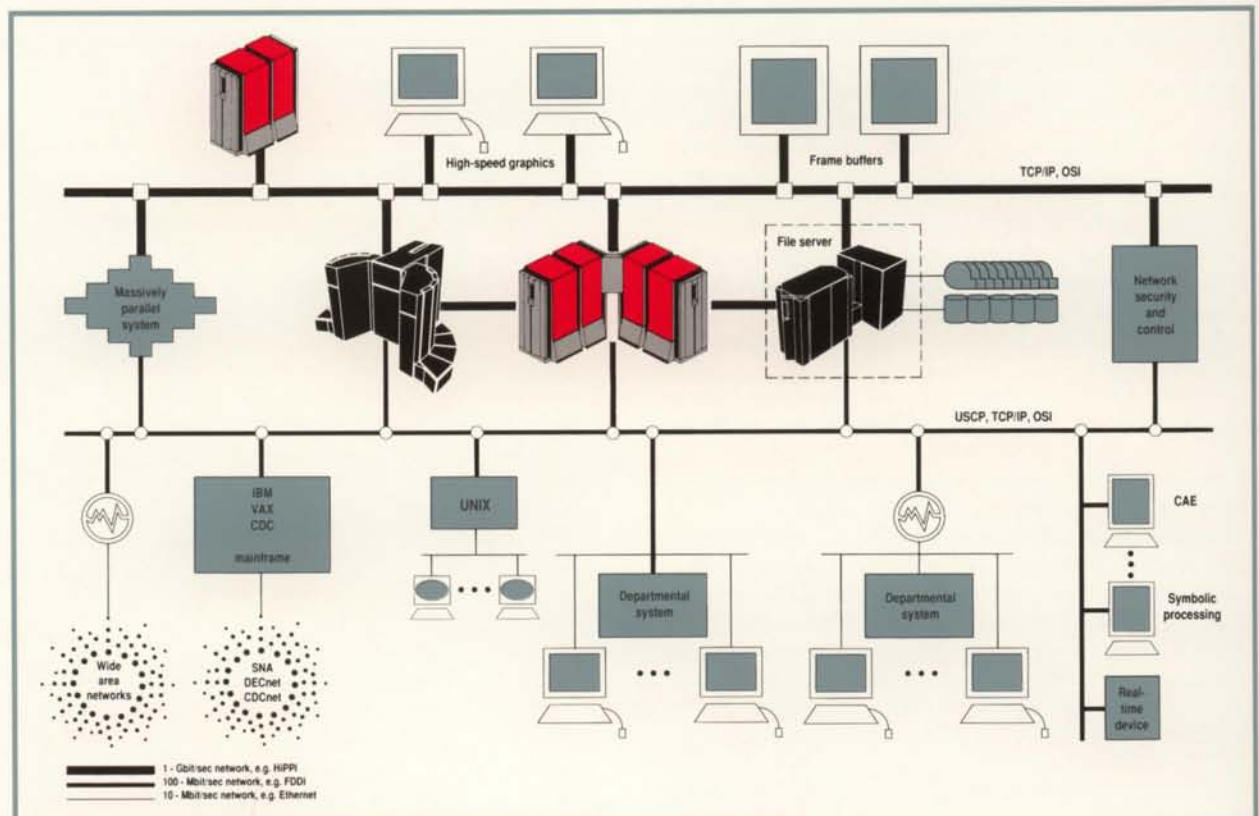
## Delivering supercomputing power to your desktop

Cray Research is dedicated to making supercomputing more accessible through Network Supercomputing. Because Cray Research supercomputers adhere to industry standards and support a variety of proprietary interfaces from other vendors, they can easily be integrated into heterogeneous computing environments.

The many communication products and protocols supported by Cray Research allow applications to be distributed

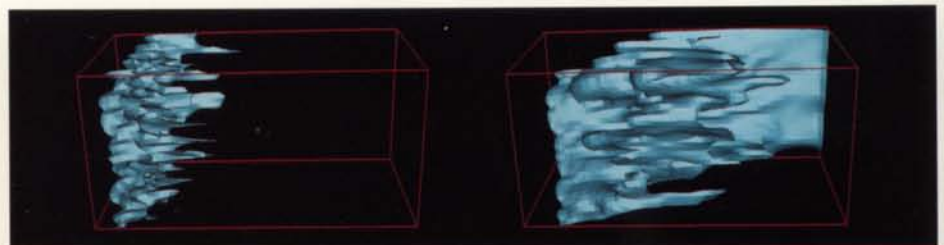
within your network. Thus, other systems on your network may perform data handling, graphic display, and other functions, while the CRAY Y-MP8 systems handle what they do best: large simulations that enable researchers to solve problems that formerly were impractical or impossible to solve.

Through the implementation of networking standards, Cray Research provides connectivity to virtually all UNIX-based mainframes, minicomputers, and workstations. These standards include the TCP/IP networking protocol and applications, the X Window System, the Network File



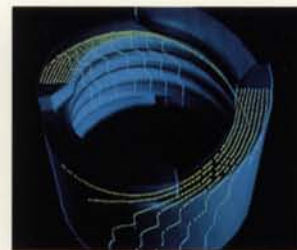
*CRAY Y-MP8 systems integrated into a heterogeneous networking environment.*

*Iso-surfaces of carbon dioxide in petroleum.*





*Left, automotive airbag simulation. Image shows the effects of wrinkling, creasing, and tearing due to overinflation.*



*Right, polymer flow through a spiral mandrel die.*

System, the Open Systems Interconnection (OSI) of the International Standards Organization (ISO), and 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. Station software runs on a variety of systems and workstations to provide the logical connection to a CRAY Y-MP computer system. Standard Cray Research 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 your productivity with a distributed processing environment that provides optimal workload distribution. The result is a combination of flexibility and computing power unparalleled in the computer industry.

## CRAY Y-MP8 model highlights

### Hardware

- ☐ Up to eight 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
- ☐ SECCED memory protection
- ☐ 32-bit addressing capability
- ☐ Large, fast central memories
- ☐ Available SSD

### Software

- ☐ UNICOS, based on the UNIX System V operating system
- ☐ Enhancements to UNICOS for large-scale scientific computer environments
- ☐ A vectorizing and autotasking Fortran compiler
- ☐ An optimized Fortran mathematical and I/O subroutine library
- ☐ A scientific subroutine library optimized for the CRAY Y-MP system
- ☐ A multitasking library
- ☐ A wide variety of system utilities
- ☐ A vectorizing C compiler
- ☐ A vectorizing ISO Level 1 Pascal compiler
- ☐ CAL, the Cray macro assembler
- ☐ Software for connecting to multi-vendor environments
- ☐ A wide variety of applications



# Support

## **Support and maintenance**

Cray Research has developed a comprehensive array of flexible service options to meet your needs. From pre-installation site planning through the life of the system, ongoing hardware and software support is part of the service commitment Cray Research makes to every customer. Cray Research also provides comprehensive user documentation for both hardware and software products. Technical software training is available at your site or at Cray Research training facilities.

Cray Research has over a decade of experience serving supercomputer customers. With ongoing hardware and software support from trained specialists, new remote support capabilities extend the expertise of a worldwide technical network to every customer.

## **Maximized system availability**

The new CRAY Y-MP8 models 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-MP computer system undergoes rigorous operational and reliability tests.

To assure high system availability, Cray Research has developed the most advanced system support tools in the industry. Support tools run under a new online System Maintenance and Remote Test Environment (SMARTE) that provides continuous error detection and isolation. SMARTE schedules all diagnostic activity, automatically reports errors, and provides a common X Window System interface to all online diagnostics and concurrent maintenance tools.

## **The CRAY Y-MP8 supercomputers**

The CRAY Y-MP8 systems are part of a total supercomputing solution that bridges the gap between inspiration and innovation. For more information on the CRAY Y-MP8E and CRAY Y-MP8I supercomputer systems, contact your nearest Cray Research representative.



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Automobile side impact image courtesy of Ford Motor Company, United Kingdom; Cefiro automobile image courtesy of Dr. Ryutaro Himeno, Nissan Motor Co., Ltd.; helicopter and airliner images courtesy of Frank Dvorak, Brian Maskew, and David Clark, Analytic Methods, Inc.; aircraft fanblade image courtesy of Rolls Royce plc.; beer pasteurization image courtesy of Dr. Michael Engelman, Fluid Dynamics International; blood vessel image courtesy of Dr. Klement Leinstreuer, North Carolina State University; hurricane image courtesy of Anders Grimsrud and Tony Meys, Cray Research, Inc., and the European Center for Medium Range Weather Forecasts; computer cabinet and injection molding images courtesy of Kent Misegades, Cray Research, Inc.; UniChem images courtesy of Erich Wimmer, Cray Research, Inc.; petroleum image courtesy of Gene Shiles, Cray Research, Inc., and British Petroleum; airbag images courtesy of Mike Long, Cray Research, Inc., and John Hallquist and Doug Stillman of Lawrence Livermore Software Technologies; spiral mandrel die image courtesy of Dr. Dennis Coyle, General Electric R&D.

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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.