With the world's largest central
memory at your fingertips,
you can redefine the boundaries
of science and technology.

The CRAY Y-MP M90 supercomputer series

The CRAY Y-MP M90 series – large memories deliver new capabilities

With up to 32 Gbytes of central memory, the CRAY Y-MP M90 systems are designed to solve some of the world's largest computational problems. As a complement to the fast memory CRAY Y-MP systems, the large memory CRAY Y-MP M90 series provides a high-performance alternative where solution time is constrained by memory capacity.

The CRAY Y-MP M90 series memory capacity minimizes the need for out-of-memory solutions for large problems. Multiple large problems can utilize the very large real memory, providing superior performance.

To maximize user productivity, all Cray Research supercomputers feature a powerful software application support environment. As part of a total system solution, the application support environment includes UNICOS, the world's first and highest-performance UNIX-based supercomputer operating system, as well as a set of powerful compilers, development tools, libraries, and data storage systems.

The large memories of the CRAY Y-MP M90 systems and the proven production functionality of UNICOS work in tandem to provide the following unique problem-solving capabilities:

■ Solve problems that cannot be solved on other systems. *The large central memories of the CRAY Y-MP M90 series allow you to run large jobs that are not practical to run on smaller memory systems. For example, you can run multiple copies of MSC/NASTRAN jobs of 1 Gbyte or more in a production setting.*

■ Streamline innovation. *Large memories allow scientists to use new algorithms that can provide significant speed-ups over out-of-memory solutions. For example, when using the quantum chemistry code GAUSSIAN to optimize molecular structures, these new algorithms deliver two to three times faster throughput – allowing you to reach an optimized structure in less time.*

■ Integrate problem pieces into total solutions. *Large memories remove the burden on the user to break models into pieces or "super-elements." For example, when modeling an automobile body with a small memory system, you might have to model the fenders and other body panels individually and then tie those pieces together after each of them has been run independently. With a large memory solver, you can run problems of this size as one piece or many models concurrently.*

■ Increase productivity. *By minimizing the need to swap out jobs to disk storage, the large memories of the CRAY Y-MP M90 system series handle multi-user interactive workloads more efficiently.*

The CRAY Y-MP M90 series of supercomputers

When you set out to solve the world's largest scientific and engineering problems, you want to focus on the task at hand – not the constraints of your computational tools. Now, with the introduction of the CRAY Y-MP M90 supercomputer series, you can solve more challenging computational problems with greater ease than ever before.

The CRAY Y-MP M90 systems combine unmatched problem-solving capabilities with supercomputing processing speeds, powerful UNICOS system software, and the largest central memories ever offered in the industry. With up to 32 Gbytes (4 Gwords) of central memory, the CRAY Y-MP M90 systems offer up to 125 times more memory capacity than the original CRAY Y-MP system.

Increased user productivity doesn't stop with the advantages of large memory; UNICOS eliminates barriers between you and the problems you need to solve. With powerful networking software and compliance to the POSIX 1003.1 standard, UNICOS ensures that your Cray Research system can be easily integrated into heterogeneous computing environments.

A new branch of the CRAY Y-MP capabilities

With up to eight CPUs, the CRAY Y-MP M90 series is a cost-effective solution for users with memory-constrained workloads. By leveraging the strengths of the proven UNICOS system software, these large memories offer the following advantages:

☐ *Superior performance on large jobs.* Cray Research has optimized a number of key third-party applications to take advantage of the large memories of the CRAY Y-MP M90 series of systems. Because the CRAY Y-MP M90 systems can run large jobs in memory, they minimize solution time for large problems.

☐ *Improved performance on large interactive workloads.* Because the CRAY Y-MP M90 systems have the world's largest central memories, they offer a superior solution for large interactive workloads. The CRAY Y-MP M90 systems provide optimal performance, increased job size capacity, and the ability to support large numbers of interactive jobs.

☐ *Improved I/O performance through central memory disk data cache (ldcache).* By using a portion of the CRAY Y-MP M90 central memory as a disk data cache, you can dramatically improve performance on I/O-intensive workloads.

☐ *Ease of programming.* Without the need to write out-of-memory solvers, you can easily program the CRAY Y-MP M90 systems to perform multiple iterations on large jobs in a production or research setting.

☐ *High memory bandwidth.* With four memory ports per CPU, the CRAY Y-MP M90 series of systems features up to 17.1 Gbytes/sec of memory bandwidth.

☐ *Easy access to all areas of memory.* Unlike the distributed memories and global cache memories used in some systems, any portion of the central memory of the CRAY Y-MP M90 systems can be accessed easily and immediately by any processor. As a result, the central memories of the CRAY Y-MP M90 systems run at full speed on operations like global gather, while distributed and global cache memories experience severe performance degradation.

☐ *Remove the need for an SSD solid-state storage device.* With large memories, the need for secondary storage often can be eliminated. However, an optional SSD is also offered for those who wish to use it for I/O cache or job swapping.

A full range of large memory systems

The CRAY Y-MP M90 series consists of three models. As the most powerful member of the series, the CRAY Y-MP M98 system is available with four to eight CPUs and up to 32 Gbytes (4 Gwords) of central memory. In a single cabinet, the CRAY Y-MP M94 system offers up to four CPUs and 16 Gbytes (2 Gwords) of central memory. With outstanding price/performance at a low cost of ownership, the CRAY Y-MP M92 integrates up to two CPUs and 8 Gbytes (1 Gword) of central memory in a single chassis.

CRAY Y-MP M90 configurations

Model	CPUs	Central memory size (Gbytes)	I/O clusters	Optional SSD size (Gbytes)
CRAY Y-MP M92	1 or 2	1, 2, or 8	1 - 2	4
CRAY Y-MP M94	2 - 4	4 or 16	1 - 4	4
CRAY Y-MP M98	4 - 8	8 or 32	1 - 8	16, 32, or 64

The world's largest central memory capacity – the CRAY Y-MP M98 supercomputer
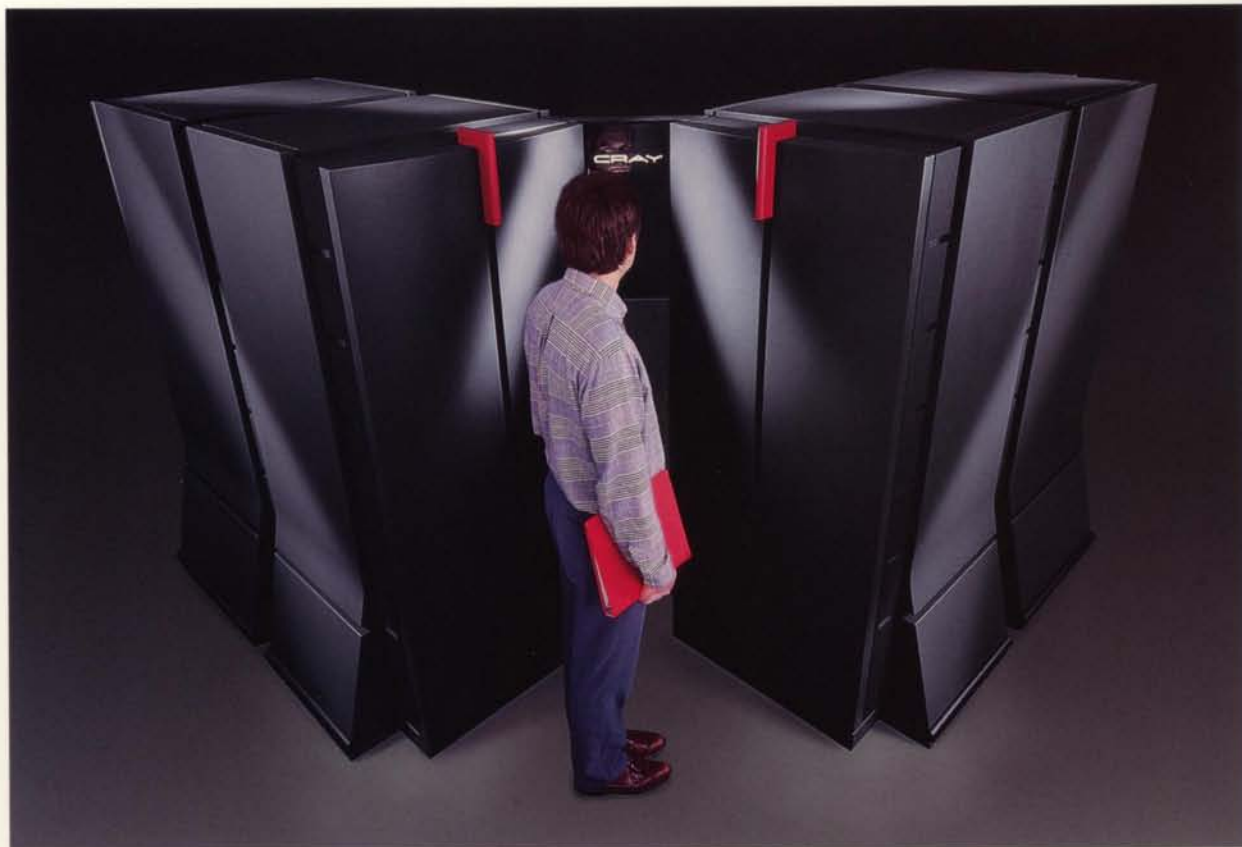
The CRAY Y-MP M98 system is the most powerful member of the CRAY Y-MP M90 series. With up to eight CPUs, the CRAY Y-MP M98 system offers the largest central memory and secondary storage capacity available on any computer system.

The CRAY Y-MP M98 system offers an unprecedented level of computing power, memory capacity, and throughput. By combining its proven, balanced architecture with the latest 4 Mbit and 16 Mbit DRAM memory technology, the CRAY Y-MP M98 system provides access to up to 32 Gbytes (4 Gwords) of central memory. Individual jobs can be as large as 16 Gbytes.

The CRAY Y-MP M98 system combines exceptional functionality with the proven capabilities of the UNICOS operating system. The CRAY Y-MP M98 system can be used as a highly responsive interactive tool for application developers and as a production throughput engine for the most demanding computational problems.

Powerful I/O capabilities

To provide system balance, efficiency, and high performance, the CRAY Y-MP M98 system uses the proven I/O technology found in other current CRAY Y-MP systems. This technology provides power as well as versatility

Supercomputers are used to simulate physical phenomena that would be difficult or impossible to create experimentally. These simulations provide the necessary insight to reduce design cycles and produce innovations.
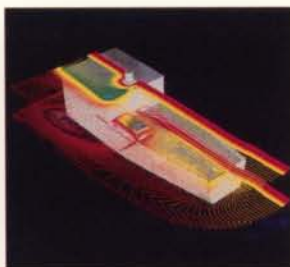
Transient electrical fields at one instant of time corresponding to a prescribed incident wave pulse. The objective is to predict the maximum field intensities on the ship surface for optimum location of sensors.
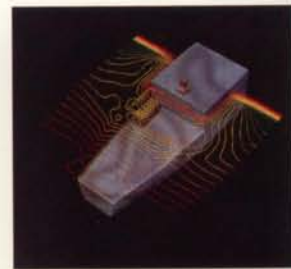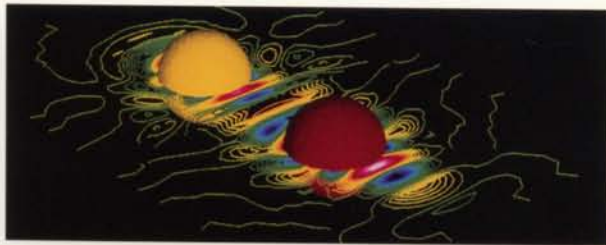
with an aggregate I/O bandwidth of 11.72 Gbytes/sec and one to eight I/O clusters (IOCs). Each IOC supports up to 16 channel adapters for connection to disk storage units, tape units, and communications connections, including HIPPI channels.

The highest secondary storage capacity available

The CRAY Y-MP M98 system offers an optional integrated SSD solid-state storage device. The SSD provides very-high-speed secondary memory of up to 64 Gbytes (8 Gwords) at a lower cost per Gbyte than with previous SSDs. With support for up to four 1250 Mbyte/sec channels to the SSD, the CRAY Y-MP M98 system provides rapid access to this massive storage capacity, which allows you to tackle larger problems.

Configuration options

The CRAY Y-MP M98 computer system is field upgradable. The base CRAY Y-MP M98 configuration includes four CPUs, 8 Gbytes (1 Gword) of central memory, and one IOC with seven channel adapters of your choice. Upgrade options include additional central processing units, IOCs, central memory capacity, and an SSD.

Physical description

The CRAY Y-MP M98 system comprises one or two rectangular cabinets. The mainframe cabinet contains the CPUs, up to two I/O clusters, and the central memory. The second cabinet contains up to six additional I/O clusters and an optional SSD. Each cabinet measures 46 inches wide by 75.5 inches deep by 76.25 inches high (117 cm x 192 cm x 194 cm).

CRAY Y-MP M98 product specifications

CPU

Technology	Custom silicon 6200 gate-array circuits
Number of CPUs	4 - 8
Peak performance	2.67 GFLOPS
Memory ports	4 ports per CPU

Memory

Technology	60-ns, 4-Mbit, or 16-Mbit DRAM
Memory banks	256
Memory size	8 or 32 Gbytes (1 or 4 Gwords)
Total memory bandwidth	17.1 Gbytes/sec

I/O

Number of I/O clusters	1 - 8
Total system I/O bandwidth	11.72 Gbytes/sec
HIPPI channels	100 or 200 Mbytes/sec
LOSP channels	6 Mbytes/sec
HISP channels	200 Mbytes/sec
VHISP channels	1250 Mbytes/sec

Optional SSD

Capacity	16, 32, or 64 Gbytes
Bandwidth	1.25 or 5 Gbytes/sec

Physical characteristics

Mainframe cabinet footprint area	22 ft^2 (2 m^2)
IOS cabinet footprint area	22 ft^2 (2 m^2)

The CRAY Y-MP M94 – large central memory capacity in a single cabinet

The CRAY Y-MP M94 system is a powerful, general purpose supercomputer with up to four CPUs, a large central memory, and an IOS – all in the same cabinet. With a wide range of configuration options including one to four CPUs, the CRAY Y-MP M94 system offers exceptional computing power, memory capacity, and throughput.

The CRAY Y-MP M94 is compatible with all CRAY Y-MP systems. By combining its proven, balanced architecture with high-density 4 Mbit or 16 Mbit DRAM memory technology, the CRAY Y-MP M94 system provides 4 or 16 Gbytes (512 or 2048 Mwords) of central memory capacity.

The CRAY Y-MP M94 system combines exceptional functionality with the proven capabilities of the UNICOS operating system. The CRAY Y-MP M94 system can be used as a highly responsive interactive tool for application developers and as a production throughput engine for the most demanding computational problems.

Powerful I/O capabilities

To maintain system balance, efficiency, and high performance, the CRAY Y-MP M94 system uses the proven I/O technology found in other current CRAY Y-MP systems. This technology provides power as well as versatility with an aggregate I/O bandwidth of 5.86 Gbytes/sec and one to four I/O clusters (IOCs). Each IOC supports up to 16 channel adapters for connection to disk storage units, tape units, and communications connections including HIPPI channels.
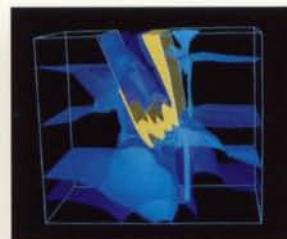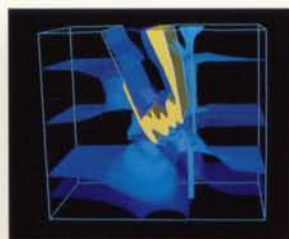
Simulation of gold mine historical mining sequence. Images show how mine safety factors change as ore is removed. The blue vertical shaft represents the mine shaft, while the yellow portion represents the home stake formation gold-bearing body.
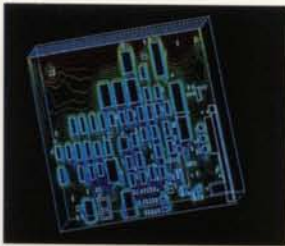
Convection flow past a VT131 logic board as computed by FLUENT. Blue indicates hot areas, while red indicates cool areas.
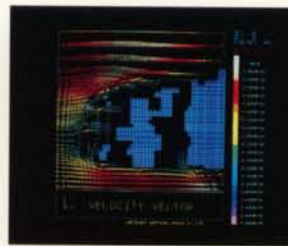
Velocity vectors in Daihatsu subcompact automobile design as calculated using STREAM.

High SSD capacity

The CRAY Y-MP M94 system offers an optional integrated SSD solid-state storage device. The SSD provides very-high-speed secondary memory of up to 4 Gbytes (512 Mwords) at a lower cost per Gbyte than previous SSDs. With support for up to two 1250 Mbyte/sec channels to the SSD, the CRAY Y-MP M94 system provides rapid access to this secondary storage capacity.

Configurations to meet present needs, with room to grow

The CRAY Y-MP M94 computer system offers excellent practical upgradability, allowing it to grow with your needs. The base CRAY Y-MP M94 configuration includes two CPUs, 4 Gbytes (512 Mwords) of central memory, and one IOC with seven channel adapters of your choice. Upgrade options include additional central processing units, IOCs, central memory capacity, and an SSD.

Physical description

The rectangular CRAY Y-MP M94 cabinet contains the CPUs, IOS, central memory, and optional SSD. The cabinet measures 46 inches wide by 75.5 inches deep by 76.25 inches high (117 cm x 192 cm x 194 cm).

CRAY Y-MP M94 product specifications

CPU

Technology	Custom silicon 6200 gate-array circuits
Number of CPUs	2 - 4
Peak performance	1.3 GFLOPS
Memory ports	4 ports per CPU

Memory

Technology	60-ns, 4-Mbit, or 16-Mbit DRAM
Memory banks	128
Memory size	4 or 16 Gbytes (512 or 2048 Mwords)
Total memory bandwidth	8.6 Gbytes/sec

I/O

Number of I/O clusters	1 - 4
Total system I/O bandwidth	5.86 Gbytes/sec
HIPPI channels	100 or 200 Mbytes/sec
LOSP channels	6 Mbytes/sec
HISP channels	200 Mbytes/sec
VHISP channels	1250 Mbytes/sec

Optional SSD

Capacity	4 Gbytes
Bandwidth	1.25 or 2.5 Gbytes/sec

Physical characteristics

Cabinet footprint area	22 ft^2 (2 m^2)

Large memory within reach – the CRAY Y-MP M92 supercomputer

The CRAY Y-MP M92 system offers the advantages of large-scale supercomputers at a cost of ownership that brings it within reach of a broad range of users. With up to two CPUs and as much as 8 Gbytes (1 Gword) of central memory, the CRAY Y-MP M92 system provides a cost-effective solution for users with large memory workloads.

The CRAY Y-MP M92 system combines exceptional functionality with the proven capabilities of the UNICOS operating system. The CRAY Y-MP M92 system can be used as a highly responsive interactive tool for application developers and as a production throughput engine for the most demanding computational problems.

The CRAY Y-MP M92 system offers significant performance and price/performance advantages over traditional mainframe and departmental systems, yet it is as easy to install as these types of systems. The CRAY Y-MP M92 system can be air cooled and does not require a raised floor, special site plumbing, or motor generator set. As a result, it costs less to install, operate, and maintain.

Reducing the cost of large-scale supercomputing

The following features give the CRAY Y-MP M92 system a low cost of ownership:

☐ It can be air cooled and thus does not require any special site plumbing; it requires only an environment with commercial air conditioning capacity. The CRAY Y-MP M92 system can also be cooled by building water.

☐ Its electrical power system uses commercially available power and does not require a motor generator set. The CRAY Y-MP M92 system can be installed nearly anywhere in the world because it runs on any of the following common sources of electrical power: 208 or 480 Vac, 3 phase, 60 Hz, or 380 to 415 Vac, 3 phase, 50 Hz.

☐ It has a limited number of connections, which minimizes the time and cost of installation.

☐ Its high reliability and enhanced maintenance features make low cost, on-call hardware maintenance options possible.
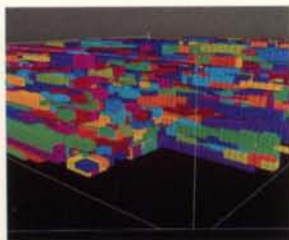
Petroleum reservoir simulation used for recovery profile predictions. Each color represents a particular grouping of sand bodies. Simulations performed with the three-dimensional, compositional simulator VIP-EXECUTIVE.
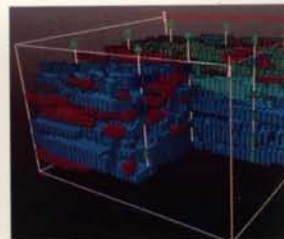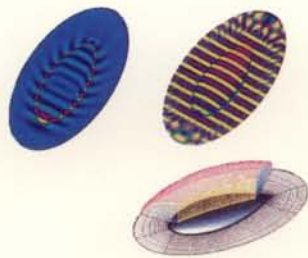
Almond-shaped targets are used as scatterers to predict the Radar cross section (RCS) of low-observable shapes. The figure shows scattered electrical fields (top left) and total electrical fields (top right) at one instant of time. The bottom right figure shows the multizone grid arrangement used for calculation.

Powerful I/O capabilities

To maintain system balance, efficiency, and high performance, the CRAY Y-MP M92 system uses the proven I/O technology found in other current CRAY Y-MP systems. This technology provides power as well as versatility with an aggregate I/O bandwidth of 2.93 Gbytes/sec and one or two I/O clusters (IOCs). Each IOC supports up to 16 channel adapters for connection to disk storage units, tape units, and communications connections including HIPPI channels.

Large SSD capacity

The CRAY Y-MP M92 system offers an optional integrated SSD solid-state storage device. The SSD provides very-high-speed secondary memory of up to 4 Gbytes (512 Mwords) at a lower cost per Gbyte than with previous SSDs. With support for a 1250 Mbyte/sec channel to the SSD, the CRAY Y-MP M92 system provides rapid access to this storage capacity, which allows you to tackle larger problems.

Configuration options

The CRAY Y-MP M92 computer system is field upgradable. The base CRAY Y-MP M92 configuration includes one CPU, 1 Gbyte (128 Mwords) of central memory, and one IOC with seven channel adapters of your choice. Upgrade options include an additional central processing unit, an IOC, increased central memory capacity, and an optional SSD.

Physical description

The CRAY Y-MP M92 system comprises one or two rectangular cabinets. The mainframe cabinet contains the CPUs, IOCs, and central memory. The second cabinet contains the optional SSD. Each cabinet measures 32 inches wide by 65 inches deep by 78 inches high (81 cm x 165 cm x 198 cm). Each cabinet is attached to a cooling unit that measures 60 inches wide by 32 inches deep by 72 inches high (152 cm x 81 cm x 183 cm).

CRAY Y-MP M92 product specifications

CPU

Technology	Custom silicon 6200 gate-array circuits
Number of CPUs	1 - 2
Peak performance	667 MFLOPS
Memory ports	4 ports per CPU

Memory

Technology	60 ns, 4-Mbit or 16-Mbit DRAM
Memory banks	64
Memory size	1, 2, or 8 Gbytes (128, 256 or 1024 Mwords)
Total memory bandwidth	4.3 Gbytes/sec

I/O

Number of I/O clusters	1 - 2
Total system I/O bandwidth	2.93 Gbytes/sec
HIPPI channels	100 or 200 Mbytes/sec
LOSP channels	6 Mbytes/sec
HISP channels	200 Mbytes/sec
VHISP channels	1250 Mbytes/sec

Optional SSD

Capacity	4 Gbytes
Bandwidth	1.25 Gbytes/sec

Physical characteristics

Mainframe or SSD cabinet footprint area	13 ft^2 (1.2 m^2)
Cooling unit footprint area	13 ft^2 (1.2 m^2)

Cooling

	Air or water cooled

Performance-oriented, feature-rich software

UNICOS operating system

The UNICOS operating system is the most powerful and feature-rich UNIX-based operating system available to supercomputer users. UNICOS is an interactive and batch operating system that offers a number of advantages including high performance, resiliency, full production functionality, POSIX 1003.1 compliance, and easy integration into heterogeneous computing environments.

UNICOS delivers very high performance and high reliability on production workloads. Together with the powerful CRAY Y-MP M90 supercomputer series hardware and Autotasking capabilities, 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, tunable accounting, multi-level security, and batch processing.

To help programmers build applications in less time, UNICOS includes a powerful application development tool set. Visual and line-oriented tools automatically analyze codes for programming and performance problems, offer expert advice for making improvements, and provide graphics to speed assimilation and manipulation of this information.

Compilers

Cray Research offers the most powerful compilers in the industry, including the CF77 Fortran compiling system, the Cray Standard C Compiler, C++, Cray Ada, and Pascal. The CF77 compiling system was the first Fortran compiler in the industry with support for automatic parallel processing, automatic vectorization, and scalar optimization. These compiling features do not require code modification by the user, and full optimization is on by default – a capability unique in the industry.

The CF77 compiling system ensures portability with ANSI Fortran77 compliance. The flexibility of CF77 allows it to accept many Fortran90 constructs as well as nonstandard constructs written for compilers from other vendors.

The CF77 compiling system compiles Fortran77 programs into executable code modules that take full advantage of the CRAY Y-MP M90 vector capabilities, while its Autotasking software automatically exploits the performance potential of parallel processing. For those codes that are not highly vectorizable, CF77 ensures the best possible execution time by providing maximized scalar optimization for the CRAY Y-MP M90 systems.

UNICOS highlights

Full production functionality
- Batch and interactive processing
- High-speed tape support
- Resource management
- Extensive accounting features
- Checkpoint/restart
- Networking
- Online system diagnostics
- IEEE data format support
- Automatic data conversion
- Multi-level security

High performance
- Multiprocessing compilers
- Efficient, asynchronous I/O
- Striped disks
- File system extensions

User productivity
- Industry standard interfaces
- Compatibility across entire CRAY Y-MP product line
- Advanced program development tools
- Performance analysis tools with expert system capabilities

Storage management
- Data Migration Facility (DMF)
- Cray REELlibrarian
- Production quality tape service
- STK 4400 Automated Cartridge System support

F-18 aircraft flowfield. Image shows pressure contours and the vortical nature of the flow, as well as traces showing the path of selected fluid particles. Computations required 100 million 64-bit words of memory for the solution at 1.25 million grid points.

Electric field intensity around a military aircraft. The figure shows the variation (red is negative and blue is positive) of the vertical component of the electric field throughout a plane close to a military aircraft. Results obtained by EMMA T2 code. PATRAN has been used for preprocessing and visualization is via AVS.

Laminar, compressible flow over the forebody and strake of an F-18 at a high angle of attack (30°) typical of a high-g maneuver (Mach 0.3). This Navier-Stokes solution was computed using the NASA Langley code CFL3D.

Because supercomputing applications written in C language are becoming increasingly popular, Cray Research offers the highest-performance ANSI Standard C compiler in the industry. 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 Release 3.0 compiler takes full advantage of the CRAY Y-MP M90 system performance capabilities with automatic vectorization, scalar optimization, and Autotasking.

Autotasking

The CF77 compiling system and the Cray Standard C Compiler include Autotasking features that can improve parallel processing performance on CRAY Y-MP systems. The Autotasking software automatically divides a program into discrete tasks that can be performed concurrently on multiple processors in CRAY Y-MP M90 systems. Autotasking also includes a convenient, powerful set of directives that allow programmers to fine-tune their code for maximized performance. Expert systems provide assistance to users who perform this type of fine tuning. In production environments, these directives can be used to improve both individual job performance and overall system throughput.

Applications

Cray Research offers leading-edge applications for nearly every scientific and engineering discipline, including the most widely used third-party application programs. Cray Research has optimized a number of key third-party applications to take advantage of the large memories of the CRAY Y-MP M90 systems. 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, electronics, chemistry, energy, petroleum, and defense.
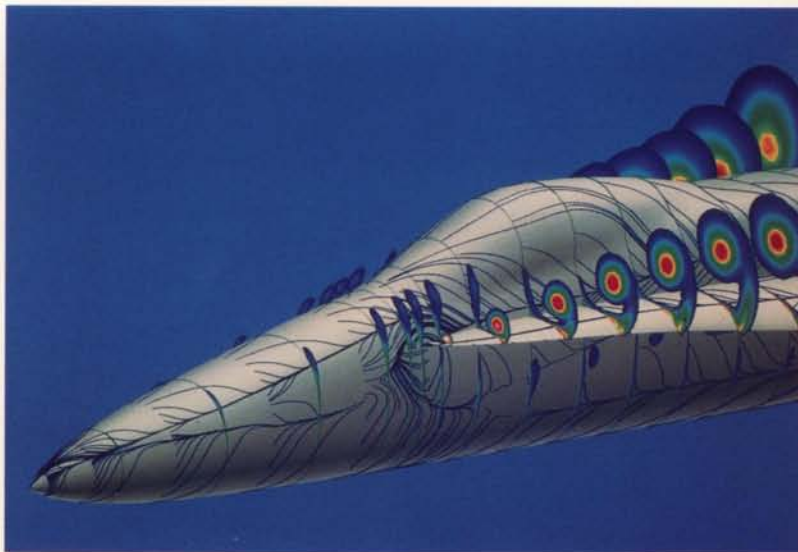
To augment the utility of its supercomputers, Cray Research has developed specialized, key application packages such as:

☐ *UniChem,* Cray Research's 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.

☐ *CRI/*Turbo*Kiva,* a powerful combustion simulation environment that provides a reliable and effective analysis tool for designing cleaner-burning internal combustion engines. CRI/*Turbo*Kiva is an enhanced engineering version of Kiva II, Los Alamos National Laboratory's public domain engine flow, spray, and chemical reaction simulation code.

Visualization

Network supercomputing

The power of visualization

A wide variety of visualization products make Cray Research systems even easier to use and increase user productivity. Distributed visualization capabilities allow scientists and engineers to easily exploit the unparalleled performance of Cray Research supercomputers while taking advantage of the exceptional graphics capabilities offered by workstations. Standard windowing and widget libraries that run on Cray Research systems have the same "look and feel" as the most common workstation environments, making Cray Research systems even easier to use and making you even more productive.

The following types of visualization products are available to enhance the value of Cray Research solutions:

☐ *Standard windowing and widget libraries.* Cray Research supports and endorses the following standard windowing and widget libraries as part of the Cray Visualization Toolkit (CVT):
- Release X11R4 of the X Window System
- Sun Microsystems' XView toolkit (OPEN LOOK)
- Open Software Foundation's (OSF) Motif 1.1 Toolkit
- Silicon Graphics, Inc. Distributed Graphics Library (DGL)
☐ *Visualization applications.* With interactive menu-driven engineering visualization packages like Cray Research's Multipurpose Graphic System (MPGS), you can work with a wide variety of engineering applications. Other third party applications are also available.
☐ *Application building environments.* To build customized visualization applications with minimal programming and maximum ease of use, the following visually based, object-oriented building environments are available for Cray Research systems. These environments allow scientists and engineers with unique visualization requirements to integrate their existing data sets and algorithms for fast, custom viewing and analysis.
- Cray Explorer, available from Cray Research, Inc.
- AVS (Application Visualization System), available on Cray Research platforms from AVS, Inc.
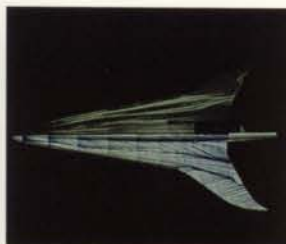
Network supercomputing – delivering the power to your desktop

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 as well as a variety of language extensions, network protocols, and utilities from other vendors, they can be integrated easily into heterogeneous computing environments.

An array of communication products and protocols supported by Cray Research allows applications to be distributed within your network. Through the implementation of official, emerging, and de facto networking standards, Cray Research provides connectivity 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 High Performance Parallel Interface (HIPPI), and the Fiber Distributed Data Interface (FDDI), as well as other networking standards.

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

Network supercomputing increases user productivity by allowing access to a wide range of computing platforms for optimal workload distribution. The result is a combination of flexibility and computing power unparalleled in the computer industry.

Airflow over a High Speed Civil Transport model calculated using TLNS3D, a central difference, finite volume, Navier-Stokes code. The computed flow pattern shows the correct shape and growth of the primary and secondary vortices and is found to be in agreement with the experimental data.

High Speed Civil Transport surface flow visualization calculated with TLNS3D (top) compared with experimental oil flow (bottom).

Radar cross section (RCS) of a military aircraft. Red indicates regions of high RCS and blue indicates low RCS. Calculations performed using a frequency domain code with an out-of-core solver from the EMMA software suite. PATRAN has been used for preprocessing and visualization is via MPGS.

Disk drives

Cray Research offers high performance, reliable mass storage devices that provide large storage capacities in a small physical space. The high performance I/O subsystem capabilities allow multiple high performance disk drives to be accessed simultaneously. Each I/O cluster has the capability to support over 250 Gbytes of disk storage, providing the CRAY Y-MP M90 systems with high-speed access to several times more online data than was possible with the original CRAY Y-MP Model D system.

The CRAY Y-MP M90 systems support current Cray Research disk storage devices including the following disk drives:

☐ *The DD-60 disk drive* is a 24-Mbyte/sec disk drive with a sustained transfer rate of 20 Mbytes/sec and a capacity of 1.96 Gbytes. Up to eight DD-60 disk drives can be connected to each disk channel adapter in the IOS. Each I/O cluster configured with 16 DD-60 disk drives can deliver performance of up to 320 Mbytes/sec (up to 200 Mbytes/sec in each direction). Disk striping provides single file transfer rates of several times the rate of individual disk drives.

☐ *The DS-42 disk subsystem* is a mass storage system that delivers reliable, cost-effective high-speed disk storage for CRAY Y-MP M90, CRAY Y-MP C90, CRAY Y-MP, CRAY X-MP, and CRAY-2 computer systems. With a storage capacity of 38.92 Gbytes and a sustained transfer rate of 9.6 Mbytes/sec for each of four data paths, the DS-42 disk subsystem provides high-speed access to vast amounts of data using new, high-reliability 8-inch disk technology.

For more information on other disk drives supported by the CRAY Y-MP M90 systems, contact your Cray Research representative.
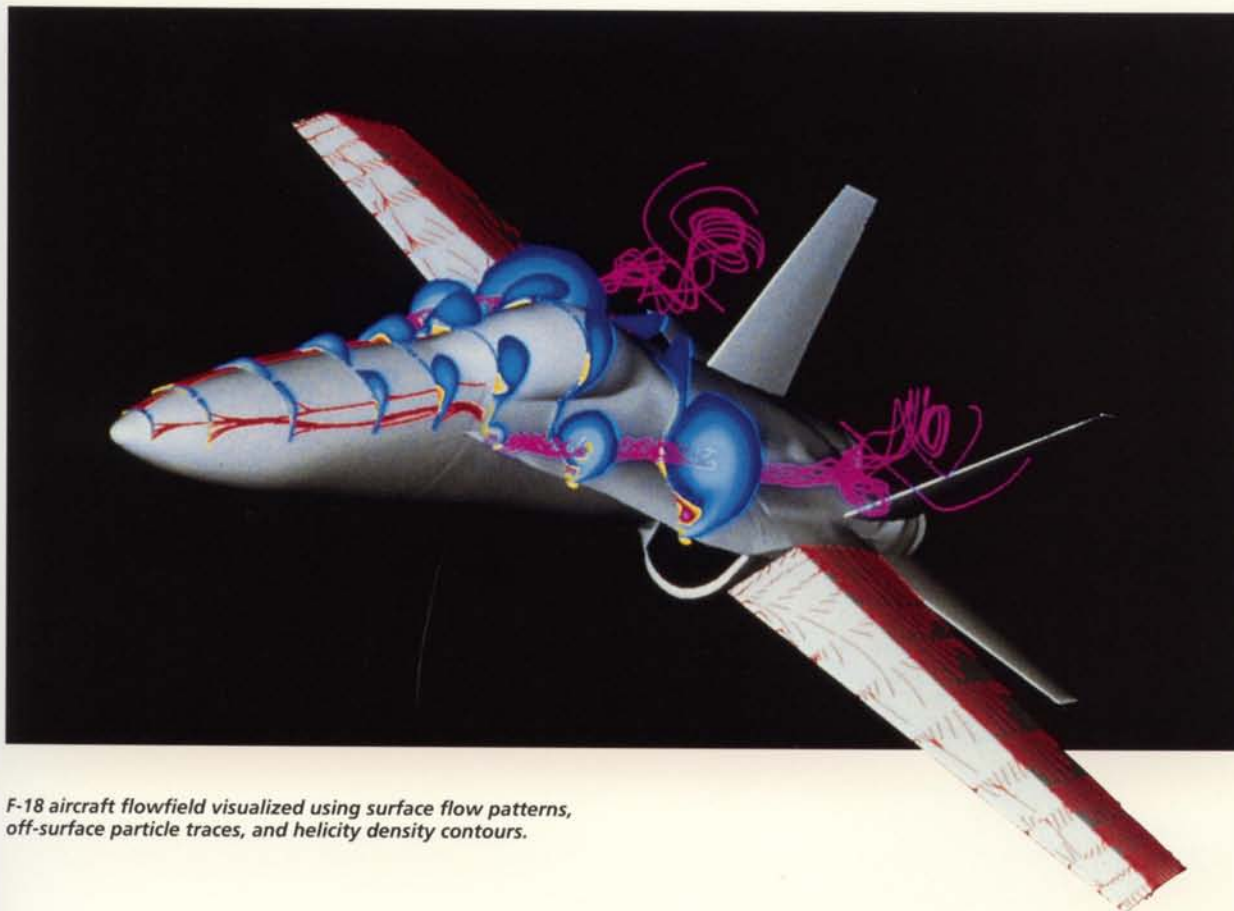
F-18 aircraft flowfield visualized using surface flow patterns, off-surface particle traces, and helicity density contours.

Maximized system availability

The new CRAY Y-MP M90 systems provide high system reliability while maintaining high performance. 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.

Cray Research service – fulfilling customer expectations

Cray Research has over two decades of experience serving supercomputer customers. To ensure that we fulfill customer expectations, we have developed the following comprehensive array of services to meet your needs:

☐ *Site planning*. Cray Research site planning experts work with you to prepare your facility for your Cray Research computer system and ensure that your installation goes smoothly.
☐ *Local support*. Wherever your system is installed in the world, Cray Research offers flexible, local support offerings tailored to your service needs. To expedite service, Cray Research has highly qualified technical people available in more than 20 countries.
☐ *Support centers*. Through the life of your system, ongoing hardware and software support is part of the service commitment Cray Research makes to every customer. Cray Research has established regional support centers to provide technical support to customers. Support center staff provide a broad range of services:
   - Help users to obtain, install, and use Cray Research software, including user-level, operating-system, and networking products.
   - Dispatch requests for hardware assistance.
   - Answer general questions about Cray Research services and products.
   - Provide solutions to software problems involving Cray Research products.

☐ *CRInform*. This online information service provides a direct link to our service organization that allows you to report problems and request technical assistance. It also allows you to dial into Cray Research and find out about new products, training offerings, and publications.
☐ *Software training*. Technical software training is available at your site or mainly at Cray Research training facilities. Cray Research also provides comprehensive user documentation for both hardware and software products.
☐ *Remote support*. This capability allows Cray Research to troubleshoot, monitor, and perform key maintenance functions on your supercomputer from a remote location. Should you allow remote support, we can apply expertise to problems more quickly and increase system availability.
☐ *SMARTE*. To assure high system availability, Cray Research 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-MP M90 supercomputer series – expanding the frontiers of science and engineering

The CRAY Y-MP M90 computer systems offer unrivaled supercomputing performance and the largest central memories available for technical computing. As part of a complete supercomputing solution, these systems provide the insight you need to approach your largest and most challenging problems with revolutionary solutions.

For more information on the CRAY Y-MP M90 supercomputer systems, contact your Cray Research representative.

Radar cross section (RCS) of a finned projectile computed from surface electrical fields at one instant of time. The RCS was obtained from solving the Maxwell's equations on a CRAY Y-MP supercomputer.

Image credits:

Simulation of the historical mining sequence courtesy of Dr. William Pariseau of the University of Utah and Jeff Johnson of the United States Bureau of Mines. Convection flow past a VT131 logic board courtesy of FLUENT, Inc. Daihatsu subcompact automobile design simulation courtesy of Daihatsu Motor Company and Software Cradle Company, Limited. Petroleum reservoir slides courtesy of British Petroleum. Almond-shaped target images courtesy of Dr. Vijaya Shankar, Rockwell International Science Center. F-18 aircraft flowfield solution obtained by Farhad Ghaffari. Radar cross section of military aircraft image and electric currents on aircraft body image courtesy of the Sowerby Research Center, British Aerospace. Laminar, compressible flow over the forebody and strake of an F-18 was computed using the NASA Langley code CFL3D. Airflow over a High Speed Civil Transport model calculated using TLNS3D. Radar cross section (RCS) of a military aircraft courtesy of Sowerby Research Centre, British Aerospace. F-18 aircraft flowfield computations by Y.M. Rizk, K. Gee, and L.B. Schiff, NASA Ames Research Center. Radar cross section of a finned projectile obtained from solving the Maxwell's equations on a CRAY Y-MP supercomputer.