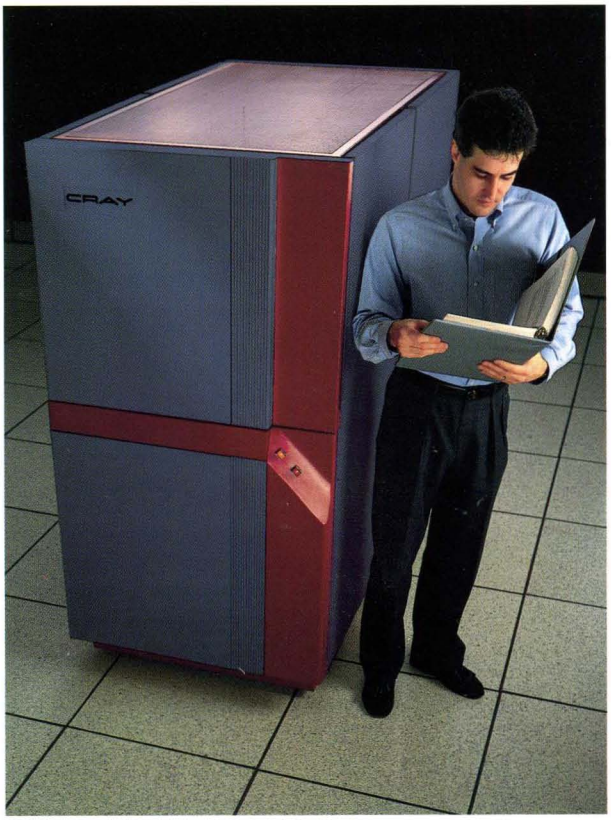
The CRAY XMS Minisupercomputer System

CRAY RESEARCH, INC.

Introducing the CRAY XMS Minisupercomputer System



Cray Research, the supercomputer leader, now offers an unsurpassed range of computing options, from a leading price/performance system to the world's most powerful supercomputer. The CRAY XMS delivers the balanced Cray Research 64-bit vector architecture via the powerful and easy-to-use UNICOS operating system. With the CRAY XMS system, Cray Research now offers you a clear pathway to the unlimited power of large-scale supercomputing.

The CRAY XMS system will meet your needs for:

- ☐ A system suited to departmental budgets
- ☐ A pathway to Cray Research large-scale supercomputer systems
- ☐ A cost-effective UNICOS application development platform
- ☐ A powerful system in a secure environment

The CRAY XMS system is compact, easy to install, and inexpensive to operate. Its low power requirements, high reliability, and high serviceability minimize operating costs. And it offers the most throughput performance in its price range for multi-user technical computing requirements.

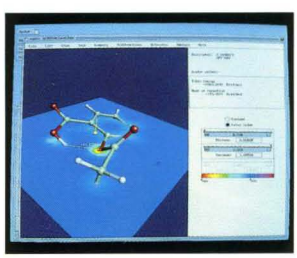
Reliable, high-performance software

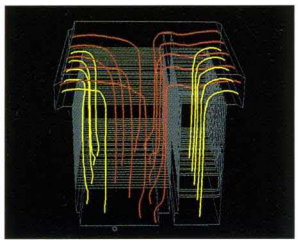
The CRAY XMS system runs the same powerful operating system used by the entire Cray Research product line: the UNICOS operating system. Based on UNIX System V, the UNICOS operating system is easy to use and is the most fully featured, highest-performance UNIX-based operating system available.

The UNICOS user environment delivers a highly productive combination of optimizing compilers and easy-to-use tools. The CF77 Fortran compiling system and Standard C compiler, along with a variety of library routines and utilities, make the Cray Research programming environment the most dependable and productive software environment available. By adhering to industry standards, the Cray Research software environment provides easy portability for applications users and developers. Because binaries from the CRAY XMS system will run on CRAY X-MP and CRAY Y-MP systems, work is easily scaled to larger Cray Research systems.

Cray Research's UniChem integrates popular computational chemistry techniques under a common user interface that improves user productivity. Its open architecture allows other applications to be attached.

UniChem's direct-manipulation graphical user interface, which runs on a graphics workstation, lets users manage data, import molecular structures or build them from UniChem fragment libraries, choose a computational method, select computational parameters, control computations, and visualize the results — all in the same framework and style, regardless of the specific application package used. The ability to do all these tasks through one user interface reduces the time to solution, allowing more simulations to be run in a given time.





Cray Research's Multipurpose Graphic System (MPGS) is an interactive, menu-driven graphics tool that improves the user's ability to analyze and interpret results through visualization. MPGS runs on a UNIX-based workstation communicating with the simulation on the CRAY XMS via TCP/IP. Simulations are post-processed while they are still on the CRAY XMS. Memory and CPU-intensive tasks are processed on a CRAY XMS, while the user interface and local graphics are processed on the graphics workstation. This distributed processing technique ensures the efficient use of both computer systems, and the visualizations often provide entirely new understandings of results.

Network Supercomputing

The CRAY XMS system can be used as a stand-alone system or as a node in a heterogeneous computing environment. Like all Cray Research systems, the CRAY XMS system supports connectivity to a wide variety of computer systems. This extensive connectivity protects existing network investments and enhances the productivity of users by providing access to a wide range of resources.

Applications

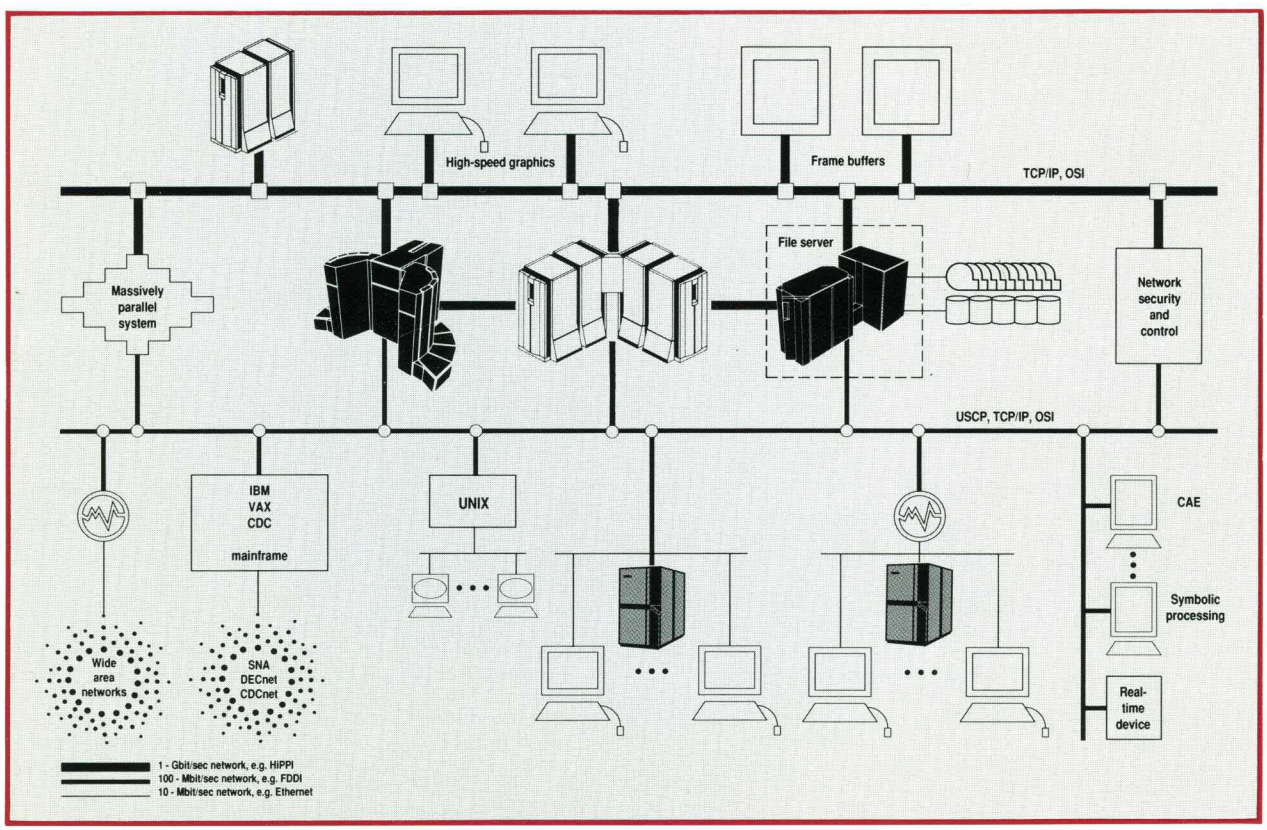
More third-party applications run on Cray Research computer systems than on any other high-performance computer system. Applications for nearly every scientific and engineering discipline, including over 500 third-party programs, will run on the CRAY XMS system. As part of its significant commitment to user productivity, Cray Research offers the UniChem chemistry application environment and the Multipurpose Graphic System (MPGS) for output visualization. Key applications such as MSC/NASTRAN can be run on the CRAY XMS system; then as the problem size increases, the problem can be run on larger Cray Research systems.

User productivity

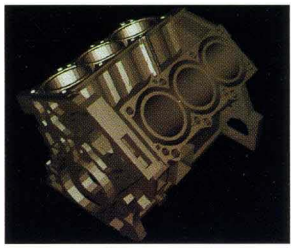
The CRAY XMS provides significant computing capabilities. New Cray Research users will be introduced to a highly productive user environment, along with a cost-effective pathway to large-scale supercomputing. Established Cray Research users will appreciate the compatibility of the CRAY XMS.

All Cray Research systems adhere to industry standards, providing easy integration into heterogeneous computing environments.

Through its implementation of networking standards, Cray Research provides connectivity to virtually all UNIX-based mainframes, minicomputers, and workstations. These standards include TCP/IP, the X Window System, NFS, the Open Systems Interconnection (OSI) of the International Standards Organization (ISO), and the Fiber Distributed Data Interface (FDDI), as well as other networking standards. Network Supercomputing delivers a powerful and flexible user environment.



The CRAY XMS system integrates into a heterogeneous networking environment.



MSC/NASTRAN is a large-scale, general-purpose digital computer program that solves engineering analysis problems utilizing the finite element method. Analysis capabilities include static and dynamic structural analysis, material and geometric nonlinearity, heat transfer, aeroelasticity, acoustics, electromagnetism and other types of field problems. It has been used by large and small companies engaged in such fields as automotive, aerospace, civil engineering, shipbuilding, offshore oil, industrial equipment, chemical engineering, optics, and government research.

Balance: the key to CRAY XMS system performance

Like all Cray Research systems, the CRAY XMS is a blend of architectural components balanced to maximize system throughput.

A wide selection of peripherals are available for the CRAY XMS system. A VME-based I/O subsystem communicates with the CPU over a 40 Mbyte/sec channel. Cost-effective ESDI disk drives are available, along with a high-performance disk array that can sustain a transfer rate of over 12 Mbytes/sec on large blocks.

As always, Cray Research is committed to fundamental engineering excellence and innovation, and this commitment is plainly evident in the CRAY XMS system.

CRAY XMS system highlights

Hardware

- ☐ 36 MFLOPS peak vector performance; 18 MIPS peak scalar performance
- ☐ One CPU with 128 Mbytes of four-ported, 16-way interleaved Error Correction Code (ECC) memory
- ☐ 576 Mbyte/sec memory bandwidth
- ☐ 40 Mbyte/sec VME-based I/O system
- ☐ Supports a wide variety of high-performance peripheral equipment
- ☐ Fan-cooled; does not require a special environment
- ☐ Effective, low-cost support
- ☐ High reliability due to proven component technology
- ☐ Ethernet and HYPERchannel connections

Software

UNICOS operating system:

- ☐ Based on UNIX System V, with Berkeley extensions
- ☐ Extensive enhancements to UNIX for large-scale scientific computing
- ☐ A wide variety of system utilities
- ☐ Feature-rich
- ☐ Portable

Compilers:

- ☐ Autovectorizing Fortran compiling system
- ☐ Optimized Fortran mathematical and I/O subroutine library
- ☐ Optimized scientific subroutine library
- ☐ Autovectorizing C compiler
- ☐ Ada
- ☐ Autovectorizing ISO Level 1 Pascal
- ☐ CAL, the Cray macro assembler
- ☐ Interlanguage communication support

Images used in this brochure:

UniChem delivers multiple molecular modeling and simulation techniques in a single, integrated software environment. The figure shows the structure and electron density of an aspirin molecule, built, calculated, and visualized using UniChem.

Airflow through a computer cabinet visualized using MPGS. Image depicts the geometry and particle paths in a four-processor HP 9000 Model 850 computer cabinet. Data courtesy of Kent Misegades, Cray Research, Inc. Code: FIDAP

Engine block depicted with shaded images. Data courtesy of General Motors Corporation. Code: MSC/NASTRAN

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MCPF-X-0291

CRAY XMS Minisupercomputer System

The world's leading supercomputer company now offers a high-performance minisupercomputer, the CRAY XMS system. Cray Research now offers unsurpassed supercomputing capability that ranges from a leading price/performance minisupercomputer to the world's most powerful computer system. The XMS system is a 64-bit minisupercomputer based on the proven Cray Research vector architecture and, like all Cray Research systems, runs the powerful Cray Research UNICOS operating system. Cray Research has just made your pathway to real supercomputing clear: the XMS minisupercomputer.

The system can be used as:

- ☐ A minisupercomputer pathway into the full Cray Research product line
- ☐ A cost-effective UNICOS application development platform
- ☐ A Cray-compatible entry-level supercomputer at a price an individual department can afford
- ☐ A Cray-compatible platform for secure operations

The XMS represents power in a small package, delivering 36 MFLOPS peak vector and 18 MIPS peak scalar performance. The system is compact, easy to install, and inexpensive to operate; and its low power requirements, high reliability, and high serviceability help minimize operating costs. The powerful XMS system offers the most performance in its price range, with Cray compatibility.

Product highlights

- ☐ 36 MFLOPS peak vector performance; 18 MIPS peak scalar performance
- ☐ One CPU with 32, 64, or 128 MBytes of four-ported, 16-way interleaved Error Correction Code (ECC) memory
- ☐ 40 MByte/sec VME-based I/O system
- ☐ Supports a wide variety of high-performance peripheral equipment
- ☐ Fan-cooled; does not require a special environment
- ☐ Effective, low-cost support
- ☐ High reliability due to proven component technology
- ☐ Easy application transportability — and thus significant scalability — to Cray Research supercomputers
- ☐ Powerful and productive UNICOS user environment
- ☐ Autovectorizing CF77 Fortran compiling system
- ☐ Standard C compiler
- ☐ TCP/IP, NFS, and the X Window System are supported by Ethernet and HYPERchannel connections

Powerful system software

The XMS runs the UNICOS operating system, the same operating system used throughout the Cray Research supercomputer product line. The UNICOS operating system, based on the AT&T UNIX System V operating system, is the most fully featured and highest performing UNIX-based operating system available on large-scale computer systems today. The XMS also runs the same powerful and productive compiler software, including the CF77 Fortran compiling system and Standard C, along with a variety of useful library routines and utilities. Binaries from the XMS will run on CRAY X-MP and CRAY Y-MP systems, allowing easy application transportability — and thus significant scalability — to Cray Research supercomputers.

Networking

The XMS can serve as a stand-alone machine or can be networked into a Cray Research supercomputing environment. The XMS is supported by communications software and hardware interfaces to meet a variety of customer connectivity needs. Included is the TCP/IP protocol, a widely accepted protocol for interconnecting UNIX systems, NFS, and the X Window System. These are supported by Ethernet and HYPERchannel connections.

CRAY RESEARCH, INC.

XMS

A broad range of applications
More third-party application programs are available to run on Cray Research supercomputers than on any other supercomputer systems, and the XMS system can run these programs with little or no modification. Cray Research is aggressively working with third-party applications vendors in the areas of fluid dynamics, mechanical engineering, computational chemistry, and others to license these programs for the XMS system.

Modular I/O system
A wide selection of peripherals can be interfaced to the XMS system through a VME-based Input/Output Subsystem that communicates with the CPU via a 40 MByte/sec channel. Affordable ESDI disk drives and a disk array operating at up to 16 MByte/sec provide high-performance disk I/O.

Easy installation
The XMS system is easy to install, due to its small size, low power consumption, and simple fan cooling.

Efficient, effective support
System support is "on-call" and is enhanced by Cray Research's SCANbus diagnostic facility, which allows local or remote diagnosis using scan paths designed into the CPU boards. With SCANbus, faults can be detected quickly and accurately to the component level.

User benefits
Current Cray Research supercomputer users will appreciate how easily the XMS system integrates into their existing computer network. Cray Research applications readily port to the XMS system so that users can begin their production and research immediately in the familiar and effective Cray Research UNICOS environment.

The XMS system provides new Cray Research customers with an introduction to Cray Research's powerful UNICOS user environment. The system affords new customers a cost-effective pathway into the world of Cray Research supercomputing.

Like other Cray Research products, the XMS system comes with Cray Research's commitment to excellence and leadership in large-scale computing.

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XMS

CRAY XMS
Central Processing Unit

The CRAY XMS Central Processing Unit (CPU) design combines advanced TTL/CMOS technologies with a highly optimized architecture that is CRAY X-MP instruction set compatible. The CRAY XMS offers excellent performance and a superior price/performance ratio. Furthermore, the small size, low power consumption, fan cooling, and high reliability of the CRAY XMS make it ideal for use in almost any environment.

The CRAY XMS architecture is based on five major, tightly-coupled subsystems: Instruction Unit, Vector Unit, Scalar Unit, Memory Unit, and I/O Unit. This structure yields a peak computational rate of 36 MFLOPS and high throughput for a wide range of applications with various degrees of vectorizability or inherent parallelism.

The Instruction Unit executes the CRAY X-MP instruction set, enabling programs currently running on CRAY X-MP and CRAY Y-MP systems to be used without modification on the CRAY XMS.

The Vector Unit contains a multi-ported vector register file which supports as many as 16 word transfers per clock cycle — with a bandwidth of 2.3 GB/s. It can fully support all concurrent vector operations including vector-memory and vector-scalar data transfers and chaining.

The Scalar Unit contains a multi-ported scalar register file that supports simultaneous scalar operations with low latencies. With 18-MIPS peak performance for a 64-bit scalar operation, and an Instruction Unit that can issue instructions at the rate of one per cycle, the CRAY XMS provides robust scalar processing.

The Memory Unit serves the other major subsystems at very high data transfer rates. Its four-ported design has an aggregate bandwidth of 576 MB/s and supports two vector reads, one vector write, and one I/O transfer. The 16-way, fully interleaved structure minimizes bank conflicts.

The I/O Unit supports a 40 MB/s data channel for external communication.

Reliability

The CRAY XMS CPU utilizes proven off-the-shelf devices that give it an inherently high level of reliability. This intrinsic reliability is augmented by Cray Research's commitment to excellence that begins with the initial design.

Serviceability

The CRAY XMS CPU incorporates sophisticated features to enhance its serviceability. Diagnostic capability is designed into the CPU boards in the form of scan paths. This capability is accessed either locally or remotely via the Master I/O processor in the I/O Subsystem. Using the diagnostic scan, the Master I/O processor can set and examine the state of internal registers and step the functional units through execution cycles. The result is accurate and expedient fault detection to the component level.

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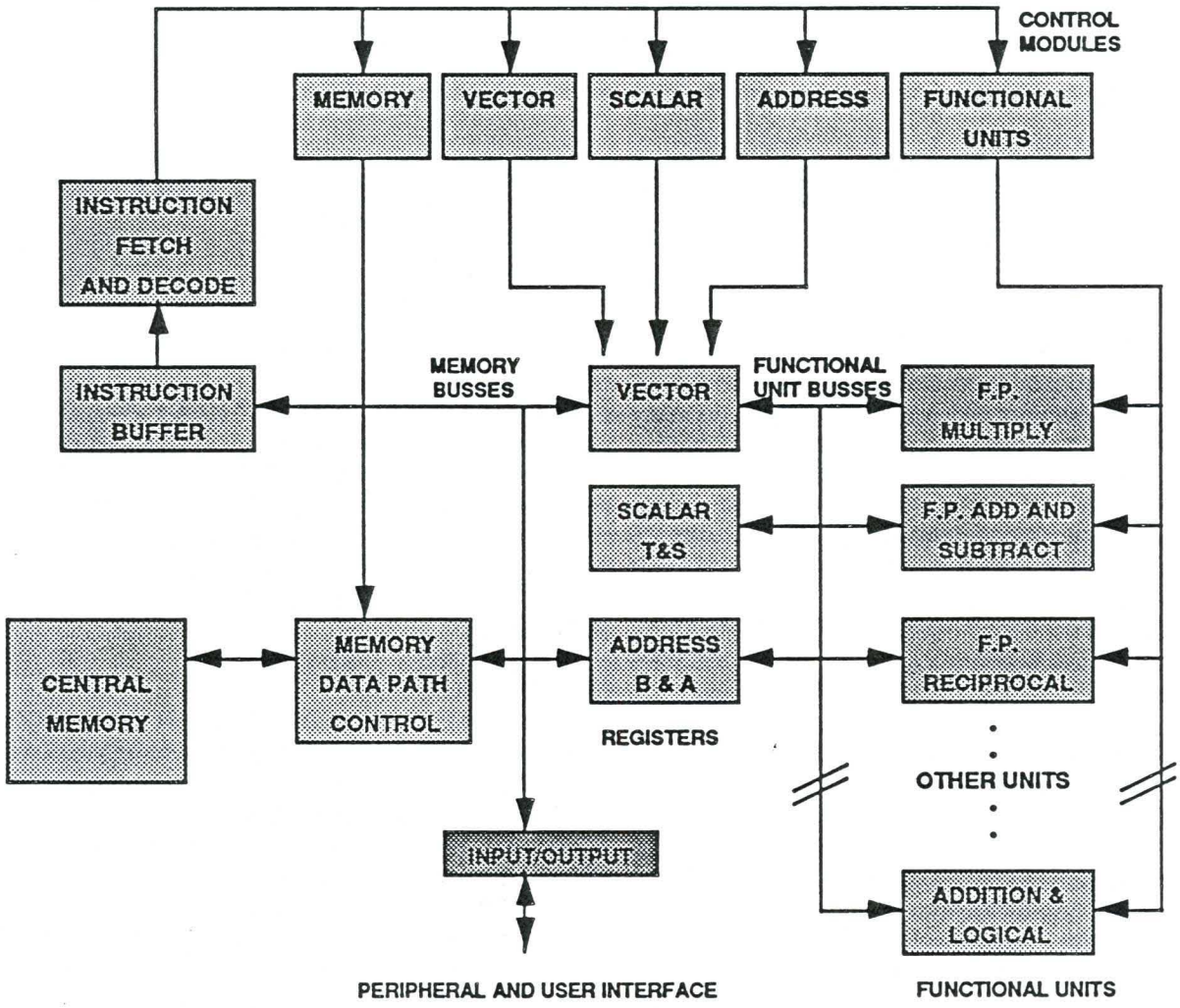
CPU FUNCTIONAL BLOCK DIAGRAM



CPU SPECIFICATIONS

ARCHITECTURE
- — Full CRAY X-MP instruction set
- — Hardware support for scatter/gather, compressed index, and enhanced addressing mode
- — 55 ns single- phase clock

COMPUTATION RATE
- — 36 MFLOPS peak vector performance
- — 18 MIPS peak scalar performance

CENTRAL MEMORY
- — 576 MB/s aggregate bandwidth
- — 144 MB/s aggregate bandwidth to I/O
- — Up to 128 Mbytes of storage
- — Error detection/correction (SECDED)

VECTOR REGISTERS (64-Bit)
- — Eight 64-word registers
- — 2.3 GB/s aggregate bandwidth

SCALAR REGISTERS (64-Bit)
- — 8 registers (S)
- — 64 buffer registers (T)

ADDRESS REGISTERS (24-Bit)
- — 8 address registers (A)
- — 64 buffer registers (B)

FUNCTIONAL UNITS
- — 13 functional units
- — Concurrent operation
- — Floating point, integer, logical operations for vector, scalar, and address operands

INPUT/OUTPUT
- — VME-based IOS supports tape, disks, and networking