

A Brief Overview of Your  
CRAY XMS™ Computer System

SG-3093

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Cray Research, Inc.

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The UNICOS operating system is derived from the UNIX System Laboratories, Inc. UNIX System V operating system. UNICOS is also based in part on the Fourth Berkeley Software Distribution under license from The Regents of the University of California.

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# Preface

This publication gives a brief overview of the hardware and software provided with CRAY XMS computer systems. It includes the following information:

- Section 1: CRAY XMS System Overview
- Section 2: Software Overview
- Section 3: Documentation and Training

A set of Cray Research software technical documentation and training workbooks is included with each CRAY XMS computer system. Throughout this overview, specific Cray Research publication titles are listed in the text to help you become familiar with the content of the documentation provided with CRAY XMS systems. Please refer to the publications order form in section 3 for a complete list of the Cray Research software technical documentation and training workbooks provided with CRAY XMS computer systems.

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## Note

Most publications provided with CRAY XMS computer systems also support CRAY Y-MP, CRAY X-MP, and CRAY-1 systems. Because these publications were printed prior to the development of the CRAY XMS computer system, they do not specify that they also support CRAY XMS systems.

Since these publications also support CRAY Y-MP, CRAY X-MP, and CRAY-1 systems, it is important to read the *Differences for UNICOS 5.1 on the CRAY XMS Systems* technical note, publication SN-3086. This technical note identifies UNICOS 5.1 software features documented in Cray Research publications that are not supported on CRAY XMS systems. Generally, the features are the following:

- Multitasking support (CRAY XMS systems have only 1 CPU)
- Front-end station support

- High-performance tape support
  - SSD and buffer memory support (ldcache)
  - Multilevel security support
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This overview publication is also available through the Cray Research, Inc. Distribution Center. Refer to the publications order form in section 3 for information about how to order this publication or other Cray Research publications that support CRAY XMS computer systems.

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# 1. CRAY XMS System Overview

This section provides an overview of the CRAY XMS computer system, including the I/O subsystem and peripherals supported.

## 1.1 The CRAY XMS system

The CRAY XMS computer system can serve as a stand-alone machine, and it is supported by communications software and hardware interfaces to meet a variety of customer connectivity needs. The Transmission Control Protocol/Internet Protocol (TCP/IP) is available, and the UNICOS Network File System (NFS) and the X Window System, Version 11, Release 3 are supported. These interfaces are supported by Ethernet and HYPERchannel connections. Although user terminals cannot be connected to a CRAY XMS system directly, an Ethernet terminal server can provide this capability.

The CRAY XMS system runs the Cray Research UNICOS operating system 5.1 release, which is provided in binary form. UNICOS is derived from the UNIX System Laboratories, Inc. UNIX System V operating system. UNICOS is also based in part on the Fourth Berkeley Software Distribution (4.3BSD) under license from The Regents of the University of California. UNICOS provides the standard UNIX user environment, including most of the standard UNIX system calls and commands, as well as additional capabilities that enhance performance on Cray Research computer systems.

The Cray Research Fortran77 compiling system (CF77) and the Cray Research Standard C compiler are also provided with the CRAY XMS system. These compilers are used throughout the Cray Research supercomputer product line. Binary code from a CRAY XMS system can run on CRAY X-MP and CRAY Y-MP systems. CRAY XMS and CRAY X-MP binary code can run on a CRAY Y-MP system if the user selects "X-mode" at run time. This

compatibility allows for easy transfer of user jobs between Cray Research supercomputers and a CRAY XMS system.

CRAY XMS computer systems can be used effectively in a number of areas, including the following:

- As an entry-level Cray Research supercomputer.
- As a remote or departmental compute server.
- For UNICOS application development.
- As a secure system operating in a vault.
- For UNICOS migration for customers using the COS or CTSS operating systems; users can migrate codes to UNICOS and learn UNICOS.

Your system maintenance contract describes the support provided by Cray Research for your CRAY XMS system. Please contact your Cray Research account representative for additional information about support for your system.

## 1.2 I/O subsystem

The I/O subsystem (IOS) of a CRAY XMS computer system is built into the system cabinet. The IOS provides fast data transmission between the central memory of the CRAY XMS system and peripheral devices and networks.

The CRAY XMS IOS has one I/O Processor, which controls the peripheral devices and networks. The user I/O interface is the same as on CRAY Y-MP, CRAY X-MP, or CRAY-1 systems.

One terminal serves as the IOS console as well as the UNICOS system console. The IOS console provides the following capabilities:

- Control of the CPU state
- Read/write access to the CPU central memory
- Deadstart



- Access to all the peripherals through various commands
- Many main CPU debugging tools and diagnostics

The IOS is documented in the *CRAY XMS Systems IOS Reference Guide*, publication SG-3085.

## 1.3 Peripherals

Peripheral hardware can be interfaced to a CRAY XMS computer system through the VME-based IOS that communicates with the CPU via a 40-Mbyte/s channel. CRAY XMS computer systems support the following peripheral hardware:

- Up to eight 1.56-Gbyte DS-2 disk subsystems (there must be one DS-2 in a system).
- A single 6.2-Gbyte disk array subsystem (DAS) that is capable of providing a sustained data transfer rate exceeding 13 Mbyte/s on large blocks. There is a maximum of three DS-2 disk subsystems if a DAS is included in the configuration.
- A 9-track tape subsystem (TD-1 and TCU-1); 75 ips with recording densities of 800, 1600, and 6250 bpi.
- Network connections via Ethernet (EI-1) or Network Systems Corporation (NSC) HYPERchannel.
- A 2.5-Gbyte, 8-mm cartridge tape drive subsystem (EX-1).
- A 150-Mbyte, 1/4-inch archive cartridge tape drive subsystem (AD-1).

### 1.3.1 DS-2 disk subsystem connection

The DS-2 disk subsystem disk drive is a 5<sup>1</sup>/<sub>4</sub>-inch, high-performance Winchester disk drive with a capacity of 780 Mbytes unformatted or 673 Mbytes formatted. The disk drive operates at data transfer rates of approximately 1 to 1.5 Mbytes/s. Advanced technology has reduced the average seek time to only 16 milliseconds.

A direct-drive DC motor, designed for continuous operation, is used in the DS-2 disk drive. Reliability of the DS-2 disk drive is exceptionally high with a mean time between failures (MTBF) in excess of 40,000 hours of power-on operation. No preventive maintenance is required. The DS-2 disk subsystem disk drive connects to the CRAY XMS DS-2 disk subsystem disk controller, which supports up to four drives.

The DS-2 disk subsystem disk controller is an intelligent controller that supports from one to four disk drives. Intelligent disk management techniques include overlapping seek operations on multiple drives connected to the disk controller.

The disk controller provides error correction through a 48-bit error correction code (ECC). Media defect management includes sector and track mapping and sector slipping, in addition to reading the drive-resident media defect map. The controller allocates alternate locations for defective sectors.

### **1.3.2 DAS-1 disk array subsystem connection**

The DAS-1 disk array subsystem consists of an intelligent disk array controller supporting a bank of eight drives for data storage. Also included are one drive for parity and error recovery and one spare drive serving as a standby should one of the data storage drives become inoperable. The disk drive used is the DS-2 disk subsystem disk drive.

Data is transferred in parallel by the array controller to and from all drives comprising the data storage bank. A hardware striping technique is used to distribute the data evenly among the drives and retrieve it in a similar fashion. The DAS-1 array provides a sustained data transfer rate in excess of 13 Mbytes/s on large blocks.

Complete media defect management built into the array controller automatically handles bad sector and track replacement for both initial and subsequently developed flaws. Data integrity is further enhanced using a 48-bit error correction polynomial stored with every 1024 bytes written to disk.

If a disk becomes inoperable, the parity drive allows the array controller to dynamically regenerate the data on that disk onto the standby drive. The standby drive is automatically switched

in to take the place of the failed drive, and operation of the array subsystem continues uninterrupted.

### 1.3.3 TDS-1 tape drive subsystem connection

The TDS-1 9-track tape drive subsystem consists of the TCU-1 tape controller unit with one TD-1 tape drive. The TD-1 drive is a high-performance, digital vacuum-buffered drive for 1/2-inch open-reel tape. Read/write tape speed is 75 ips for 800 bpi, 1600 bpi, and 6250 bpi recording densities.

Standard 10 1/2-inch open reels are loaded automatically. Smaller reels are threaded automatically when the tape tip is placed in the thread chute and the load switch is depressed twice. Multiple load retries are initiated automatically if the tape leader is imperfect, minimizing the need for operator intervention.

### 1.3.4 Network connections

CRAY XMS computer systems running UNICOS can be connected to multiple computer systems using TCP/IP via either Ethernet or a HYPERchannel local area network from Network Systems Corporation (NSC). The DX series of NSC HYPERchannel equipment is supported. The NSC HYPERchannel DX product line (including the Cray Research system N130 adapter and EN641 IP router) allows integration of different networks, including HYPERchannel-50, HYPERchannel-10, and Ethernet. See the *CRAY XMS Systems IOS Reference Guide*, publication SG-3085, for additional information.

### 1.3.5 EX-1 8-mm cartridge tape drive subsystem

The CRAY XMS EX-1 8-mm cartridge tape drive is a highly reliable, helical scan cartridge tape drive for archiving files to 8-mm cartridge tape. It stores up to 2.5 Gbytes of data on a single 3.7 x 2.5 x .06 inch cartridge.

The EX-1 enables unattended backup, requiring manual intervention only if more than 2.5 Gbytes of data are to be dumped or reloaded. It has resident error recovery procedures to ensure data reliability and to minimize intervention by the I/O Processor.

### **1.3.6 AD-1 archive cartridge tape drive subsystem**

The CRAY XMS AD-1 archive tape drive is a high-performance streaming tape drive for archiving files to 1/4-inch cartridge tape. Read/write tape speed is 90 ips with 10,000 bpi tape density. The AD-1 tape drive supports highspeed end-of-record data seeking and uses end-of-tape seek to eliminate cartridge tolerance variations. It also has a highspeed direct block access capability. A reference burst is used for accurate tracking while off-track stepping allows reliable error recovery.

## 2. Software Overview

This section provides an overview of the software supported on CRAY XMS systems running the UNICOS 5.1 release, which includes the following:

- Cray Research compilers and assembler.
- UNICOS, including networking software, batch processing, program debuggers, performance analysis tools, system libraries, and some “key” UNICOS enhancements that have been made to the basic UNIX system.

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### Note

This section is not intended to provide you with an exhaustive list of all software features and utilities included with your CRAY XMS system. Instead, it provides you with a quick overview of your CRAY XMS software capabilities. It also points you to other Cray Research publications to help you become familiar with the documentation included with your system, which describes all CRAY XMS software.

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Cray Research customers currently running UNICOS 5.1 on CRAY Y-MP, CRAY X-MP, or CRAY-1 systems should also refer to the *Differences for UNICOS 5.1 on the CRAY XMS Systems* technical note, publication SN-3086, for additional information.

## 2.1 Cray Research compilers and assembler

The following subsections describe the Cray Research compilers and assembler that are supported on CRAY XMS systems.

### 2.1.1 CF77 compiling system

The Cray Research autovectorizing CF77 compiling system provides a fully validated ANSI X3.9–1978 Fortran Standard language and includes most ANSI X3.9–1966 features. The compiler has been certified by the Federal Compiler Testing Center through the Fortran Compiler Validation System (FCVS). CF77 provides several ANSI 8X language extensions, notably longer identifier names, limited array syntax, and automatic array storage assignment. Continued development of the CF77 compiling system focuses on methods that deliver the highest performance and functionality from Cray Research systems.

The latest revision of the CF77 compiling system is included as part of the standard software provided with CRAY XMS systems. See the *CF77 Compiling System 4.0 Release Notice*, publication C7-4.00-BAN-RN, for additional information.

The CF77 compiling system is documented in the following Cray Research publications:

- *CF77 Compiling System, Volume 1: Fortran Reference Manual*, publication SR-3071
- *CF777 Compiling System Ready Reference*, publication SQ-3070
- *CF77 Compiling System, Volume 2: Compiler Message Manual*, publication SR-3072
- *CF77 Compiling System, Volume 4: Parallel Processing Guide*, publication SG-3074
- *UNICOS User Commands Reference Manual*, publication SR-2011

### 2.1.2 Cray Research Standard C compiler

The Cray Research autovectorizing Standard C compiler conforms to the C Standard ANSI X3.159–1989. The C programming language is a high-level language used extensively in the creation of the UNIX operating system and the majority of the utility programs that comprise UNIX. It is a computer language that is available on processors ranging from microcomputers to mainframe computers as well as Cray Research computer systems. C is useful as a language for a wide range of applications, especially byte manipulation and interactive graphics. The capabilities of C complement the scientific orientation of Fortran.

The latest revision of the Cray Research Standard C 2.0 compiler is included as part of the standard software provided with CRAY XMS systems. See the *Cray Research Standard C 2.0 Release Notice*, publication AC-2.00-UAN-RN, for additional information.

The Cray Research Standard C compiler is documented in the following publications:

- *Cray Standard C Programmer's Reference Manual*, publication SR–2074
- Plauger and Brodie's *Standard C Programmer's Quick Reference*, publication S1–2074
- *Volume 2: UNICOS C Library Reference Manual*, publication SR–2080

### 2.1.3 Pascal compiler

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#### Note

The latest revision of the Cray Research Pascal 4.0 compiler is supported by CRAY XMS systems. However, the Pascal 4.0 compiler is not automatically included as part of the standard software provided with CRAY XMS systems, although it can be ordered from Cray Research.

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The Cray Pascal compiler transforms Pascal code into machine-language instructions that execute on a Cray Research computer system. Pascal is a high-level, general-purpose computer language that emphasizes the virtues of structure, simplicity, and portability. Using Pascal, a programmer can implement algorithms and data structures in a high-level, machine-independent manner without sacrificing efficiency. The Cray Pascal compiler offers automatic vectorization, optimization, and instruction scheduling so that high performance is achieved. Program units written in other languages may be called directly from Pascal routines.

Cray Pascal complies with the Level 1 requirements of Standard ISO 7185, defined by the International Standards Organization (ISO), with some extensions and restrictions. The compiler issues messages identifying these extensions to help transport a program to a machine running a different implementation of the language.

The Cray Research Pascal 4.0 compiler is documented in the *Pascal Reference Manual*, publication SR-0060.

For additional information, see the *Pascal 4.0 Release Notice*, publication PS-4.00-BAN-RN, which is available from the Cray Research Distribution Center, or contact your Cray Research account representative.

#### 2.1.4 CAL version 2 assembler

The Cray Research assembly language (CAL) enables a user to closely tailor a program to the architecture of the CRAY XMS CPU. By using CAL, a programmer can express symbolically all hardware functions of the Cray Research system. A set of versatile pseudo operations for defining macro instructions and controlling the assembler augments the instruction repertoire. A macro library provides macros for subroutine entry and exit, allowing easy subroutine linkage to Fortran.

The CAL version 2 assembler, release 3.2, is included as part of the standard software provided with CRAY XMS systems. The CAL version 2 assembler is documented in the *CAL Assembler Version 2 Reference Manual*, publication SR-2003.



## 2.2 UNICOS

The Cray Research operating system UNICOS provides a standard UNIX user environment. It is derived from the UNIX System Laboratories, Inc. UNIX System V operating system and provides interactive, local batch, and remote batch user interfaces. Several functions of the Fourth Berkeley Software Distribution (4.3BSD) along with significant Cray Research extensions have been added to provide additional performance and operational enhancements consistent with the needs and desires of the minisupercomputer user.

UNICOS provides for multiprogramming, permitting a single user or many users to execute processes simultaneously. Concurrent batch and interactive processing is supported via Cray Research's Network Queueing System (NQS) and TCP/IP. TCP/IP is a standard networking protocol supported on most vendors' systems, providing access to a CRAY XMS system from a wide variety of platforms.

Cray Research has made numerous enhancements to basic UNIX, but the traditional UNIX user interface is preserved in the UNICOS environment. Cray Research enhancements that enable UNICOS to fully use the power of the Cray Research minisupercomputer include the following:

- TCP/IP networking software.
- UNICOS Network File System (NFS), which supports Sun Microsystems, Inc. NFS version 3.2.
- Support for Sun Microsystems, Inc. network information service (NIS).
- Support for the X Window System, which is a product of the Massachusetts Institute of Technology (MIT).
- Batch processing capabilities.
- Process and job recovery capabilities.
- Debugging aids.
- Performance utilities.
- Enhanced I/O capabilities to deliver minisupercomputer performance.
- File system and resource management enhancements.

- Accounting features.
- Implementation of the group membership method available in 4.2BSD, providing more effective control of access to the file system.

The following subsections provide an overview of the networking software, batch processing, program debuggers, performance tools, and system libraries supported under UNICOS for CRAY XMS systems. Also, some “key” UNICOS enhancements that have been made to the basic UNIX system are highlighted.

## 2.2.1 Networking capabilities

A primary advantage of UNICOS is its ability to fit effectively into existing environments as part of a computer network. Networking capabilities under UNICOS for CRAY XMS systems are available through an implementation of the TCP/IP protocol suite. In addition, Sun Microsystems’ Network File System (NFS) and MIT’s X Window System, Version 11, Release 3 are supported.

### 2.2.1.1 TCP/IP

TCP/IP is based on the Summer of 1988 TCP/IP release from Berkeley, often referred to as the 4.3BSD tahoe code. The Cray Research implementation includes networking application and administrative programs as well as systems programmer commands. A number of user-level programs provide interactive and file transfer capabilities to other operating systems. UNIX-to-UNIX communication using the TCP/IP protocol suite is provided in a convenient set of programs that include capabilities for file transfer, remote command processing, interactive service, and mail.

UNICOS TCP/IP is consistent with the authoritative standards for the Internet protocols and has made full use of the reference implementations as well as other available information. The Internet RFC standards are taken as precedent when a conflict occurs. In addition, other standards and documents related to UNICOS TCP/IP are supported by products used with a Cray Research computer system. For instance, there are several Ethernet-related standards that are not supported on Cray

Research computer systems but are supported by an Ethernet gateway.

UNICOS TCP/IP is documented in the following publications:

- *TCP/IP Network User's Guide*, publication SG-2009
- *UNICOS File Formats and Special Files Reference Manual*, publication SR-2014
- *TCP/IP Network Administrator's Guide*, publication SG-2021
- *UNICOS Administrator Commands Reference Manual*, publication SR-2022
- *Volume 5: UNICOS Network Library Reference Manual*, publication SR-2057

### 2.2.1.2 UNICOS Network File System (NFS)

The UNICOS Network File System (UNICOS NFS) is a software product that allows users to share directories and files across a network of machines. UNICOS, using TCP/IP, supports the capabilities of the UNIX System Laboratories, Inc. UNIX System V port of Sun Microsystems' NFS version 3.2. These capabilities include PC NSF, block-mode input/output, and the network information service (NIS). UNICOS NFS users can use standard UNICOS I/O calls, standard commands, and standard permission controls to access files from any connected file system. Similarly, other NFS users can make use of UNICOS file systems from anywhere in the local network environment. The user interface to UNICOS NFS is transparent.

UNICOS NFS uses a client/server model to provide transparent access to files across the network. A server is any machine that allows a portion of its local disk space to be exported (made available for remote mounting). A client is any machine that makes a request for an exported file system. When a UNICOS user issues an I/O call (such as read, write, open, close, create, or delete) for a file that resides on a file system mounted by UNICOS NFS, the call is transmitted to the server machine. When the server receives the request, it performs the indicated operation. In the case of read or write requests, the indicated data is returned to the client or written to disk, respectively.

UNICOS NFS also includes a set of distributed processing tools developed by Sun Microsystems. RPC, XDR, NIS, **rpcgen**, and

others are in this set of tools. The Remote Procedure Call (RPC) routines allow users to create distributed applications that can call procedures residing in any host on the network. These routines extend procedure-call semantics into the network environment and use XDR routines to ensure that data sent across the network is in a machine-independent format.

UNICOS NFS administrative tools are provided as well as user identification (UID) mapping and group lists replacement (GID) mapping. GID allows users located in different administrative domains on a large network to all concurrently access a single Cray Research system, even though users may have different user IDs or group IDs between their local systems and the Cray Research system. UID and GID mapping may be used in combination with NIS.

UNICOS NFS is documented in the following publications:

- *UNICOS Administrator Commands Reference Manual*, publication SR-2022
- *UNICOS NFS Administrator's Manual*, publication SR-2064
- *UNICOS Yellow Pages (YP) Administrator's Guide*, publication SG-2063

The RPC facility is documented in the *Remote Procedure Call (RPC) Reference Manual*, publication SR-2089.

### 2.2.1.3 Network information service (NIS)

UNICOS includes an implementation of the Sun Microsystems, Inc. network information service (NIS) distributed data lookup service. The SUN NIS database service is used to administer all hosts on a network that are members of an NIS domain. Primarily, this means that users have a common password, user identification (UID), and group identification (GID) within an NIS domain, since the NIS domain is usually comprised of all hosts on a network. Cray Research systems may be configured as NIS clients, NIS slave servers, or NIS master servers. It is recommended that Cray Research systems running with the NIS feature always be configured as NIS slave servers.

Cray Research systems use NIS for **passwd** and **group** databases only. Cray Research systems do not use any other NIS databases, such as **hosts** or **networks**. The **hosts**, **networks**, and

other NIS databases can be supported on Cray Research systems for use by other, non-Cray Research systems on the network.

NIS does not necessarily eliminate the need for ID mapping. NIS is a configuration option that may be turned on or off; the default for the NIS feature is “off.” Configuring NIS into the system necessarily increases the amount of disk space required for command binaries.

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### Note

Because of trademark conflicts, Sun Microsystems, Inc. has changed the name of their Yellow Pages product to network information service (NIS); however, the use of the `yp` commands and file names will remain. Cray Research documentation will be revised to reflect the new product name as each publication is updated.

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UNICOS NIS is documented in the following publications:

- *UNICOS User Commands Reference Manual*, publication SR-2011
- *UNICOS Administrator Commands Reference Manual*, publication SR-2022
- *UNICOS Yellow Pages (YP) Administrator's Guide*, publication SG-2063

#### 2.2.1.4 X Window System

The X Window System is a product of the Massachusetts Institute of Technology (MIT). The X Window System Version 11, Release 3 is supported. The X Window System allows the Cray Research computer system to write graphics and text output directly to any bit-map display terminal that runs this software.

The UNICOS implementation of the MIT X Window System follows the client-server model: The client is a highly transportable package that can be moved from host to host, and the server provides workstation-dependent support. The X Window System allows a client application running in the Cray Research system to interact with a user at a bit-mapped graphic workstation. The user workstation runs a server program that displays output (text and graphics) from clients

and passes user events (key clicks, mouse movement and button presses) back to the client. The client program does not need to be concerned with the type of workstation hardware or operating system. Only the client program resides on a Cray Research computer system running UNICOS.

The programming interface for the X Window System is contained in the **xlib** library, which provides host-independent and network-transparent access to the X server that runs on the user's workstation. The **xlib** Version 11, Release 3 from MIT includes support for **Xtoolkit** and Athena Widgets and fixes to Releases 1 and 2.

The **man** pages documenting the X Window System are provided in the *UNICOS User Commands Reference Manual*, publication SR-2011.

The X Window System release documentation from MIT is available directly from MIT. Also, the *XLIB Programming Manual* (2-volume set) and the *X Window System User's Guide* are available from O'Reilly & Associates, Inc. publishers; the *Introduction to the X Window System* is available from Prentice Hall, Inc.; and the *X Window System C Library and Protocol Reference* is available from Digital Press.

## 2.2.2 Batch capabilities

UNICOS provides for multiprogramming, permitting a single user or many users to execute processes simultaneously. Concurrent batch processing is supported through Cray Research's Network Queueing System (NQS). The remote queueing system (RQS) provides remote access to NQS from front-end systems and workstations that are based on UNIX and support TCP/IP.

### 2.2.2.1 Network Queueing System

The UNICOS Network Queueing System (NQS) provides for the execution and control of batch work within the Cray Research computer system. NQS permits the creation of a batch environment and manages the workload and resources. For example, the batch environment can be composed of UNIX

front-end systems running RQS for job submission or one or more Cray Research systems running NQS.

NQS allows the user to perform the following activities:

- Submit requests to a batch queue. The user can specify numerous qualifications for the batch request, including time, memory and CPU resource limits, exporting of environment variables, class name, and the queue to which the request is submitted.
- Submit a batch request interactively or submit a batch job from a front-end computer job stream.
- Display the status of NQS queues. The `qstat` command displays the ordering of NQS requests and provides information about the requests in their respective queues.
- Delete or signal NQS requests.
- Display supported batch limits and shell strategies for each host.

NQS allows the system administrator to perform the following activities:

- Establish queues that manage batch requests by their resource requirements.
- Establish priorities for queues and set selection algorithm.
- Define a multiple system batch environment.
- Control the flow of requests through the queues.
- Initiate an orderly shutdown of batch environment with checkpointing of executing jobs.

UNICOS NQS is documented in the following publications:

- *UNICOS User Commands Reference Manual*, publication SR-2011
- *UNICOS Administrator Commands Reference Manual*, publication SR-2022
- *UNICOS System Administrator's Guide for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems*, publication SG-2018

### 2.2.2.2 Remote Queueing System

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#### Note

RQS is not automatically provided as part of the standard software with CRAY XMS systems; however, it can be ordered from Cray Research. A license is required for RQS; also, there is a right-to-use charge. For additional information about RQS, contact your Cray Research account representative.

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The remote queueing system (RQS) provides reliable, secure, remote access to NQS from front-end systems and workstations that are based on UNIX and support TCP/IP. RQS is written in C for code transportability. Users can submit jobs to UNICOS, control the jobs, and request status about the submitted jobs through RQS without logging into the Cray Research system. NQS and RQS interfaces for users and administrators are the same; therefore, users and administrators need not learn two different systems to do their work. Because RQS communicates with the Cray Research system using TCP/IP, RQS can reside at any node in the network provided that the node uses a TCP/IP connection to the Cray Research system. RQS need not reside in all nodes.

### 2.2.3 Debuggers

Cray Research provides the following powerful and efficient debuggers as part of its standard system software:

- **adb**, the absolute debugger of UNIX System Laboratories, Inc. UNIX System V
- **CDBX**, a symbolic or absolute interactive debugger
- **DEBUG**, a symbolic dump utility
- **SYMDUMP**, a run-time symbolic dump utility
- **Dynamic Runtime Debugger (DRD) and Dynamic Dump Analyzer (DDA)**

The symbolic debuggers work with all language processors that generate debug symbol tables as part of their binary output.



This includes all compilers and the assembler on Cray Research systems. The debuggers allow the user to reference data items by their names in Fortran, C, Pascal, or CAL.

### 2.2.3.1 *adb*

The **adb** UNIX System V absolute debugger provides the capabilities to view memory locations of programs; to display memory data in octal, hexadecimal, integer, or floating point; to change memory locations of files; and to breakpoint programs. The **adb** debugger is documented in the *UNICOS User Commands Reference Manual*, publication SR-2011.

### 2.2.3.2 *CDBX*

CDBX is a source-level, symbolic, interactive debugger. Based on the 4.3BSD **dbx** debugger, CDBX contains enhancements to improve its utility on Cray Research computer systems. CDBX includes all **dbx** commands, except for the **whatis** command. The **dbx** command is an alternative command to invoke CDBX. If users enter the **dbx** command, they receive a message stating that the **dbx** debugger is not supported in UNICOS, and then CDBX is invoked.

CDBX is a powerful debugger that permits interactive debugging of applications written in Fortran, C, Pascal, or CAL (and any combination). CDBX includes commands that provide on-line help, handle signals, and provide information about symbols. CDBX uses source files, if available, printing the current source line when program execution reaches a breakpoint or completes a "step." It has commands to list lines from the source file, search the source file for character strings, and invoke an editor to more carefully examine or change the source file. A CDBX user can use symbolic references to variables, subroutines, or labels, or can use absolute addresses, and also has access to all of the registers in the mainframe.

CDBX supports an optional X Window System interface in addition to the traditional line-oriented interface. The X Window System interface presents users with a debugging window, which displays source code and the debugging session and permits commands to be entered using a mouse or keyboard.

CDBX is documented in the following publications:

- *UNICOS CDBX Symbolic Debugger Reference Manual*, publication SR-2091
- *UNICOS CDBX Debugger User's Guide*, publication SG-2094
- *UNICOS User Commands Reference Manual*, publication SR-2011

### 2.2.3.3 DEBUG

DEBUG provides another way to obtain symbolic interpretation of a user corefile. The DEBUG command requests a full, symbolic dump of the contents of all active variables in the application at the time the corefile was obtained. This listing can then be viewed offline. Options on the command line provide limited options for controlling the amount of information provided by DEBUG.

DEBUG is documented in the *UNICOS Symbolic Debugging Package Reference Manual*, publication SR-0112.

### 2.2.3.4 SYMDUMP

SYMDUMP is a subroutine that can be called from within an application to obtain output similar to that of DEBUG during execution of the application. This provides a convenient alternative to inserting print statements for variables being examined during debugging.

SYMDUMP is documented in the *UNICOS Symbolic Debugging Package Reference Manual*, publication SR-0112.

### 2.2.3.5 DRD and DDA

The Cray Research Dynamic Runtime Debugger (DRD) and Dynamic Dump Analyzer (DDA) are provided in UNICOS 5.1. However, they will be replaced by CDBX in the UNICOS 6.0 release.

DRD and DDA are documented in the *UNICOS Symbolic Debugging Package Reference Manual*, publication SR-0112.

## 2.2.4 Performance analysis tools

Cray Research provides the following performance analysis tools with CRAY XMS computer systems. Performance analysis tools are documented in the following publications:

- *UNICOS Performance Utilities Reference Manual*, publication SR-2040
- *UNICOS User Commands Reference Manual*, publication SR-2011

### 2.2.4.1 *ftref*

The **ftref** utility analyzes Fortran source listings and provides structural information about them. This analysis does not use information derived from executing a program. The analysis can contain the following information:

- Global cross-reference listing of common block variables, referenced by source line number.
- A listing for each program unit showing its entry point, calling program units, called subprograms, and common blocks used.
- A static call tree of all program units or any desired subset.

### 2.2.4.2 *procstat* and *procrpt*

The **procstat** utility gathers statistics on the input/output activity of the program being monitored, with only a minimum of overhead time incurred by **procstat** itself. The statistics gathered include the number of characters read and written, the number of I/O calls made, and the amount of wait time associated with the I/O requests. These statistics are gathered and reported for each individual file name.

In addition, **procstat** statistics show the amount of memory activity for the program being monitored, including the amount of memory requested and the number of times the system was called to service a memory-size change request.

The post-processor utility program **procrpt** organizes the statistics generated by **procstat** into a more readable report.

### 2.2.4.3 *prof* and *profview*

The **prof** profiling utility allows a user to determine areas of high execution activity of the program being monitored. Since the statistics are gathered by the UNICOS operating system, this utility has little impact on the user's program. Areas of high execution activity are made visible by **prof**, showing how often the particular instruction program area was executed by percentage, hit count, and estimated time. The **prof** analysis tool indicates which routine contained the high activity, showing the localized area down to the level of an individual Fortran line number. By studying the data provided by **prof**, the user can determine which routines need further optimization efforts and which routines can be safely de-emphasized from the optimization efforts.

The interactive utility **profview** makes it easier for the user to review and study the statistics generated by the **prof** utility.

### 2.2.5 UNICOS libraries

Much of the power of UNICOS comes from its libraries. Through the I/O libraries, UNICOS supports a wide selection of Fortran I/O methods specific to Cray Research systems as well as standard methods. UNICOS provides a set of run-time commands and tools, such as **procstat** and **assign**, that allow the user to analyze and optimize the I/O within programs, often without changing the source code.

UNICOS offers an unusually powerful facility called Flexible File I/O (FFIO) to address the incompatibility of data files across a network of different systems. FFIO permits a program to process non-native files on Cray Research systems as if they are native, simply by letting the user identify such files to the library via a command. FFIO also permits the user to utilize memory and other resources to improve Fortran I/O performance.

UNICOS also offers an optimized ANSI C library and a highly optimized library of elementary mathematical routines used by Fortran and C.

UNICOS system libraries are documented in the following Cray Research publications:

- *Volume 1: UNICOS Fortran Library Reference Manual*, publication SR-2079
- *Volume 2: UNICOS C Library Reference Manual*, publication SR-2080
- *Volume 3: UNICOS Math and Scientific Library Reference Manual*, publication SR-2081
- *Volume 4: UNICOS System Calls Reference Manual*, publication SR-2012
- *Volume 5: UNICOS Network Library Reference Manual*, publication SR-2057

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#### Note

Cray Research maintains a directory of all applications software currently available for Cray Research computer systems. The Cray Research Industry, Science, and Technology Department contributes Cray Research-developed packages and serves as a focal point for information on user-developed packages. Third-party applications are subject to vendor quality assurance and license fee procedures when moved to a new hardware platform such as the CRAY XMS system. Negotiations for such licensing are in process. For additional information about applications software available for CRAY XMS computer systems, contact your Cray Research account representative.

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### 2.2.6 Key UNICOS enhancements to basic UNIX

Cray Research has made enhancements to basic UNIX, but the traditional UNIX user interface is preserved in the UNICOS environment. Some key enhancements that enable UNICOS to fully use the power of your CRAY XMS system are highlighted in this subsection. Please refer to the technical documentation

provided with your CRAY XMS system for complete information for the following and for all UNICOS features.

### 2.2.6.1 Job and process recovery

Two UNICOS commands, **chkpnt** and **restart**, allow the user to checkpoint and restart a process or an entire job. All checkpoint and recovery decisions are made at the user level. For an orderly system shutdown, the system sends out a SIGSHUTDN signal to all processes, indicating that a shutdown is imminent.

The **chkpnt** and **restart** commands call the following:

- The **chkpnt** system call causes a user process or job to checkpoint its current operating environment to the named restart file. Processes with open pipes can be checkpointed and restarted if their pipe connections do not go outside the job group being checkpointed.

A restart file contains sufficient information to restart the process or job described by the checkpoint image, provided that the required files are present.

- The **restart** system call causes recovery of the process or job described in the named restart file. The system verifies that the process or job can recover from the last checkpoint image.

Jobs run under NQS are automatically recovered through orderly scheduled shutdowns.

The **qchkpnt** command permits the batch job to perform a checkpoint and resume processing. This capability allows protection from unscheduled system interruptions by creating a restart file that NQS can use to restart jobs during the next system startup.

The **chkpnt**, **qchkpnt**, and **restart** commands are documented in the *UNICOS User Commands Reference Manual*, publication SR-2011. The **chkpnt** and **restart** system calls are documented in *Volume 4: UNICOS System Calls Reference Manual*, publication SR-2012.

### 2.2.6.2 User database (UDB)

A versatile facility called the user database (UDB) is provided, which includes an entry for each user allowed to run jobs or log

onto a UNICOS system. The UDB is derived from the `uentry` file implemented in previous UNICOS systems; this file, in turn, was based on the traditional `/etc/passwd` and `/etc/group` UNIX files. The UDB can be used to quickly access an individual user's information and to allow the safe change of information about a user from multiple sources.

All jobs and processes that enter the running system are assigned limit information obtained from the UDB. This action occurs for interactive as well as batch access.

The UDB is documented in the following publications:

- *UNICOS User Commands Reference Manual*, publication SR-2011
- *UNICOS File Formats and Special Files Reference Manual*, publication SR-2014
- *UNICOS System Administrator's Guide for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems*, publication SG-2018
- *UNICOS Administrator Commands Reference Manual*, publication SR-2022
- *Volume 2: UNICOS C Library Reference Manual*, publication SR-2080

### 2.2.6.3 Share scheduling facility

The UNICOS share scheduling facility allows explicit allocation of predetermined, administrator-specified shares of CPU resources on a per-user and per-group basis. The share allocation is accomplished by analysis of historical data of usage that is accumulated by the UNICOS kernel. The analysis is performed by a daemon process that advises the kernel through priority adjustments. The facility is based on a package written by the University of Sydney called the Sydney Fair Share Scheduler. The UNICOS share scheduling facility relies on the user database (UDB) feature.

The UNICOS share scheduling facility is documented in the following publications:

- *UNICOS User Commands Reference Manual*, publication SR-2011

- *Volume 4: UNICOS System Calls Reference Manual*, publication SR–2012
- *UNICOS File Formats and Special Files Reference Manual*, publication SR–2014
- *UNICOS Administrator Commands Reference Manual*, publication SR–2022
- *UNICOS System Administrator's Guide for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems*, publication SG–2018

#### 2.2.6.4 Accounting

UNICOS provides the Cray Research system user and the system administrator with accurate measurements of the user's resource usage. Both standard UNIX System Laboratories, Inc. UNIX System V process accounting and the enhanced Cray Research system accounting (CSA) are provided. Information available for user jobs includes interactive sessions and NQS jobs.

UNICOS accounting provides the following:

- Process accounting, including features such as elapsed time, CPU time, memory usage, I/O requests, I/O wait time (lock and unlock in memory), and device usage and connect time.
- Job accounting, including features such as summary of file system usage, accumulation of process statistics, and NQS queue time.
- Administration tools, including flexible billing, flexible nonperiodic/periodic accounting report generation, and accounting file management.

UNICOS accounting is documented in the following publications:

- *UNICOS System Administrator's Guide for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems*, publication SG–2018
- *UNICOS Administrator Commands Reference Manual*, publication SR–2022



- *UNICOS User Commands Reference Manual*, publication SR-2011
- *UNICOS File Formats and Special Files Reference Manual*, publication SR-2014

### 2.2.6.5 Resource management

The following resource management software is part of standard UNICOS.

- **System performance:** The **crayperf** facility, composed of the **crayperfd** daemon and the **crayperf** display program, allows system administrators to monitor in real time the performance of a Cray Research system running UNICOS. It is an application for displaying graphical data about system performance. It also manages a set of displays showing data received from the **crayperfd** daemon. The displays are windows in the X Window System Version 11, Release 3.

The **crayperf** facility is documented in the following publications:

- *UNICOS Administrator Commands Reference Manual*, publication SR-2022
- *UNICOS System Administrator's Guide for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems*, publication SG-2018
- **Disk offloading support:** Physical devices can be marked "read only," inhibiting further file allocation. Files can be removed from the device and saved in another designated area when the device is having hardware problems.

Disk offloading support is documented in the following publications:

- *UNICOS Administrator Commands Reference Manual*, publication SR-2022
- *UNICOS System Administrator's Guide for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems*, publication SG-2018
- **Disk quotas:** The disk quotas feature (also referred to as the file system quotas feature) provides a mechanism that allows system administrators to control the amount of disk space used by various clients. This capability limits the total

volume of disk space consumed by a user, by a group, or by an account. Both file space and the number of files can be limited. File systems may be configured individually. A “soft limit” is provided to give a warning when the quota is becoming exhausted; a “hard limit” sets the upper boundary. A per-user background process called **quotamon** waits for quotas signals to generate messages. It incurs little CPU overhead; however, it does require a slot in the process table.

The disk quotas feature is documented in the following publications:

- *UNICOS User Commands Reference Manual*, publication SR-2011
  - *UNICOS Administrator Commands Reference Manual*, publication SR-2022
  - *UNICOS System Administrator’s Guide for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems*, publication SG-2018
  - *UNICOS File Formats and Special Files Reference Manual*, publication SR-2014
- **File system monitor:** The file system monitor provides for management of “disk full” conditions. It consists of a daemon that watches the volume of free space in all configured file systems, along with an operator interface, **fsmon**, that displays information on current disk capacity. The monitor provides a warning mechanism that is triggered at either of two optional threshold values. The warning mechanism works independently for each file system. When free space falls below a threshold, site-specified policing action can be initiated. A different policing action can be applied at each threshold. The file system monitor is capable of signaling other system components, such as NQS, to prohibit new work from entering the system.

The file system monitor is documented in the following publications:

- *UNICOS System Administrator’s Guide for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems*, publication SG-2018
- *UNICOS Administrator Commands Reference Manual*, publication SR-2022

- **Resource limits:** The `limit` system call provides the capability to record and enforce resource limits. Additionally, whenever processes initiate under UNICOS, either as batch or interactive, limit information is extracted from the UDB and assigned to the new process via the `limit` system call.

The resource limits feature is documented in the following publications:

- *UNICOS Administrator Commands Reference Manual*, publication SR-2022
  - *Volume 4: UNICOS System Calls Reference Manual*, publication SR-2012
  - *UNICOS System Administrator's Guide for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems*, publication SG-2018
- **Memory scheduling:** Weighting factors in the algorithm used to calculate memory priority allow a site to determine the relative importance of job size, job priority, and time out of memory when ordering jobs that are eligible for core residence.

The memory scheduling feature is documented in the following publications:

- *UNICOS System Administrator's Guide for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems*, publication SG-2018
- *UNICOS Administrator Commands Reference Manual*, publication SR-2022
- *Volume 4: UNICOS System Calls Reference Manual*, publication SR-2012



# 3. Documentation and Training

This section describes the technical documentation and training workbooks provided with a CRAY XMS computer system. The publications order form is included at the end of this section and provides a complete list of documentation that supports CRAY XMS computer systems.

## 3.1 Documentation

The following publications are provided with the CRAY XMS computer system, which are CRAY XMS-specific:

- *Differences for UNICOS 5.1 on the CRAY XMS Systems* technical note, publication SN-3086
- *CRAY XMS Systems IOS Reference Guide*, publication SG-3085
- *UNICOS 5.1 System Installation Bulletin for CRAY XMS Systems*, publication UC-05.1-UDN-RN

In addition, the other publications provided with the CRAY XMS computer system also support CRAY Y-MP, CRAY X-MP, and CRAY-1 systems. Because these publications were printed prior to the development of the CRAY XMS computer system, they do not specify that they also support CRAY XMS systems. Since these publications also support CRAY Y-MP, CRAY X-MP, and CRAY-1 systems, it is important to read the *Differences for UNICOS 5.1 on the CRAY XMS Systems* technical note, publication SN-3086. This technical note identifies UNICOS 5.1 software features documented in Cray Research publications that are not supported on CRAY XMS systems. Generally, the features are the following:

- Multitasking support (CRAY XMS systems have only 1 CPU)
- Front-end station support
- High-performance tape support

- SSD and buffer memory support (ldcache)
- Multilevel security support

### 3.1.1 On-line documentation

Some of the reference documentation provided with CRAY XMS systems is also available on-line in preformatted files called manual (man) pages. These man pages can be accessed by using the **man** command. The following documentation is included on-line (man pages) with the software package for CRAY XMS systems:

- *UNICOS User Commands Reference Manual*, publication SR-2011
- *UNICOS Administrator Commands Reference Manual*, publication SR-2022
- *CRAY XMS Systems IOS Reference Guide*, publication SG-3085
- *UNICOS File Formats and Special Files Reference Manual*, publication SR-2014
- *Volume 1: UNICOS Fortran Library Reference Manual*, publication SR-2079
- *Volume 2: UNICOS C Library Reference Manual*, publication SR-2080
- *Volume 3: UNICOS Math and Scientific Library Reference Manual*, publication SR-2081
- *Volume 4: UNICOS System Calls Reference Manual*, publication SR-2012
- *Volume 5: UNICOS Network Library Reference Manual*, publication SR-2057

The software package also offers both a permuted index and a functional index for these publications in on-line form. These indexes are accessed with the **man** command options **-k** and **-i**, respectively.

### 3.1.2 General UNIX documentation

Several useful publications not available through Cray Research, Inc. describe the UNIX operating system. *Understanding UNIX: A Conceptual Guide*, by Groff and Weinberg, is a good overview for management or the casual user. *The UNIX Programming Environment*, by Kernighan and Pike, provides a more in-depth study appropriate for programmers using UNIX systems. The following bibliography lists these and other useful books on UNIX systems and the C Language:

- Bach, Maurice T. *The Design of the UNIX Operating System*. Prentice-Hall, 1986.
- Birns, Brown, and Muster. *UNIX for People*. Prentice-Hall, 1985.
- Comer, D. *InterNetworking with TCP/IP Principles, Protocols, and Architecture*. Prentice Hall, 1988.
- Kernighan, Brian W. and Dennis M. Ritchie. *The C Programming Language*. Prentice-Hall.
- Kernighan, Brain W. and Rob Pike. *The UNIX Programming Environment*. Prentice-Hall, 1984.
- Leffler, Samuel J., Marshall Kirk McKusick, Michael J. Karels, and John S. Quarterman. *The Design and Implementation of the 4.3BSD UNIX Operating System*. Addison-Wesley Publishing Company, 1989.
- McGilton, H. and Rachel Morgan. *Introducing The UNIX System*. McGraw Hill, 1983.
- Plum, T. *C Programming Guidelines*. Plum-Hall.
- Plum, T. *Learning to Program in C*. Plum-Hall.
- Sobell, Mark G. *A Practical Guide to UNIX System V*. Benjamin Cummings, 1985.
- Wood, Patrick H., and Stephan G. Kochan. *UNIX System Security*. Hayden Book Company, 1985.
- "UNIX System." *AT&T Bell Laboratories Technical Journal* (October 1984).
- "UNIX Time-Sharing System." *Bell System Technical Journal*, vol. 57, no. 6, part 2 (July/August 1978).

## 3.2 Training

The following three training workbooks are provided with CRAY XMS systems:

- *UNICOS 5.1 Command Language and Shell Programming Course*, workbook XMS-UCL 5.1
- *UNICOS 5.1 Utility Programs Course*, workbook XMS-UUP 5.1
- *UNICOS 5.1 System Administration Course*, workbook XMS-USA 5.1

These workbooks, along with the technical publications provided, serve as the base of a self-study program for customer system administrators.

In addition, Cray Research training courses are available on a tuition basis to customers with CRAY XMS systems. The UNICOS System Administration (USA) course offered by Cray Research is currently available. During the first half of 1991, a special system administration course will be available to customers who have systems supported by a Cray Research service center. This course will address system administration in a self-support environment, the operator console, the CRAY XMS IOS, and remote support issues.

Training is available for all current Cray Research software products. The Cray Research *Software Training Catalog* provides course descriptions, training schedules, and registration information. For more information on training contact:

- Your local Cray Research training coordinator. If you are within the U.S. and east of the Mississippi River, call (301) 595-5100; if you are within the U.S. and west of the Mississippi River, call (800) 283-8998.
- Your Cray Research account representative.
- Cray Research Corporate Training Center (612) 683-3825.



### 3.3 CRAY XMS system publications order form

The software package provided with your CRAY XMS system contains one set of technical documentation and training workbooks to support your CRAY XMS system running the UNICOS 5.1 release. Please use this order form to order any **additional** publications.

Cray Research 3-ring binders are available and can also be ordered using this order form (see subsection 3.3.2, "Binders").

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Company: \_\_\_\_\_ Telephone number: \_\_\_\_\_

Purchase order number: \_\_\_\_\_

Bill to: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Ship to: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Send the completed order form to:

**Mail to:** Cray Research, Inc.  
2360 Pilot Knob Road  
Mendota Heights, MN 55120 U.S.A.  
Attention: Distribution Center - Order Desk

You can also fax your order form to (612) 681-5920 or call the order desk at one of the following numbers:

- (800) 284-2729, extension 5901 or 5907
- (612) 681-5901
- (612) 681-5907

### 3.3.1 Additional publications

Please indicate the number of additional publications you are ordering on the appropriate blank. To order Cray Research binders for the additional publications you are ordering from this form, refer to subsection 3.3.2, "Binders."

#### 3.3.1.1 General UNICOS manuals

Qty.	Stock No.	Publication
___	SG-3093	<i>A Brief Overview of Your CRAY XMS System</i> ; contact the Cray Research Distribution Center for price.
___	SR-2011 5.0	<i>UNICOS User Commands Reference Manual</i> , Price: \$54.55 (BIND SL L 3)
___	SQ-2056 5.0	<i>UNICOS User Commands Ready Reference</i> , Price: \$8.25
___	SN-3086	<i>Differences for UNICOS 5.1 on the CRAY XMS Systems</i> ; contact the Cray Research Distribution Center for price. (BIND SL L 1)
___	SR-2049 5.0	<i>UNICOS Index for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems</i> , Price: \$50.30 (BIND SL L 1.5)
___	SR-2040 B	<i>UNICOS Performance Utilities Reference Manual</i> , Price: \$14.50 (BIND SL L 1)
___	SR-2014 5.0	<i>UNICOS File Formats and Special Files Reference Manual</i> , Price: \$26.65 (BIND SL L 1)
___	SR-2015 5.0	<i>UNICOS Kernel Error Message Manual</i> , Price: \$13.70 (BIND SL L 1)
___	SQ-2060	<i>UNICOS Shell and Variable Ready Reference</i> , Price: \$7.60
___	SG-2053	<i>UNICOS Overview for Data Center Managers</i> , Price: \$28.05 (BIND SL L 1)
___	SG-2009 D	<i>TCP/IP Network User's Guide</i> , Price: \$13.85 (BIND SL L 1)
___	SR-2089	<i>Remote Procedure Call (RPC) Reference Manual</i> , Price: \$17.00 (BIND SL L 1)
___	SG-2010 C	<i>UNICOS Primer</i> , Price: \$23.40 (BIND SL L 1)
___	SG-2050	<i>UNICOS Text Editors Primer</i> , Price: \$19.25 (BIND SL L 1)
___	SG-2052 A	<i>UNICOS Overview for Users</i> , Price: \$14.00 (BIND SL L 1)
___	SQ-2054	<i>UNICOS vi Reference Card</i> , Price: \$1.00
___	SQ-2055 A	<i>UNICOS ed Reference Card</i> , Price: \$1.00
___	SG-2017 B	<i>UNICOS Source Code Control System (SCCS) User's Guide</i> , Price: \$10.90 (BIND SL L 1)

<b>Qty.</b>	<b>Stock No.</b>	<b>Publication</b>
___	SG-2016 C	<i>UNICOS Support Tools Guide</i> , Price: \$28.20 (BIND SL L 1)
___	SN-2067	<i>Defining and Compiling terminfo Definitions for the UNICOS Operating System</i> , Price: \$2.65 (BIND SL L 1)

### 3.3.1.2 UNICOS administrator manuals

<b>Qty.</b>	<b>Stock No.</b>	<b>Publication</b>
___	UC-05.1-UDN-SIB	<i>UNICOS 5.1 System Installation Bulletin for the CRAY XMS Systems</i> ; contact the Cray Research Distribution Center for price. (BIND SL L 1)
___	SG-2018 C	<i>UNICOS System Administrator's Guide for CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 Computer Systems</i> , Price: \$53.70 (BIND SL L 1.5)
___	SG-3085	<i>CRAY XMS Systems IOS Reference Guide</i> ; contact the Cray Research Distribution Center for price. (BIND SL L 1.5)
___	SR-2022 5.0	<i>UNICOS Administrator Commands Reference Manual</i> , Price: \$39.25 (BIND SL L 1.5)
___	SG-2021 D	<i>TCP/IP Network Administrator's Guide</i> , Price: \$36.05 (BIND SL L 1)
___	SG-2063	<i>UNICOS Yellow Pages (YP) Administrator's Guide</i> , Price: \$9.80 (BIND SL L 1)
___	SR-2064 A	<i>UNICOS NFS Administrator's Manual</i> , Price: \$18.95 (BIND SL L 1)

### 3.3.1.3 Product and language processor manuals

<b>Qty.</b>	<b>Stock No.</b>	<b>Publication</b>
___	SR-3071	<i>CF77 Compiling System, Volume 1: Fortran Reference Manual</i> , Price: \$43.20 (BIND SL L 1.5)
___	SQ-3070	<i>CF77 Compiling System Ready Reference</i> , Price: \$6.65
___	SR-3072	<i>CF77 Compiling System, Volume 2: Compiler Message Manual</i> , Price: \$16.05 (BIND SL L 1)
___	SG-3074	<i>CF77 Compiling System, Volume 4: Parallel Processing Guide</i> , Price: \$38.15 (BIND SL L 1.5)
___	SR-2074 2.0	<i>Cray Standard C Programmer's Reference Manual</i> , Price: \$34.15 (BIND SL L 1)
___	S1-2074	<i>Plauger and Brodie's Standard C Programmer's Quick Reference</i> , Price: \$7.95

Qty.	Stock No.	Publication
___	SR-0066 F	<i>Segment Loader (SEGLDR) and ld Reference Manual</i> , Price: \$17.00 (BIND SL L 1)
___	SQ-0303 A	<i>SEGLDR Reference Card</i> , Price: \$1.50
___	SR-2091 5.1	<i>UNICOS CDBX Symbolic Debugger Reference Manual</i> , Price: \$32.15 (BIND SL L 1)
___	SG-2094 5.0	<i>UNICOS CDBX Debugger User's Guide</i> , Price: \$20.05 (BIND SL L 1)
___	SR-0112 C	<i>UNICOS Symbolic Debugging Package Reference Manual</i> , Price: \$17.00 (BIND SL L 1)
___	SR-0013 J	<i>UPDATE Reference Manual</i> , Price: \$25.50 (BIND SL L 1)
___	SQ-0302 A	<i>UPDATE Directives Reference Card</i> , Price: \$1.50
___	SR-0074 C	<i>SORT Reference Manual</i> , Price: \$17.65 (BIND SL L 1)
___	SR-0085 B	<i>Symbolic Machine Instructions Reference Manual</i> , Price: \$22.30 (BIND SL L 1)
___	SQ-0083 C	<i>CRAY Y-MP, CRAY X-MP EA, CRAY X-MP, and CRAY-1 CAL Assembler Version 2 Ready Reference</i> , Price: \$9.30
___	SR-2003 C	<i>CAL Assembler Version 2 Reference Manual</i> , Price: \$39.45 (BIND SL L 1.5)

#### 3.3.1.4 Library, macros, and opdefs manuals

Qty.	Stock No.	Publication
___	SR-2079 5.0	<i>Volume 1: UNICOS Fortran Library Reference Manual</i> , Price: \$36.40 (BIND SL L 1.5)
___	SR-2080	<i>Volume 2: UNICOS C Library Reference Manual</i> , Price: \$49.15 (BIND SL L 1.5)
___	SR-2081 5.0	<i>Volume 3: UNICOS Math and Scientific Library Reference Manual</i> , Price: \$34.40 (BIND SL L 1)
___	SR-2012 5.0	<i>Volume 4: UNICOS System Calls Reference Manual</i> , Price: \$19.95 (BIND SL L 1)
___	SR-2057 5.0	<i>Volume 5: UNICOS Network Library Reference Manual</i> , Price: \$18.90 (BIND SL L 1)
___	SR-0012 D	<i>Macros and Opdefs Reference Manual</i> , Price: \$35.50 (BIND SL L 1)

**3.3.1.5 Software training workbooks and training catalog****Qty. Stock No. Publication**

\_\_\_ XMS-UCL 5.1 *UNICOS 5.1 Command Language and Shell Programming Course*,  
Price: \$40.00 (BIND SL L 1.5)

\_\_\_ XMS-UUP 5.1 *UNICOS 5.1 Utility Programs Course*, Price: \$35.00 (BIND SL L 1.5)

**Qty. Stock No. Publication**

\_\_\_ XMS-USA 5.1 *UNICOS 5.1 System Administration Course*, Price: \$55.00 (BIND SL L 2)

\_\_\_ TR-CUSTCAT *Cray Research, Inc. Software Training Catalog for Customers*

**3.3.2 Binders**

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