Introducing CrayLibs

IN–2167 2.0

Cray Research, Inc.

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The UNICOS operating system is derived from UNIX® System V. The UNICOS operating system is also based in part on the Fourth Berkeley Software Distribution (BSD) under license from The Regents of the University of California.

Cray Research Software Documentation Map

The information on the following pages highlights the major body of documentation available for Cray Research customers. The manuals are organized into categories by product designation:

Product	Description
Programming environments	Cray Research programming environments provide an integrated development environment by combining compilers with development tools and libraries.
UNICOS operating system	The UNICOS operating system provides basic system control and management functions. It provides services, including basic batch and interactive system access for users, operating system interfaces for programmers, networking facilities, and sophisticated resource management for administrators. UNICOS MAX, in conjunction with UNICOS on the host system, provides operating system functionality on CRAY T3D systems.
Networking products	Cray Research networking products provide media connections, network programming access, and batch and interactive access for users across a heterogeneous network of computers.
Operating systems supplementary products	The operating systems supplementary products include a variety of products that are used in conjunction with Cray Research operating systems but are not included on the same media.

To use the map, find the product designation closest to your specific needs or role as a Cray Research system user. Documents listed under other categories also may be of interest to you; documents are listed only once, underneath the product to which they most directly apply. The date on the bottom of the page tells you when the information was last revised.

For more information

In addition to the map, you can use the following publications to find documentation specific to your needs:

- *Software Documentation Ready Reference,* publication SQ–2122, serves as a general index to the Cray Research documentation set. The booklet lists documents and man pages according to topic.
- *Software Overview for Users*, publication SG–2052, provides an overview of Cray Research software, including operating systems, programming environments, libraries, tools, applications, and so on. It directs you to documentation that contains user-level information.
- *User Publications Catalog*, publication CP–0099, briefly describes all Cray Research manuals available to you, including some not shown on the map. Cray Research customers who subscribe to the Cray Inform (CRInform) program can access this information on CRInform.

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Programming Environments

Ada

Cray Ada Environment, Volume 1: Reference Manual (SR–3014)

Cray Ada Environment, Volume 2: Programming Guide (SR–3082)

Assemblers

Cray Assembler for MPP (CAM) Reference Manual (SR–2510)†

Cray Assembly Language (CAL) for Cray PVP Systems Ready Reference (SQ–3110)

Cray Assembly Language (CAL) for Cray PVP Systems Reference Manual (SR–3108)†

Fortran Compilers

CF90 Ready Reference (SQ–3900)

CF90 Commands and Directives Reference Manual (SR–3901)†

CF90 Fortran Language Reference Manual, Vol. 1 (SR–3902)†

CF90 Fortran Language Reference Manual, Vol. 2 (SR–3903)†

CF90 Fortran Language Reference Manual, Vol. 3 (SR–3905)†

CF90 SPARC Ready Reference (SQ–3904)

Introducing the CF90 SPARC Programming Environment (IN–2155)†

Cray MPP Fortran Reference Manual (SR–2504)†

CF77 Fortran Language Reference Manual (SR–3772)

Cray Standard C Compiler

Cray Standard C Reference Manual (SR–2074)†

Cray Standard C Ready Reference (SQ–2076)

Cray Standard C Reference Manual for MPP (SR–2506)†

C++ Compiler

Cray C/C++ Reference Manual (SR–2179)†

Cray C/C++ Ready Reference (SQ–2180)

CrayLibs

Application Programmer's I/O Guide (SG–2168)†

Application Programmer's Library Reference Manual (SR–2165)*

Introducing CrayLibs (IN–2167)†

Math Library Reference Manual (SR–2138)*

Parallel Virtual Machine (PVM) Reference Card (SQ–2512)

PVM and HeNCE Programmer's Manual (SR–2501)†

Scientific Libraries Reference Manual (SR–2081)*

CrayTools

Compiler Information File (CIF) Reference Manual (SR–2401)†

Cray TotalView Debugger Reference Card (SQ–2519)

Guide to Parallel Vector Applications (SG–2182)†

Introducing the Cray TotalView Debugger (IN–2502)†

Introducing the MPP Apprentice Tool (IN–2511)†

Introducing the Program Browser (IN–2140)†

UNICOS CDBX Symbolic Debugger Reference Card (SQ–2110)

UNICOS CDBX Symbolic Debugger Reference Manual (SR–2091)†

UNICOS CDBX Debugger User's Guide (SG–2094)†

General

Cray Research MPP Software Guide (SG–2508)†

CRAY T3D Emulator User's Guide (SG–2500)†

Installing Programming Environment Products (SG–5191)

Migrating to the CRAY T90 Series IEEE Floating Point (SN–2194)†

Optimizing Code on Cray PVP Systems (SG–2192)†

Programming Environment Installation Guide (SG–5217)

Message Passing Toolkit

MPT: PVM Programmer's Manual (SR–2196)†

MPT: MPI Programmer's Manual (SR–2197)†

† Available with CrayDoc
* Man pages available with the `man` command

UNICOS Operating System

General UNICOS

Software Documentation Ready Reference (SQ–2122)

Software Overview for Users (SG–2052)†

User's Guide to Online Information (SG–2143)†

UNICOS `ed` Reference Card (SQ–2055)

UNICOS Environment Variables Ready Reference (SQ–2117)

UNICOS File Formats and Special Files Reference Manual (SR–2014)*

UNICOS Standard Shell Reference Card (SQ–2115)

UNICOS User Commands Ready Reference (SQ–2056)*

UNICOS User Commands Reference Manual (SR–2011)*

UNICOS `vi` Reference Card (SQ–2054)

UNICOS Visual Interfaces User's Guide (SG–3094)†

Networking Feature Use and Administration

Front-end Protocol Internal Reference Manual (SM–0042)

FTA User and Administrator Manual (SG–2144)†

Kerberos Administrator's Guide (SG–2306)†

Kerberos User's Guide (SG–2409)†

Network Queuing System (NQS) User's Guide (SG–2105)†

ONC+ Technology for the UNICOS Operating System (SG–2169)†

Remote Procedure Call (RPC) Reference Manual (SR–2089)†

TCP/IP Network User's Guide (SG–2009)†

UNICOS Networking Facilities Administrator's Guide (SG–2304)†

UNICOS NQS and NQE Administrator's Guide (SG–2305)†

UNICOS Station Call Processor (USCP) Administrator's Guide (SG–2308)†

UNICOS MAX

Cray MPP Loader User's Guide (SG–2514)†

Cray MPP Simulator User's Guide (SG–2503)†

CRAY T3D Administrator's Guide (SG–2507)†*

UNICOS Basic Administration and Operation

CRAY EL Series IOS Commands Ready Reference (SQ–2162)*

CRAY EL Series IOS Commands Reference Manual (SR–2408)*

CRAY EL Series IOS Messages (SQ–2402)

CRAY IOS-V Commands Reference Manual (SR–2170)*

CRAY IOS-V Messages (SQ–2172)†

General UNICOS System Administration (SG–2301)†

`nmake` Reference Card (SQ–2146)

OLNET Online Diagnostic Network Communications Program Maintenance Manual for UNICOS (SD–1021)†

Online Maintenance Tools Guide for Cray PVP Systems (SD–1012)†

UNICOS Basic Administration Guide for CRAY J90 Series and CRAY EL Series (SG–2416)†

UNICOS Configuration Administrator's Guide (SG–2303)†

UNICOS Installation Guide (SG–2112)

UNICOS Installation Guide for the CRAY EL Series (SG–5201)

UNICOS Installation Guide for the CRAY J90 Series (SG–5271)

UNICOS Installation Menu System Reference Card (SQ–2411)

UNICOS Installation/Configuration Menu System User's Guide (SG–2412)†

UNICOS Resource Administration (SG–2302)†

UNICOS Shared File System (SFS) Administrator's Guide (SG–2114)†

UNICOS Feature Use and Administration

UNICOS Administrator Commands Reference Manual (SR–2022)*

UNICOS Administrator Commands Ready Reference (SQ–2413)*

UNICOS Message System Programmer's Guide (SG–2121)†

UNICOS Multilevel Security (MLS) Feature User's Guide (SG–2111)†

UNICOS System Security Overview for Administrators (SG–2141)†

UNICOS Tape Subsystem Administrator's Guide (SG–2307)†

UNICOS Tape Subsystem User's Guide (SG–2051)†

UNICOS under UNICOS Administrator's Guide (SG–2156)†

† Available with CrayDoc
* Man pages available with the `man` command

UNICOS Operating System (continued)

Programming Support

Segment Loader (SEGLDR) and `ld` Reference Manual (SR–0066)†

SEGLDR Reference Card (SQ–0303)

UNICOS System Libraries Ready Reference (SQ–2147)*

UNICOS System Libraries Reference Manual (SR–2080)*

Programming Support (continued)

UNICOS Macros and Opdefs Reference Manual (SR–2403)*

UNICOS System Calls Reference Manual (SR–2012)*

UNICOS X Window System Reference Manual (SR–2101)†

X Window System Resources Ready Reference (SQ–2123)

Networking Products

ATM

Asynchronous Transfer Mode (ATM) Administrator's Guide (SG–2193)†

fy Driver

fy Driver Administrator's Guide (SG–2132)

HIPPI

HIPPI Channel Administrator's Guide (SG–2159)

Network Queuing Environment (NQE)

NQE User's Guide (SG–2148)†

NQE Ready Reference (SG–2149)

NQE Administration (SG–2150)†

Introducing NQE (IN–2153)†

RQS MVS

RQS User's Guide for IBM MVS Systems (SG–2405)

RQS Administrator's Guide for IBM MVS Systems (SG–2406)

Fiber Distributed Data Interface (FDDI)

Fiber Distributed Data Interface (FDDI) Administrator's Guide (SG–3091)

RQS VMS

RQS/NQC User's Guide for DEC OpenVMS/VAX and AXP Systems (SV–3151)

RQS/NQC Administrator's Guide for DEC OpenVMS/VAX and AXP Systems (SV–3152)

SUPERLINK VM

SUPERLINK VM User's Guide: RQS Component (SI–0170)

SUPERLINK VM Administrator's Guide: RQS Component (SI–0171)

SUPERLINK VMS

SUPERLINK Administrator's Guide for DEC VAX/VMS Systems (SV–3154)

SUPERLINK User's Guide for DEC VAX/VMS Systems (SV–3153)

Operating Systems Supplementary Products

CCMT

Concurrent Maintenance Tools (CCMT) Guide (SD–1027)†

Cray/REELlibrarian (CRL)

Cray/REELlibrarian (CRL) Administrator's Guide (SG–2127)

Cray/REELlibrarian (CRL) User's Guide (SG–2126)

SMARTE

System Maintenance and Remote Testing Environment (SMARTE) Guide (SD–1017)†

Data Migration Facility (DMF)

Cray Data Migration Facility (DMF) Administrator's Guide (SG–2135)†*

Cray Data Migration (DMF) MSP Writer's Guide (SN–2098)†

OWS

Support System Reference Manual (SR–3077)*

Support System Operator's Guide (SG–3078)†

Support System Administrator's Guide (SG–3079)†

Support System Ready Reference (SQ–3080)

† Available with CrayDoc
* Man pages available with the `man` command

Record of Revision

The date of printing or software version number is indicated in the footer.

Version	*Description*
1.1	June 1994. Original printing. This manual documents the CrayLibs product released with the Programming Environment 1.1 release for Cray Research massively parallel processing (MPP) systems and Cray Research parallel vector processing (PVP) systems.
1.2	October 1994. Revised to support the Programming Environment 1.2 release for Cray MPP systems and Cray PVP systems.
2.0	December 1995. Revised to support the Programming Environment 2.0 release for Cray MPP systems and Cray PVP systems.

Preface

This publication documents the Cray Research CrayLibs product released with the Programming Environment version 2.0. The CrayLibs product contains several libraries (a collection of subprograms grouped around specific subjects). The library routines can be called from source code written in a number of programming languages, including Fortran, C, Pascal, and assembly language.

The information in this document discusses new features for the Programming Environment (PE) 2.0 release, as well as new features which were added and released with PE 1.2.1 and PE 1.2.2. All new features are relevant for Cray Research parallel vector processing (PVP) systems or Cray Research massively parallel processing (MPP) systems only; they are not valid for CRAY X-MP or CRAY-2 systems.

The CrayLibs product includes the following libraries:

- The Application Libraries (composed of `libf`, `libdb`, `libu`, portions of `libc`, and `libsma`). Some library routines are released with UNICOS; see section 2, page 7, for details.
- The Math Library routines.
- The Scientific Library routines.
- The Shared Memory library.

Related publications

The following manuals document the CrayLibs product. All man pages in these manuals can also be viewed online by using the `man` command:

- *Math Library Reference Manual*, publication SR–2138
- *Scientific Libraries Reference Manual*, publication SR–2081
- *Application Programmer's Library Reference Manual,* publication SR–2165

The following Cray Research manuals describe the products in the Programming Environment. These publications describe the operating system, input/output (I/O), and other related topics.

- *Segment Loader (SEGLDR) and `ld` Reference Manual*, publication SR–0066
- *UNICOS User Commands Reference Manual*, publication SR–2011
- *UNICOS User Commands Ready Reference*, publication SQ–2056
- *Guide to Parallel Vector Applications*, publication SG–2182
- *Software Overview for Users*, publication SG–2052
- *UNICOS CDBX Symbolic Debugger Reference Manual*, publication SR–2091
- *UNICOS CDBX Debugger User's Guide*, publication SG–2094
- *Introducing the Program Browser*, publication IN–2140
- *Interlanguage Programming Conventions*, publication SN–3009
- *Application Programmer's I/O Guide*, publication SG–2168
- *UNICOS Visual Interfaces User's Guide*, publication SG–3094

In addition to these documents, several documents are available that describe Cray Research's compiler systems. Some of these manuals are as follows:

- *CF90 Ready Reference*, publication SQ–3900
- *CF90 Commands and Directives Reference Manual*, publication SR–3901
- *CF90 Fortran Language Reference Manual, Volume 1*, publication SR–3902
- *CF90 Fortran Language Reference Manual, Volume 2*, publication SR–3903
- *CF90 Fortran Language Reference Manual, Volume 3*, publication SR–3905

- *CF77 Commands and Directives*, publication SR–3771
- *CF77 Fortran Language Reference Manual*, publication SR–3772

Ordering publications

The *User Publications Catalog*, publication CP–0099, describes the availability and content of all Cray Research hardware and software documents that are available to customers. Cray Research customers who subscribe to the Cray Inform (CRInform) program can access this information on the CRInform system.

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Customers who subscribe to the CRInform program can order software release packages electronically by using the `Order Cray Software` option.

Customers outside of the United States and Canada should contact their local service organization for ordering and documentation information.

Conventions

The following conventions are used throughout this document:

Convention	Meaning
`command`	This fixed-space font denotes literal items such as commands, files, routines, path names, signals, messages, and programming language structures.
`manpage`(*x*)	Man page section identifiers appear in parentheses after man page names. The following list describes the identifiers: 1 User commands 1B User commands ported from BSD

Convention	Meaning
	2 System calls 3 Library routines, macros, and opdefs 4 Devices (special files) 4P Protocols 5 File formats 7 Miscellaneous topics 7D DWB-related information 8 Administrator commands Some internal routines (for example, the `ddcnt`() routine) do not have man pages associated with them.
variable	Italic typeface denotes variable entries and words or concepts being defined.
`user input`	This bold fixed-space font denotes literal items that the user enters in interactive sessions. Output is shown in nonbold, fixed-space font.
`abbreviation`	Underlining indicates the shortest possible abbreviation for a command.
[ ]	Brackets enclose optional portions of a command line.
...	Ellipses indicate that a preceding command-line element can be repeated.

The following machine naming conventions may be used throughout this document:

Term	Definition
Cray PVP systems	All configurations of Cray parallel vector processing (PVP) systems, including the following: CRAY C90 series (CRAY C916, CRAY C92A, CRAY C94, CRAY C94A, and CRAY C98 systems) CRAY C90D series (CRAY C92AD, CRAY C94D, CRAY C98D systems) CRAY EL series (CRAY Y-MP EL, CRAY EL92, CRAY EL94, and CRAY EL98 systems) CRAY J90 series (CRAY J916 and CRAY J932 systems) CRAY T90 series (CRAY T94, CRAY T916, and CRAY T932 systems) CRAY Y-MP E series (CRAY Y-MP 2E, CRAY Y-MP 4E, CRAY Y-MP 8E, and CRAY Y-MP 8I systems) CRAY Y-MP M90 series (CRAY Y-MP M92, CRAY Y-MP M94, and CRAY Y-MP M98 systems)
Cray MPP systems	All configurations of Cray massively parallel processing systems, including the CRAY T3D series (CRAY T3D MC, CRAY T3D MCA, and CRAY T3D SC systems)
All Cray Research systems	All configurations of Cray PVP and Cray MPP systems that support this release
SPARC systems	All SPARC platforms that run the Solaris operating system version 2.3 or later

The default shell in the UNICOS operating system, referred to in Cray Research documentation as the standard shell, is a version of the Korn shell that conforms to the following standards:

- Institute of Electrical and Electronics Engineers (IEEE) Portable Operating System Interface (POSIX) Standard 1003.2–1992
- X/Open Portability Guide, Issue 4 (XPG4)

The UNICOS operating system also supports the optional use of the C shell.

Cray UNICOS Version 9.0 is an X/Open Base 95 branded product.

The POSIX standard uses *utilities* to refer to executable programs that Cray Research documentation usually refers to as *commands*. Both terms may appear in this document.

Online information

The following types of online information products are available to Cray Research customers:

- CrayDoc online documentation reader, which lets you see the text and graphics of a document online. The CrayDoc reader is available on workstations. To start the CrayDoc reader at your workstation, use the `cdoc`(1) command.
- Man pages, which describe a particular element of the UNICOS operating system or a compatible product. To see a detailed description of a particular command or routine, use the `man`(1) command.
- UNICOS message system, which provides explanations of error messages. To see an explanation of a message, use the `explain`(1) command.
- Cray Research online glossary, which explains the terms used in a document. To get a definition, use the `define`(1) command.
- `xhelp` help facility. This online help system is available within tools such as the Program Browser (`xbrowse`) and the MPP Apprentice tool.

For detailed information on these topics, see the *User's Guide to Online Information*, publication SG–2143.

Reader comments

If you have comments about the technical accuracy, content, or organization of this document, please tell us. You can contact us in any of the following ways:

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- Contact your Cray Research representative and ask that a Software Problem Report (SPR) be filed. Use `PUBLICATIONS` for the group name, `PUBS` for the command, and `NO-LICENSE` for the release name.

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- Use the postage-paid Reader’s Comment Form at the back of the printed document.

We value your comments and will respond to them promptly.

Contents

Introduction [1]

This manual describes the CrayLibs product that is released with the Programming Environment version 2.0 for both Cray Research parallel vector processing (PVP) and Cray Research massively parallel processing (MPP) systems.

The new features for CrayLibs described in this document are available for Cray PVP systems or Cray MPP systems. This does not include CRAY X-MP or CRAY-2 systems.

This document contains the following sections:

- "Programming Environment 2.0 Features," page 7, contains general overview information about the current Programming Environment release.
- "Documentation History," page 13, contains a summary of the documentation history of the CrayLibs product set and contains a brief description of enhancements for the current release.
- "Syntax Summary: Application Library Routines," page 25, contains a brief synopsis of the command lines of all Fortran library routines.
- "Syntax Summary: Math Library Routines," page 89, contains a brief synopsis of the command lines of all Math Library routines.
- "Syntax Summary: Scientific Library Routines," page 113, contains a brief synopsis of the command lines of all Scientific Library routines.
- "Syntax Summary: Fortran Shared Memory (SHMEM) Routines," page 165, contains a brief synopsis of the command lines of all shared memory routines.

For details about the syntax summary for C library routines (the majority of which are **not** shipped with the CrayLibs product), see the *UNICOS System Libraries Ready Reference,* publication SQ–2147.

Calling functions from Fortran, C, or CAL

1.1

Because of differences in the calling sequences for these languages, and other language differences, there are variations in what functions can be called and how they are called.

Calling from Fortran Programs

1.1.1

Some of the function names given in this manual are in uppercase letters, and some are in lowercase letters. The Fortran language is case-insensitive, so the Cray Research Fortran compilers map all code in uppercase. This means that functions with lowercase names cannot be called from Fortran programs.

Calling from C programs

1.1.2

The C language is case-sensitive, so you must use the exact case specified in the documentation when coding references to a function.

All the functions documented in this manual are callable from C programs. The following rules can be used:

- When the function is not declared in a Standard C header, explicitly declare the function as external and specify the type of the return value.
- When calling the function, pass the address of the arguments by using the address operator (&) for each argument, or by using a pointer to the argument for the argument. Array names are considered to be addresses, so the address operator is not needed when using them.
- The value returned by the function is the value, not the address of the value.
- Specify the *fortran* keyword. The *fortran* keyword is a Cray Research extension to the C language and is useful when a C program calls a function following the Cray Research Fortran calling sequence. Specifying the *fortran* keyword causes the C compiler to verify that the arguments used in each call to the function are pass-by-address.

Calling from Cray Assembly Language (CAL)

1.1.3

External references from CAL are case-sensitive, so you must use the exact name for functions as specified in this manual. There are two standard calling methods supported by Cray Research for Math Library functions: call-by-register and call-by-address. Cray Research supports only the call-by-address method for the Scientific Library. For more information on the details of calling sequences, see the documentation for the `CALL` macro in the *UNICOS Macros and Opdefs Reference Manual,* publication SR–2403.

It is strongly recommended that function linkage be done by using the `CALL` macros. Direct user calls to functions using the return-jump instruction should be avoided.

Scalar functions return the result in registers S1 (and S2 if needed); results for complex and double precisions are returned in S3 and S4. Vector functions return their result in registers V1 (and V2 if needed); complex and double precisions are returned in V3 and V4. The number of elements computed for vector functions is determined by the contents of the vector -length register (VL) upon entry.

For example, to call the Math Library routine `SQRT` using the call-by-address sequence, let arg1 be the address of the argument.

CAL usage:

`EXT`	`SQRT`	Declare the name to be an external
`CALL`	`SQRT`,(arg1)	Call the function
(*result*)	S1	The result is returned in register S1 and stored at the address *result*

Note that the name `SQRT` must be uppercase.

To call the Math Library routine `SQRT` using the call-by-register convention, let S1 be the value of the argument.

CAL usage:

`EXT`	`SQRT%`	Declare the name to be an external
`CALLV`	`SQRT%`	Call the function
(*result*)	S1	The result is returned in register S1 and stored at the address *result*

To call the Math Library routine for vector `SQRT` using the call-by-register convention, let V1 be the value of the vector argument and VL be the vector length (between 1 and 64 values will be returned).

CAL usage:

`EXT`	`%SQRT%`	Declare the name to be an external
`CALLV`	`%SQRT%`	Call the function

The result is returned in register V1. The vector length register VL is unchanged.

Naming conventions
1.1.4

Most of the Cray Research Math Library functions adhere to the following naming convention:

`NAME`	Entry for call-by-address
`NAME%`	Entry for scalar call-by-register
`%NAME%`	Entry for vector call-by-register

Note that assembly language does not support generic function names or automatic data type conversion. For example, there is no Math Library `LOG` function for the logarithm routine. The user must specify either `ALOG`, `DLOG`, or `CLOG` for real, double-precision, or complex logarithm respectively, and the argument must be of the correct type (real, double-precision, or complex).

Register conventions

1.1.5

The documentation for some of the widely used user-callable functions contains the register usage convention for the function. Note that by default all the Cray Research Fortran compilers use the call-by-register convention for Math Library functions (it is the fastest calling sequence) and will put the % prefix or suffix on the function name where needed. If a Math Library function is declared `EXTERNAL` or `INTRINSIC`, then the compilers will generate code for call-by-address.

Programming Environment 2.0 Features [2]

This section describes significant changes in the Programming Environment for the 2.0 release and how those changes affect the CrayLibs product set.

The CrayLibs product contains the following components:

- Cray Research's Application Libraries
- Cray Research's Math Library
- Cray Research's Scientific Library

The following subsections discuss these libraries in more detail.

All new features added are intended for use on Cray PVP systems or Cray MPP systems; note that this does not include CRAY X-MP and CRAY-2 systems. See the Preface to this manual for a complete list of all machine types considered "Cray PVP systems" or "Cray MPP systems."

Application Libraries changes

2.1

This subsection briefly describes the changes to the Cray Research Application Libraries for the Programming Environment 1.2.1 and 2.0 releases.

Shared memory routines documented

2.1.1

The shared memory routines, which describe data passing, were added for the PE 1.2.1 release in online-only format. They are printed for the first time in the *Application Programmer's Library Reference Manual*, SR–2165 for the 2.0 release. The following is a list of these routines; for information about the routines, see the individual man pages or the `INTRO_SHMEM`(3) man page:

`SHMEM_AND`(3)	`SHMEM_MY_PE`(3)
`SHMEM_BARRIER`(3)	`SHMEM_OR`(3)
`SHMEM_BROADCAST`(3)	`SHMEM_PROD`(3)

SHMEM_CACHE(3)	SHMEM_PUT(3)
SHMEM_COLLECT(3)	SHMEM_QUIET(3)
SHMEM_IPUT(3)	SHMEM_SUM(3)
SHMEM_IXPUT(3)	SHMEM_SWAP(3)
SHMEM_LOCK(3)	SHMEM_WAIT(3)
SHMEM_MAX(3)	SHMEM_XOR(3)
SHMEM_MIN(3)	SHMEM_STACK(3)
START_PES(3)	INTRO_SHMEM(3)

New man pages added
2.1.2

The following new man pages were added for the PE 2.0 release to document new routines:

ffiolock(3C)
IEG2CRI(3F)
IEG2CRI_77(3F)
FSUP(3F)

Rewritten CALLSEQ(3F) man page
2.1.3

The CALLSEQ(3F) man page, which describes the calling sequence for subprograms, was rewritten for the PE 2.0 release.

Math Library changes
2.2

Information was incorporated about how the math library routines function on CRAY T90 systems which support IEEE arithmetic for the Programming Environment 2.0 release.

Scientific Library changes

2.3

This subsection briefly describes the changes to the Cray Research Scientific Library for the Programming Environment 1.2.1, 1.2.2, and 2.0 releases.

BLACS and FFT routines added

2.3.1

The following new routines were added for the PE 1.2.1 release:

GRIDINFO3D(3S)
PCOORD3D(3S)
PNUM3D(3S)
GRIDINIT3D(3S)
DESCINIT3D(3S)
DESCINIT(3S)
PCCFFT2D(3S)
PCCFFT3D(3S)
PCOORD3D(3S)
SHAD(3S)

Routine names changed/routines removed

2.3.2

The following routines were either removed or the names were changed for the PE 1.2.2 release:

Routine	Action
BLACS_INIT(3S)	name changed to BLACS_GRIDINIT(3S)
GRIDINFO(3S)	name changed to BLACS_GRIDINFO(3S)
PECOORD(3S)	name changed to BLACS_PCOORD(3S)
PENUM(3S)	name changed to BLACS_PNUM(3S)
IGMAX2D(3S)	name changed to IGAMX2D(3S)
IGMIN2D(3S)	name changed to IGAMN2D(3S)
ALOCBUFF(3S)	removed
FREEBUFF(3S)	removed

Section 2

Section 2

New routines added
2.3.3

The following new routines were added for the PE 1.2.2 release to support ScaLAP ACK:

INDXG2P(3S)	PSGETRF(3S)
INITBUFF(3S)	PSGETRI(3S)
NUMROC(3S)	PSGETRS(3S)
PSGEBRD(3S)	PSPOSV(3S)
PSGEHRD(3S)	PSPOTRF(3S)
PSGELQF(3S)	PSPOTRI(3S)
PSGEQLF(3S)	PSPOTRS(3S)
PSGEQPF(3S)	PSSYEVX(3S)
PSGEQRF(3S)	PSSYTRD(3S)
PSGERQF(3S)	PSTRTRI(3S)
PSGESV(3S)	PSTRTRS(3S)

The following routines were added for the PE 1.2.2 release to the BLACS (Basic Linear Algebra Communication Subprograms) group of routines:

BLACS_EXIT(3S)
BLACS_GRIDEXIT(3S)
BLACS_PINFO(3S)

The following routines were added for the PE 1.2.2 release to the FFT (Fast Fourier Transform) group of routines:

PSCFFT2D(3S)
PSCFFT3D(3S)

Additions to LAPACK library
2.3.4

All of the Driver routines and orthogonal factorization routines, including the QR, RQ, LQ, and QL decompositions, are provided at the PE 1.2.2 release for solving full-rank and rank-deficient linear least squares problems. In addition, the reductions to condensed form for eigenvalue and singular value problems are provided. See the INTRO_LAPACK(3S) man page for more information.

Renamed introductory man pages

2.3.5

Introductory man pages exist for all sections of the Scientific Libraries manual, describing the functionality of the routines in that section. These man pages have been renamed for the PE 2.0 release as follows:

- `INTRO_LIBSCI`(3S) describes the different categories of routines in the manual.
- `INTRO_BLAS1`(3S) describes the vector-vector linear algebra subprograms.
- `INTRO_BLAS2`(3S) (old name: `BLAS2`(3S)) describes the matrix-vector linear algebra subprograms.
- `INTRO_BLAS3`(3S) (old name: `BLAS3`(3S)) describes the matrix-matrix linear algebra subprograms.
- `INTRO_LAPACK`(3S) (old name: `LAPACK`(3S)) describes the LAPACK solvers for dense linear systems.
- `INTRO_CORE`(3S) (old name: `OUT_OF_CORE`(3S)) describes the Cray Research out-of-core routines for linear algebra.
- `INTRO_SPEC`(3S) (old name: `SPEC_SYS`(3S)) describes solvers for special linear systems.
- `INTRO_SPARSE`(3S) (old name: `SPARSE`(3S)) describes solvers for sparse linear systems.
- `INTRO_FFT`(3S) (old name: `FFT`(3S)) describes signal processing routines.
- `INTRO_MACH`(3S) (old name: `MACH_CON`(3S)) describes machine constant functions.
- `INTRO_SUPERSEDED`(3S) (old name: `SUPERSEDED`(3S)) describes superseded Scientific Library routines.
- `INTRO_BLACS`(3S) (old name: `BLACS`(3S)) describes the Basic Linear Algebra Communication Subprograms
- `INTRO_BLAS_S`(3S) (old name: `BLAS_S`(3S) describes the Basic Linear Algebra Subprograms for shared arrays.

Section 2

New man pages added
2.3.6

The following new man pages were added for the PE 2.0 release to describe support for the 32-bit FFT routines which were added in previous releases:

GGFFT(3S)	HCORRS(3S)
GHFFT(3S)	HGFFT(3S)
HCONV(3S)	HOPFILT(3S)
HCORR(3S)	

The following man pages were added at the PE 2.0 release to document the 32-bit BLAS routines:

GAXPY(3S)
GDOTC(3S)
GDOTU(3S)
HAXPY(3S)
HDOT(3S)

Documentation History [3]

This section provides a summary of the documentation release history of the different products shipped with CrayLibs 2.0. Each release of a product is described in individual subsections for the product.

This section contains the following subsections:

- "The Application Libraries" describes the documentation release history of the Application Libraries.
- "The Math Library," page 18, describes the documentation release history of the Math Library.
- "The Scientific Library," page 19, describes the documentation release history of the Scientific Library.

Note: The information in this section appears in reverse chronological order . The **most recent** release information appears first in each subsection.

Section 3

The Application Libraries

3.1

This subsection provides an overview of documented changes to the Application Libraries.

Documentation version 2.0

3.1.1

Documentation version 2.0 of the Application Libraries was released in October , 1995, with the CrayLibs 2.0 release and is documented in the *Application Programmer's Library Reference Manual*, publication SR–2165. This manual was split into 2 volumes; see the preface to the manual, or the `INTRO_APPLIBS`(3F) man page for a list of the contents of each volume.

Shared memory routines documented 3.1.1.1

The shared memory routines, which describe data passing, were added for the PE 1.2.1 release and were released in online-only format at that time. They are printed for the first time in the *Application Programmer's Library Reference Manual*, publication SR–2165, for the PE 2.0 release. The following is a list of these routines; for information about the routines, see the individual man pages or the INTRO_SHMEM(3) man page:

SHMEM_AND(3)	SHMEM_MY_PE(3)
SHMEM_BARRIER(3)	SHMEM_OR(3)
SHMEM_BROADCAST(3)	SHMEM_PROD(3)
SHMEM_CACHE(3)	SHMEM_PUT(3)
SHMEM_COLLECT(3)	SHMEM_QUIET(3)
SHMEM_IPUT(3)	SHMEM_SUM(3)
SHMEM_IXPUT(3)	SHMEM_SWAP(3)
SHMEM_LOCK(3)	SHMEM_WAIT(3)
SHMEM_MAX(3)	SHMEM_XOR(3)
SHMEM_MIN(3)	

Section 3

Other routines added 3.1.1.2

The following new man pages were added for the PE 2.0 release to document new routines and are printed in the *Application Programmer's Library Reference Manual*, publication SR–2165:

ffiolock(3C)
IEG2CRI(3F)
IEG2CRI_77(3F)
FSUP(3F)

The AQOPENM routine was added at this release, and is documented on the AQOPEN man page.

In addition, the CALLSEQ(3F) man page, which describe the calling sequence for subprograms, was rewritten for the PE 2.0 release.

Fortran intrinsics (printed version) moved
3.1.1.3

The Fortran intrinsic subroutines are now printed in the *CF90 Fortran Language Reference Manual, Volume 2*, publication SR–3903.

Documentation version 1.2
3.1.2

Documentation version 1.2 of the Application Libraries was released in October , 1994, with the CrayLibs 1.2 release. A new manual was created to document these routines for the Programming Environment. That manual, the *Application Programmer's Library Reference Manual*, publication SR–2165, documents all Fortran routines, Cray MPP synchronization routines, CF90 intrinsic subprograms and selected C routines. This subsection discusses the routines which are now printed in the *Application Programmer 's Library Reference Manual*.

Fortran intrinsics printed
3.1.2.1

The intrinsic procedures used with CF90 are now printed in the Intrinsic Procedures section of the *Application Programmer's Library Reference Manual* , publication SR–2165. See the `INTRO_INTRINSICS`(3I) man page for details about these procedures.

New routines added
3.1.2.2

The following new routines were added for the Programming Environment 1.2 release and are printed in the *Application Programmer's Library Reference Manual*, publication SR–2165:

`CRI2CRAY`(3F)	`PXFLINK`(3F)
`GETCALLERINFO`(3F)	`PXFOPEN`(3F)
`GETOARGC`(3F)	`PXFRENAME`(3F)
`GETVARGC`(3F)	`PXFRMDIR`(3F)
`PXFACCESS`(3F)	`PXFSTAT`(3F)
`PXFCHDIR`(3F)	`PXFSTRGET`(3F)
`PXFCHMOD`(3F)	`PXFSTRSET`(3F)
`PXFCHOWN`(3F)	`PXFUNAME`(3F)

Section 3

`PXFCHROOT`(3F)	`PXFUNLINK`(3F)
`PXFCREAT`(3F)	`TMPTC`(3F)

Cray MPP-only routines printed
3.1.2.3

The following routines are now printed in the *Application Programmer's Library Reference Manual*, publication SR–2165:

`BARRIER`(3C)	`TEST_BARRIER`(3C)
`CLEAR_EVENT`(3C)	`TEST_BARRIER`(3F)
`CLEAR_EVENT`(3F)	`TEST_EVENT`(3C)
`CLEAR_LOCK`(3F)	`TEST_EVENT`(3F)
`SET_BARRIER`(3C)	`TEST_LOCK`(3F)
`SET_BARRIER`(3F)	`WAIT_BARRIER`(3C)
`SET_EVENT`(3F)	`WAIT_BARRIER`(3F)
`SET_LOCK`(3F)	`WAIT_EVENT`(3C)
`INTRO_SYNC`(3F)	`WAIT_EVENT`(3F)

Section 3

FFIO C routines printed
3.1.2.4

The following C routines are now printed in the *Application Programmer's Library Reference Manual*, publication SR–2165. These routines are all used for Flexible File I/O (FFIO):

`fffcntl`(3C)	`ffreada`(3C)
`fflistio`(3C)	`ffseek`(3C)
`ffopen`(3C)	`ffwritea`(3C)
`ffpos`(3C)	`ffsetsp`(3C)
`ffread`(3C)	

Documentation Version 8.1
3.1.3

The Application Libraries were released in June, 1994, with the Cray MPP Programming Environment 1.1 release and the Programming Environment release for SPARC workstation platforms. The man pages supporting that release were available in online-only format.

Documentation version 8.1 of the Fortran Library was released in June, 1994, supporting the UNICOS 8.1 release. A manual was not printed at that time; the updated man pages were available in online-only format.

Documentation version 8.0
3.1.4

Documentation version 8.0 of the Fortran Library was released in January, 1994, to support the UNICOS 8.0 release. The man pages were available online and printed in the *UNICOS Fortran Library Reference Manual*, publication SR–2079. The following new routines were added at that time:

```
IEU2CRAY
NLOCKON
NLOCKOFF
BITVEC
```

The `SEARCH` routines were removed from the *Scientific Libraries Reference Manual* , publication SR–2081, and printed in the *UNICOS Fortran Library Reference Manual*, publication SR–2079. These routines are as follows:

```
CLUSFLT     SSORTB      ISRCHFLT
ILLZ        WHENFLT     ISRCHMEQ
INTMAX      WHENMLT     ORDERS
ISMAX       CLUSEQ      OSRCHM
ISRCHEQ     CLUSILT     WHENEQ
ISRCHILT    INFLMAX     WHENMEQ
ISRCHMLT    ISAMAX
```

Section 3

The Math Library

3.2

This subsection provides an overview of documented changes to the Math Library .

Documentation version 2.0

3.2.1

Documentation version 2.0 of the Math Library was released in October, 1995, with CrayLibs 2.0 and was documented in the *Math Library Reference Manual* , publication SR–2138. No new routines were added.

Documentation version 8.2

3.2.2

Documentation version 8.2 of the Math Library was released in October, 1994, with CrayLibs 1.2 and was documented in the *Math Library Reference Manual* , publication SR–2138. No new routines were added at that release.

Documentation version 8.1

3.2.3

Documentation version 8.1 of the Math Library was released in June, 1994, with CrayLibs 1.1. A manual was not printed for that release; the updated man pages were available online. This revision incorporated support for the Cray MPP hardware platform and the CF90 compiler. Support information was added to all man pages.

In addition, support for the older Math Library, `libmv1`, was discontinued as of this release. The documentation was changed to include only information about `libmv2`, which is the default Math Library.

Documentation version 8.0

3.2.4

Documentation version 8.0 of the Math Library was released in August, 1993, with CrayLibs 1.0 and was documented in a new manual entitled *Math Library Reference Manual,* publication SR–2138.

The `CBRT` and `DCBRT` routines were added in version 7.0.

The Scientific Library

3.3

This subsection provides an overview of documented changes to the Scientific Libraries.

Documentation version 2.0

3.3.1

Documentation version 2.0 of the Scientific Library was released in October, 1995, with CrayLibs 2.0 and is documented in the *Scientific Libraries Reference Manual*, publication SR–2081. This manual was split into 2 volumes; see the preface to the manual, or the `INTRO_LIBSCI`(3S) man page for a list of the contents of each volume.

New man pages printed

3.3.1.1

The following new routines were added for the PE 1.2.1 release in online-only format and are printed for the first time for the PE 2.0 release in the *Scientific Libraries Reference Manual*, publication SR–2081:

`GRIDINFO3D`(3S)
`PCOORD3D`(3S)
`PNUM3D`(3S)
`GRIDINIT3D`(3S)
`DESCINIT3D`(3S)
`DESCINIT`(3S)
`PCCFFT2D`(3S)
`PCCFFT3D`(3S)
`PCOORD3D`(3S)
`SHAD`(3S)

Section 3

Routine names changed/routines removed

3.3.1.2

The following routines were either removed or the names were changed for the PE 1.2.2 release; these changed routines are printed for the first time for the PE 2.0 release in the *Scientific Libraries Reference Manual*, publication SR–2081:

Routine	Action
BLACS_INIT(3S)	name changed to BLACS_GRIDINIT(3S)
GRIDINFO(3S)	name changed to BLACS_GRIDINFO(3S)
PECOORD(3S)	name changed to BLACS_PCOORD(3S)
PENUM(3S)	name changed to BLACS_PNUM(3S)
IGMAX2D(3S)	name changed to IGAMX2D(3S)
IGMIN2D(3S)	name changed to IGAMN2D(3S)
ALOCBUFF(3S)	removed
FREEBUFF(3S)	removed

Section 3

New routines added

3.3.1.3

The following new routines were added for the PE 1.2.2 release in online-only format and are printed for the first time for the PE 2.0 release in the *Scientific Libraries Reference Manual*, publication SR–2081.

- Routines added to support ScaLAPACK:

INDXG2P(3S)	PSGETRF(3S)
INITBUFF(3S)	PSGETRI(3S)
NUMROC(3S)	PSGETRS(3S)
PSGEBRD(3S)	PSPOSV(3S)
PSGEHRD(3S)	PSPOTRF(3S)
PSGELQF(3S)	PSPOTRI(3S)
PSGEQLF(3S)	PSPOTRS(3S)
PSGEQPF(3S)	PSSYEVX(3S)
PSGEQRF(3S)	PSSYTRD(3S)
PSGERQF(3S)	PSTRTRI(3S)
PSGESV(3S)	PSTRTRS(3S)

- Routines added to the BLACS (Basic Linear Algebra Communication Subprograms) group of routines:

  BLACS_EXIT(3S)
  BLACS_GRIDEXIT(3S)
  BLACS_PINFO(3S)

- Routines added to the FFT (Fast Fourier Transform) group of routines:

  PSCFFT2D(3S)
  PSCFFT3D(3S)

New man pages added
3.3.1.4

The following new man pages were added for the PE 2.0 release to describe support for the 32-bit FFT routines which were added in previous releases; these pages are printed for the first time in the *Scientific Libraries Reference Manual*, publication SR–2081:

GGFFT(3S)
GHFFT(3S)
HCONV(3S)
HCORR(3S)
HCORRS(3S)
HGFFT(3S)
HOPFILT(3S)

The following man pages were added at the PE 2.0 release to document the 32-bit BLAS routines:

GAXPY(3S)
GDOTC(3S)
GDOTU(3S)
HAXPY(3S)
HDOT(3S)

Documentation version 8.2
3.3.2

Documentation version 8.2 of the Scientific Library was released in October, 1994, with CrayLibs 1.2 and was documented in the *Scientific Libraries Reference Manual*, publication SR–2081.

Section 3

The BLAS (Basic Linear Algebra Subprogram) library was expanded to include parallel versions of the BLAS routines. These routines are implemented on Cray MPP systems only:

BLAS_S(3S)	SSYR2K_S(3S)
SGEMM_S(3S)	SSYRK_S(3S)
SSYMM_S(3S)	STRMM_S(3S)
STRSM_S(3S)	SGEMV_S(3S)
SGER_S(3S)	SSYMV_S(3S)
SSYR2_S(3S)	SSYR_S(3S)
STRMV_S(3S)	STRSV_S(3S)
SASUM_S(3S)	SAXPY_S(3S)
SCOPY_S(3S)	SDOT_S(3S)
SNRM2_S(3S)	SSCAL_S(3S)
SSWAP_S(3S)	CCFFT2D_S(3S)

Section 3

Documentation version 8.1
3.3.3

Documentation version 8.1 of the Scientific Library was released with CrayLibs 1.1 in June, 1994. A manual was not printed for that release; the updated man pages were available online. This revision of the manual incorporated support for the Cray MPP hardware platform.

At this release, the following new communication routines were added for Cray MPP systems. These routines are used to transfer data between rectangular or trapezoidal matrices on multiprocessor systems:

ALOCBUFF	IGEBS2D	ITRBR2D
BLACS	IGERV2D	ITRBS2D
BLACS_BARRIER	IGESD2D	ITRRV2D
BLACS_INIT	IGMAX2D	ITRSD2D
FREEBUFF	IGMIN2D	KPNUM
GRIDINFO	IGSUM2D	PCCORD
IGEBR2D		

Documentation version 8.0

3.3.4

Documentation version 8.0 of the Scientific Libraries was released in August, 1993, with CrayLibs 1.0 and was documented in a new manual entitled *Scientific Libraries Reference Manual*, publication SR–2081.

The older version of LAPACK (as released with version 6.0) was removed.

Support was added for many of the LAPACK routines. These routines were supported by online-only man pages; the associated man pages do not appear in the *Scientific Libraries Reference Manual.*

The `SEARCH` routines were moved from the Scientific Libraries to the Fortran Library at this release. See subsection 3.1.4, page 17, for a list of the affected routines.

Syntax Summary: Application Library Routines [4]

This section contains a summary of information for the routines in the Application Libraries. The information in this section is derived directly from the man pages for the library routines. For complete details about the routines, see the individual man pages.

The following information is documented for each routine in this subsection:

- *name* : the name of the man page where the routine is located
- *synopsis information*: the exact syntax required for the routine
- *implementation information*: a listing of all hardware and software platforms where the routine is supported

Section 4

Syntax Summary: Math Library Routines [5]

This section contains a summary of information for Mathematical library routines. The information in this section is derived directly from the man pages for the library routines. For complete details about the routines, see the individual man pages.

The following routines are **not available** on Cray MPP systems: `CDABS`, `CDLOG`, `CDCOS`, `CDSIN`, `CDSQRT`, `CDEXP`.

The following information is documented for each routine in this subsection:

- *name* : the name of the man page where the routine is located
- *synopsis information*: the exact syntax required for the routine
- *implementation information*: a listing of all hardware and software platforms where the routine is supported

Section 5

Syntax Summary: Scientific Library Routines [6]

This section contains a summary of information for Scientific library routines. The information in this section is derived directly from the man pages for the library routines. For complete details about the routines, see the individual man pages.

The following information is documented for each routine in this subsection:

- *name* : the name of the man page where the routine is located
- *synopsis information*: the exact syntax required for the routine
- *implementation information*: a listing of all hardware and software platforms where the routine is supported

Syntax Summary: Shared Memory (SHMEM) Routines [7]

Section 7

This section contains a summary of information for CF90 shared memory routines. The information in this section is derived directly from the man pages for the shared memory routines. For complete details about the routines, see the individual man pages.

The following information is documented for each subprogram in this subsection:

- *name* : the name of the man page where the routine is located
- *synopsis information*: the exact syntax required for the routine
- *implementation information*: a listing of all hardware and software platforms where the routine is supported

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Accessibility (ease of finding information)	4	3	2	1
Physical qualities (binding, printing, illustrations)	4	3	2	1
Terminology (correct, consistent, and clear)	4	3	2	1
Number of examples	4	3	2	1
Quality of examples	4	3	2	1
Index	4	3	2	1

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