SPARC COMPLIANCE DEFINITION 2.4.1

SCD 2.4.1

32/64 bits

SPARC International

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FINAL DRAFT

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Preface

Audience and Purpose

The SPARC International *SPARC Compliance Definition* (SCD) is intended for use by anyone who is creating binary compatible SPARC systems or applications.

The intended audience of the SCD documents consists of two groups: system and application developers. For system developers, the SCD provides a reference to those interfaces and features which must be supplied by a SPARC compliant system. For application developers, the SCD provides a reference to interfaces and features that may be relied upon in all SPARC compliant systems.

This publication is intended to fulfill the following purposes:

- *Identify areas beyond the System V Application Binary Interface (gABI) and the System V Application Binary Interface, SPARC Processor Supplement (psABI) that the SPARC community deems important.*
- *Address ambiguous and/or loose specifications in current ABI documents.*

Organization and Content

The SCD 2.4 has been divided into chapters, as follows:

Chapter 1 Introduction

Chapter 2 Software Installation

Chapter 3 Low-Level System Information

Chapter 4 Object Files

Chapter 5 Program Loading and Dynamic Linking

Chapter 6 Libraries

Chapter 7 Formats and Protocols

Chapter 8 System Commands

Chapter 9 Execution Environment

Chapter 10 Windowing and Terminal Interfaces

Chapter 11 Development Environments

Chapter 12 Networking

Index

This new organization follows the organization of the *System V Application Binary Interface* and *System V Application Binary Interface, SPARC Processor Supplement* documents. Having a parallel organization makes this document easier to use than previous editions of the SCD.

Publication Conventions

This publication uses page format and typographic variances to highlight particular kinds of information. These conventions of usage are generally consistent with publication conventions used by other UNIX publications, such as the AT&T *System V Interface Definition*, Third Edition.

Other Publication Conventions

The following typographical conventions are used within the text of this publication:

- *Filenames, pathnames, and system messages are shown in:*
  `typewriter font like this.`

- Titles of chapters in this publication are shown in plain Roman font, inside quotation marks like this: "Introduction."
- *Document titles are shown in plain, nonbold italic font like this: System V Interface Definition (Third Edition).*

SCD 2.4.1

Introduction

The SPARC Compliance Definition

This document is version 2.4.1 of the SPARC Compliance Definition.

The SPARC Compliance Definition, or SCD, defines a minimum set of interfaces that all SPARC Compliant systems must provide in their implementations and a maximum set of interfaces that SPARC Compliant applications must use when linking to external system libraries. The SCD provides information for binary-level compatibility, encompassing both the *System V Application Binary Interface* (gABI), and the *System V Application Binary* Interface, *SPARC Processor Supplement* (psABI) documents.

Primary Intent and Intended Audience

The primary intent of this document is to *define* the SPARC ABI (application binary interface)—that is, to provide a specification for it (which we refer to as the "SPARC Compliance Definition" or "SCD"). The SPARC ABI describes a standard set of runtime interfaces for compiled application programs which will be run on one or more systems (an operating system and hardware platform) based upon the SPARC processor. Complementary to a compiled application program is a system software product. While an application depends on (or *consumes),* this runtime interface, the system software product provides (or *offers),* the interface and all the various functional constituents associated with its provision.

To a first approximation then, the SPARC ABI may be thought of as a contract which describes the relationship between an application program and a system software product *at runtime*. The purpose of the definition is to achieve two specific objectives: First, we wish to ensure that an application binary (i.e. compiled application program) which is "conformant" to a specified version of the SPARC ABI (i.e. depends upon less or equal to the interface and content contained within that specification) may be run on *any* system software product (and hardware platform) which is "conformant" with (offers) that version of the SPARC ABI (or a later one). This ability to run a compiled application program on any of a number of different system software products and/or hardware platforms may be referred to as [binary] "portability". Second, we wish to ensure that an application binary which is conformant with a specified version of the SPARC ABI will continue to run without change on all system software products (and platforms) offering a later version of the SPARC ABI. This ability to sustain all existing application binaries irrespective of an update in system software or hardware platform may be referred to as [binary] "stability". The former property is ensured by defining a standard set of features and interface that all conformant system implementations must offer. The latter property is enabled by an upward compatible evolution of the interface (and functional constituent) contained within succeeding revisions of the SPARC ABI (and SCD).

Intended Audience

Since the SPARC ABI is an interface that separates application programs from system software products, this specification is of interest both to the developer of a system software products which offers the interface (and associated application services) and to the developer of an application which is intended to run on such systems. To that extent, this document strives to describe everything that must be contained within a system implementation for it to be considered conformant (and hence be able to run any SCD-conformant application), and the maximum set of dependencies that an application may have if it is to be considered conformant (and hence be able to run on any SCD-conformant system, including all systems conformant to a later revision of the SPARC ABI).

The primary specific purpose to which this document is put is to enable the development of *tests* of conformance for system software products and for application programs. These tests may then be applied by developers of such products to help them determine whether they are conformant.

Depending on the reader's perspective, this document may be viewed as having some shortcomings. While it tells the application development reader *what* may be relied upon, and what a well-formed application binary looks like, it does not describe *how to construct* such an application, nor all that is needed to do that. And similarly, while it tells a system software product developer all that must be provided, once again it does not describe all that may be needed in order to achieve that.

Finally, it must be admitted that this document has been addressed primarily to developers of system implementations which offer the SPARC ABI, and somewhat secondarily to developers of SPARC-compliant applications. In practice it has been used more as a means of synchronizing and standardizing the set of services and interfaces offered by several different vendors offering SPARC-based system software product implementations then anything else. The objective has been to attempt to identify the required set of application runtime services and then to standardize the way in which

these services are offered by the different system software products in order to unify the SPARC application space—to enable the development of a *single* application binary that can run on any SCD-compliant SPARC system software product, thus increasing possible deployment span for application developers and reducing their testing costs.

SCD 2.4.1—One Specification, Two ABI Standards

The SCD2.4.1, as opposed to previous versions of the SCD, describes two distinct and incompatible standards: a 32-bit ABI and an EXPERIMENTAL 64-bit ABI. SCD conforming applications must conform to either the 32-bit ABI or the 64-bit ABI (when a 64-bit ABI becomes REQUIRED). A 32-bit application can only link to 32-bit libraries and 64-bit applications can only link to 64-bit libraries.

Rationale

At this time, the 64-bit ABI is an EXPERIMENTAL interface, due to the fact that two systems vendors have yet to implement these interfaces fully for use by a number of applications. SPARC International systems vendors have agreed at this time to the EXPERIMENTAL 64-bit ABI, and are requested to implement to this EXPERIMENTAL standard as closely as possible.

Relationship to Product Branding

It is the purview of SPARC International, based on input from its members, to define a branding program, if any, based on mapping(s) into the SCD. The SCD is organized such that brands could be created for:

o 32-bit applications

o 64-bit applications

o systems supporting only 32-bit applications

o systems supporting only 64-bit applications

o systems supporting both 32-bit and 64-bit applications

Introduction Changes

The following are changes to the *System V Application Binary Interface* as reported to SPARC International.

#	Facility	Location	Description
1	How to use the System V ABI	gABI	The math routines are also available as a shared resources

Definitions of Terms

32-bit ABI or SPARC 32-bit ABI

In the context of this document, 32-bit ABI refers to a 32-bit version of the SCD for 32-bit SPARC Compliant applications and SPARC Compliant systems that support them.

64-bit ABI or SPARC 64-bit ABI

In the context of this document, 64-bit ABI refers to a 64-bit version of the SCD for 64-bit SPARC Compliant applications and SPARC Compliant systems that support them.

gABI

Depending on its context, the term gABI in this document can mean either:

1) the "System V Application Binary Interface" document;

2) those sections in the SPARC 32-bit ABI considered to be generic in nature or to be common with other UNIX systems; or

3) those sections in the SPARC 64-bit ABI considered to be generic in nature or to be common with other UNIX systems.

psABI

Depending on its context, the term psABI in this document can mean either:

1) the "System V Application Binary Interface SPARC Processor Supplement" document;

2) those sections in the SPARC 32-bit ABI considered to be processor-specific in nature and not in common with other UNIX systems; or

3) those sections in the SPARC 64-bit ABI considered to be processor-specific in nature and not in common with other UNIX systems.

Deprecated

The term "deprecated" in this document is a qualifier for the terms "interface set," "interface member," and "interface." When the term "DEPRECATED interface set" is used in this document, programmers are discouraged from using the designated interface set in new applications because the "DEPRECATED interface set" may not be supported in future versions of the SCD. The qualifier "deprecated" is orthogonal to the qualifiers "required" and "optional". When an "interface set" is designated as "deprecated" the date of deprecation will be stated by the specification. "Interface sets," marked as "deprecated," will be kept in the SCD for at least three (3) years from the original deprecation date. The "DEPRECATED interface set" will also include in its specification, the earliest date at which the designated "interface set" may be removed from the specification. No required or optional interface will be removed from the standard without first being deprecated. The terms "DEPRECATED interface member" and "DEPRECATED interface" are defined similarly.

Experimental

The term "experimental" in this document is a qualifier for the terms "interface set," "interface member," and "interface." When the term "EXPERIMENTAL interface set" is used in the document, applications programmers are warned that 1) the designated interface set may not be available on any SPARC conforming systems, and, 2) the specification of the designated interface may change at any time or be deleted from the SCD at the sole discretion of SPARC International; SPARC International makes no commitment of a three-year stable period for any "EXPERIMENTAL interface set."

Rationale

> As an example, this release of the SPARC compliance definition includes the EXPERIMENTAL Large File Support Library. This interface set is completely new. Because the Large File Support Library is new, we have no experience with the correctness of the interface. Field experience may require that certain portions of the interface change to make the interface more useful or practical.

Interface

The unadorned term "interface" means either "interface set" or "interface member" depending on the immediate context of its use. Any REQUIRED or OPTIONAL interface defined in this document will be part of the SCD--including future SCD documents--for at least three year.

Rationale

> The SCD is intended as a long term commitment to a set of common SPARC interfaces. As such, interfaces should be implemented consistently on at least two independent SPARC systems and be used by a number of applications before being designated as REQUIRED or OPTIONAL.

Interface Member

The term “interface member” is also used as a generic reference to any single facility that is provided by a platform for use by an application program.

Examples are: the printf function; the errno global data item.

Interface Set

The term “interface set” refers to a named collection of facilities, defined in the SPARC Compliance Definition, that is provided by a platform and can be used by an application. These collections, or “interface sets”, are listed in the section below titled “Structure of the SPARC Compliance Definition”.

An example is: the X11 Library Interface Set.

Optional

The term “optional” in this document is a qualifier for the terms “interface set,” “interface member,” and “interface.” When the term “OPTIONAL interface set” is used in this document, SPARC conforming systems may, but need not, supply the interface set; if a conforming system does supply the interface, the interface set must be present in its entirety, as defined by this document; applications can not rely on the designated interface set being available on any conforming systems, but if the interface set is available on a particular conforming system, a conforming application can rely on the interface set being available in its entirety on that particular conforming system. The terms “OPTIONAL interface member” and “OPTIONAL interface” are similarly defined.

Rationale

Paragraphs labeled “rationale” in this document are non-normative and are for information only. An example of a Rationale paragraph follows below.

Rationale

> The SPARC International Compliance and Compatibility Committee agreed that it would be more useful to intersperse rationale comments throughout the document than to confine them to an appendix.

Required

The term “required” in this document is a qualifier for the terms “interface set,” “interface member,” and “interface.” When the term “REQUIRED interface set” is used in this document, SPARC conforming systems must provide the interface set; conforming applications can rely on the designated interface set always being available on any conforming system. The terms “REQUIRED interface member” and “REQUIRED interface” are defined similarly.

SPARC V8 Architecture

All reference to SPARC V8 refers to the Architecture as defined in “***The SPARC Architecture Manual***”, Version 8.

SPARC V9 Architecture

All reference to SPARC V9 refers to the Architecture as defined in “***The SPARC Architecture Manual***”, Version 9.

Normative References

The SCD is based upon all or parts of certain other existing standards.

The definition of each interface in the SPARC Compliance Definition may reference one or more of the following documents. In those cases, the portion of the normative reference that is called out is part of this standard.

The normative references called out in the SPARC Compliance Definition are:

- ***SCD 2.4.1 Interface Semantics***

SPARC International

- ***System V Application Binary Interface,*** *Third Edition*

Unix Press (Prentice Hall), ISBN 0-13-100439-5

- ***System V Application Binary Interface SPARC Processor Supplement,*** *Third Edition*
  Unix Press (Prentice Hall), ISBN 0-13-104696-9
- ***The SPARC Architecture Manual****, Version 8*
  Prentice Hall, ISBN 0-13-825001-4
- ***The SPARC Architecture Manual****, Version 9*
  Prentice Hall, ISBN 0-13-099227-5
- ***System V Interface Definition,*** *Third Edition, Volumes 1 - 5*
  USL/Novell Select Code 320-136 (Volume 1), 320-137 (Volume 2), 320-138 (Volume 3),
  320-139 (Volume 4),

Volume 1	Addison-Wesley	ISBN 0-201-56652-0
Volume 2	Addison-Wesley	ISBN 0-201-56653-0
Volume 3	Addison-Wesley	ISBN 0-201-56654-0
Volume 4	Addison-Wesley	ISBN 0-201-56655-0
Volume 5	Addison-Wesley	ISBN 0-201-56656-7

- ***The X Window System*** *(Third Edition)*
  by Robert W. Scheifler and James Gettys
  Digital Press, ISBN 1-55558-088-2
- ***X Toolkit Intrinsics - C Language Interface***
  by Joel McCormack, Paul Asente, and Ralphe R.Swick
  Distributed by the X consortium with the X Version 11, Release 5
  available through FTP from export.lcs.mit.edu
- ***X11 Non-rectangular Window Shape Extension***
  by Keith Packard
  Copyright X Consortium
- ***Large Files Summit document (Adding support for arbitrary file sizes to the Single UNIX Specification)***
  URL: http://www.sparc.org/standards.html
- ***OSF/Motif Programmer's Guide*** *(Rel. 1.2- Revised)*
  Prentice-Hall, ISBN 0-13-643115-1
- ***OLIT Reference Manual***
  Sun Microsystems, Part No. 800-6055-10, Revision A
- ***ISO 9660-1988: Volume and file structure of CD-ROM for information interchange***
  1988-09-01
- ***ISO/IEC 10149: Data Interchange for read-only 120mm optical data disk (CD-ROM)***
  1989-09-01
- ***Single UNIX Specification Version 2, Commands and Utilities, Issue 5 (C604)***
  Open Group CAE Specification, ISBN 1-85912-191-8
- ***Single UNIX Specification Version 2, System Interface Definitions, Issue 5 (C605)***
  Open Group CAE Specification, ISBN 1-85912-186-0

- ***Single UNIX Specification Version 2, System Interfaces and Headers, Issue 5 (Two volumes - C606)***

  Open Group CAE Specification, ISBN 1-85912-181-0

- ***RFC 1700 (Definition of well-known TCP and UDP port numbers)***

  URL: http://info.internet.isi.edu/1s/in-notes/rfc/files

- ***POSIX 1003.1-1990*** *(ISO 9945-1) 1990 (E) (ISO/IEC) (IEEE/ANSI Std 1003.1-1990):*

  Information Technology - portable operating system interface (POSIX)

  Part 1: System Application Program Interface (API)[C Language]

  ISBN: 1-55937-061-7

- ***POSIX 1003.1b (formally 1003.4) POSIX Asynchronous I/O, and Real-time interfaces)***

  The ratified POSIX standards that generally pertain to realtime OS's consist of: 1003.1 (OS, process, filesystem and device API), 1003.2 (utilities), 1003.1b (realtime), and 1003.1c (threads). POSIX 1003.1d (which defines some additional realtime extensions like standardized interrupt handler support) is not yet ratified, although some OS's already support portions of it.

  The POSIX 1003.1 standard is ISBN 1-55937-061-0. A good O'Reilly text is "POSIX Programmer's Guide: Writing Portable UNIX Programs". Donald Lewine. ISBN: 0-937175-73-0 , http://cs-www.bu.edu/pub/ieee-rts/Home.html

The definition of each Interface in the SPARC Compliance Definition may list errata to any of the above documents. In each such listed erratum, the definition contained in the erratum supersedes the corresponding portion of the normative reference.

These documents may be acquired from most technical book stores; additionally, SPARC International provides assistance in acquiring these references. If you require assistance in acquiring these references, call SPARC International at:

(408) 748-9111

ISO documents can be ordered from:

International Organization for Standardization,

1 Rue de Varembe, Case Postale 56, CH-1211 Geneva 20 Switzerland,

(Tel) +41 22 34 12 40

URL: http://www.iso.ch

or

ANSI (ISO member for the US):

ANSI, 11 W 42nd St. 13th floor, New York, NY 10036,

(Tel) 1-212-642-4900.

Prentice-Hall documents can be obtained at:

PTR Prentice Hall, Corporate Sales Department

113 Sylvan Avenue, Englewood Cliffs, New Jersey 07632

(Tel) (201) 592-2863 (bulk copies), (Tel)(515) 284-6761 (single copies).

(Fax) (201) 592-2249

Open Group documents can be obtained at:

The Open Group, Publications Department

PO Box 96, Witney, Oxon OX8 6PG, England,

(Tel) +44 (0) 1993 708731, (Fax) +44 (0) 1993 708732.

(URL) http://www.opengroup.org

Rationale

The SCD represents a proper super-set of the required interfaces and features described in the two ABI documents. One of the purposes of this document is to serve as the conduit through which features may migrate first into the processor specific ABI (SPARC psABI), and finally into the generic ABI (gABI). Consequently, the SCD includes a set of features and their associated interfaces that are beyond the ABI definitions. These features, and their associated interfaces have been included, in some cases to correct deficiencies in the ABI specifications, and in others to standardize functionality already in common use throughout the SPARC community.

Relationship to other Standards

Some of the normative references listed above are themselves based upon other standards. These include at least the following:

- ***X/Open Portability Guide**, Issue 3 (XPG3)*

  X/Open Portability Guide 1988 X/Open Company Limited

Vol1:	XSI Commands and Utilities	ISBN:0-13-685835-X	✓
Vol2:	XSI System Interface and Headers	ISBN:0-13-685843-0	✓
Vol3:	XSI Supplementary Definitions	ISBN:0-13-685850-3	
Vol4:	Programming Languages	ISBN:0-13-685868-6	
Vol5:	Data Management	ISBN:0-13-685876-7	
Vol6:	Window Management	ISBN:0-13-685884-8	
Vol7:	Networking Services	ISBN:0-13-685892-9	
set of 7 volumes		ISBN:0-13-685819-8	

✓ Referenced indirectly in the SVID.

Future Direction

The future direction of the SCD is to POSIX. Non-POSIX parts of this document are only included for existing or experimental implementation. These parts are designated as DEPRECATED or EXPERIMENTAL.

Structure of the SCD

The Application Binary Interface defined by the SCD consists of a set of System Feature Interfaces, a set of Library Interfaces, and a Command Interface.

Each such named Interface is designated as either Required, Optional, or Experimental.

As necessary, SCD chapters have been split into 32-bit gABI, 32-bit psABI, 64-bit gABI and 64-bit psABI sections. Sections that are errata to the System V gABI or psABI are also marked as such.

System Feature Interfaces

The System Feature Interfaces are:

- Object File Format
- Program Loading and Linking
- Low-level System Information
- Formats and Protocols
- Software Installation

Library Interfaces

Each Library Interface is a collection of facilities that is implemented as one or more shared objects. (Shared objects are defined in the Object File Format section of this specification). The library interfaces are as defined in chapter 6 “Libraries” and chapter 10 “Windowing and Terminal interfaces”.

Each Library Interface consists of

- Function entry points and their names
- Function arguments for each function entry point
- Global data and their names
- Manifest constants used in definitions of function arguments and global data
- Visible data structures used in function arguments and global data
- One or more shared objects, each having a particular name, each accessible through a particular pathname, and each containing the function entry points, function entry point names, global data, and global data names defined for that Library Interface.

Command Interface

The Command Interface is the set of commands available to application programs. The Command Interface is defined in the chapter titled “Commands”.

Definition of SPARC Compliance

The terms “SPARC-compliant” and “conforming” are used interchangeably in this document. Their meaning is:

Conforming Implementations

A conforming implementation is one that provides all of the Required Interfaces, in their entirety.

A conforming implementation may provide one or more of the Optional Interfaces. Each Optional Interface that is provided must be provided in its entirety. The product documentation must state which Optional Interfaces are provided.

A conforming implementation, when provided with standard data formats and values at a named interface, will provide the behavior defined for those values and data formats at that interface. However, a conforming implementation may consist of separately packaged and/or sold components. For example, a vendor of a conforming implementation might sell the hardware, operating system and windowing system as separately packaged items.

A conforming implementation may provide additional interfaces with different names. It may also provide additional behavior corresponding to data values outside the standard ranges, for standard named interfaces. Such additional interfaces, or additional inputs to standard interfaces, are called extensions to the standard. If an implementation provides extensions to the standard, its documentation must clearly identify the extensions as such.

Conforming Application Programs

A conforming application program has the following characteristics:

Its executable files are either Bourne shell scripts or object files in the format defined for the Object File Format System Interface.

Its object files participate in dynamic linking as defined in the Program Loading and Linking System Interface.

It employs only the instructions, traps, and other low-level facilities defined in the Low-Level System Interface as being for use by application programs.

It does not require or use any interface, facility, or implementation-provided extension that is not defined in this standard in order to be installed or to execute successfully.

If it requires any Optional Interface defined in this standard in order to be installed or to execute successfully, the requirement for that Optional Interface is stated in the application's documentation.

It does not use any interface or data format that is not required to be provided by a conforming implementation; unless:

1. if any such interface or data format is used, it is generally available to anyone who wants to purchase or acquire it; and
2. if such an interface or data format is supplied by another program through direct invocation of that program during execution, that program is in turn a SPARC-compliant application; and
3. the use of that interface or data format, as well as its source, is identified in the documentation of the application program.

Rationale

A SPARC-compliant application is expected to have no dependencies on any vendor extensions to the standard. The most common such extensions are additional function entry points and additional libraries other than the ones defined in the SCD. If an application requires such extensions it is not portable, since other SCD-compliant platforms may not provide those extensions.

A SPARC-compliant application is required to use system services on the platform it's running on, rather than importing system routines from some other platform. Thus it must link dynamically to any routines in the platform that perform system traps to kernel services.

It is to be expected that some programs may be companion programs to other programs. For example, a query program may be a companion to a data base program; a pre-processor may be an adjunct to one or more compilers; a data re-formatter may convert data from one document manager to another. In such cases, the program may or may not be SPARC-compliant regardless of whether the other program it's dependent on is SPARC-compliant.

If such an application merely uses data produced by another program, the application's compliance is independent of the other program's compliance.

If such an application actually invokes another program during execution (as, for example, a third-party math library), the invoking program is SPARC-compliant only if it also constitutes a SPARC-compliant application in combination with the invoked program.

Compliance Testing

On authorization by SPARC International of a branding program, test suites will be used in conjunction with this standard to verify the conformance of applications and platforms to this standard. Contact SPARC International for additional test suite information at (408) 748-9111.

The System Compliance Test (SCT) will be used to verify a system's implementation of all the Interfaces defined in either the 32-bit ABI sections or the 64-bit ABI sections of SPARC Compliance Definition.

The SPARC Application Verifier (SAV) will be used to verify an application's adherence to the Interfaces defined in either the 32-bit ABI sections or the 64-bit ABI sections of SPARC Compliance Definition.

Changes between SCD 2.4 and SCD 2.4.1

~~1- 64 bit psABI and gABI sections are added to many chapters~~

~~2- libsys and libc are merged under libc~~

~~3- new libraries are added: libw, libucb, libresolv, librpcsvc, libintl, libelf, libnisdb, libposix4, libpthread.~~

~~4- additional functions are added to libc, libm, libnsl, and libsocket.~~

5- new errata

~~6- the old Large Files Support section is replaced by a new section based on the Large File Summit document.~~

Upward Compatibility

The interfaces in the 32-bit ABI sections of SCD 2.4.1 are upwardly compatible with the interfaces in SCD 2.3, which in turn are upwardly compatible with the interfaces in SCD 2.2, SCD 2.1 and SCD 2.0. That is to say, an application written to the interfaces defined in SCD 2.0 will run successfully without change or re-compilation on a system that implements SCD 2.1, SCD 2.2, SCD 2.3 or the 32-bit ABI sections of SCD 2.4.1.

CHAPTER 2: Software Installation

SCD 2.4.1

Software Installation

Introduction

This chapter is common to both the 32-bit ABI and 64-bit ABI.

Most information regarding software installation may be found in Chapter 2 of the gABI and Chapter 2 of the psABI. The commands supported are listed in table 2.1 below. This section is an addendum to Chapter 2, page 2-1, of the psABI. This section adds support for using CD-ROM medium for physical distribution of SCD-conforming software. It is an OPTIONAL INTERFACE. If software is distributed on CD-ROM, it must be in one of the formations specified below.

Table 2-1. Software Installation commands

`installf`	`pkgask`	`pkginfo`	`pkgrm`
`pkgadd`	`pkgchk`	`pkgparam`	`removef`

Software Installation Changes

The following are changes to the *System V Application Binary Interface*, and the *System V Interface Definition (Third Edition)* as reported to SPARC International.

#	Facility	Location	Description
1	pkginfo(AS_CMD)	SVID, Vol. II	Delete "-r" from the list of supported options for pkginfo.
2	pkgadd(AS_CMD)	gABI	Change page 2-13 of the gABI to specify that the request script, if provided, runs with a uid of root and that standard input is attached to /dev/null.
3	The request script Procedure Scripts	gABI	The description about the execution environment is incorrect. Only uid == root is guaranteed.

CD-ROM Medium

CD-ROM medium recorded in the format specified in *ISO/IEC 10149: Data Interchange for read-only 120mm optical data disk (CD-ROM)* is added to the list of approved media on page 2-1 of the *System V Application Binary Interface, SPARC Processor Supplement*.

The information on the media must be represented either

- serially as the data stream created using dd(AU_CMD) or cpio(BU_CMD) utilities; or
- as file structured data that must be represented as described in *ISO 9660: 1988 - Volume and file structure of CD-ROM for information interchange*.

  Rationale

  The most common format for CD-ROM's is the ISO 9660 format, which supports MS-DOS filesystem semantics only. The ISO 9660 format is robust and stable, and has a huge installed base. That is why the ISO 9660 format has been included in SCD2.4 as an OPTIONAL standard for SPARC-compliant systems.

Support for ISO 9660 format CD-ROM's is already available from several other operating system vendors.

Since the restrictions placed on a filesystem by the ISO 9660 format are too restrictive for most UNIX users, a POSIX conforming filesystem is needed. The Rock Ridge Interchange Protocol was created to fill this gap. The Rockridge filesystem is actually an extension to (and compliant with) the ISO 9660 specification.

The Rock Ridge filesystem appears to be stable at this time. However there are some issues concerning bootability, security, and sparse files which are still being addressed by the IEEE working group on CD-ROM filesystems. There will be some minor changes made before the Rock Ridge filesystem is adopted as a NIST (National Institute of Science and Technology) standard.

For these reasons, the Rock Ridge filesystem is being excluded from SCD 2.4.

Upon adoption as a standard by NIST, it is expected that the Rock Ridge format will be included in the standard.

CHAPTER 3: Low-Level System Information

SCD 2.4.1

Low-Level System Information

Introduction

This chapter is split into a 32-bit psABI and a 64-bit psABI section. Low-level system information pertinent to the 32-bit psABI may be found in Chapter 3 of the *System V ABI, SPARC Processor Supplement*. Information such as page size restrictions, as well as stack management, function calling sequence and data representations may be found there. On the other hand, unless explicitly stated, information in the 64-bit psABI section of this chapter is independent of System V ABI documentation.

Self-Modifying Coding Practices:

Self modified (or otherwise changed) code sequences must be the target of the appropriate sequence of FLUSH instructions prior to being executed. A specific example of a problematic code sequence can be seen in the code fragment:

```
(void) read(fd, buf, sizeof (buf));
(*(void(*)())buf)();
```

which treats the contents of "buf" as a function which has just been read in.

Reserved Auxiliary Vector types:

Company	Numbers
Sun Microsystems	2000 through 2099

Low-level System Information Changes (32-bit psABI)

#	Facility	Location	Description
1	Fundamental	psABI	Add the following to Figure 3-1:

Type	C	`sizeof`	Alignment (bytes)	SPARC
Integral	long long	8	8	signed doubleword
	signed long long	8	8	
	unsigned long long	8	8	unsigned doubleword

#	Facility	Location	Description
2	Registers and the stack Frame	psABI	Add the following description to the Stack Frame page 3-13: %i0, %i1, %o0 and %o1 64-bit integer return values appear in %i0 and %i1 (most significant word in %i0). A calling function receives values in the coincident out registers, %o0 and %o1.
3	Integral and	psABI	Add the following description:

	Pointer Arguments		64-bit integer argument uses two registers.
4	Functions Returning Scalars or No Value	psABI	Add the following description: A function that returns a 64-bit integer value places its result in %i0 and %i1 (most significant word in %i0); the calling function finds that value in %o0 and %o1.
5	Bit-Fields	psABI	On page 3-5, replace the statement: "A bit-field must entirely reside in a storage unit appropriate for its declared type." with the statement: "A bit field must entirely reside in a storage unit whose size and alignment are the size and natural alignment, respectively, of a variable having the field's declared type. This unit of storage is called the field's declared enclosing storage unit".
6	Bit-Fields	psABI	Add the following Bullet on page 3-5: "* If a bit field is accessed by multiple threads, assignments to the bit field, or to any data objects residing in the bit field's declared enclosing storage unit, should be regarded as critical sections, and should be guarded with locks to ensure mutual exclusion."
7	Bit-Fields	psABI	Add the following Bullet on page 3-5: "* A processor executing a bit field assignment should effect the assignment using instructions that read and write units of storage no larger than the field's declared enclosing storage unit."
8	Window Save	psABI	On page 3-10, add to the second bullet: Area *%r16(%l0)* is saved at *%sp+0*, *%r17(%l1)* is saved at %sp+4, and so on. *%r31(%i7)* is saved at %sp+60.
9	Function	psABI	On page 3-14, remove the phrase ", and the floating-point state register (**FSR**)" from the sentence that begins "Registers in this category include global, floating-point ..."
10	Function Calling	psABI	On page 3-14, add a paragraph after the line which ends: "application programs must never change the system global registers": Different fields of the floating-point state register (**FSR**) are treated thus: Called functions shall preserve the **RD**, **TEM**, and **NS** mode bits, unless changing those mode bits is part of the called function's documented semantics. Called functions shall preserve any **aexc** status bits set to value 1, unless clearing those bits is part of the called function's documented semantics. Otherwise, called functions should OR into aexc additional bits for un-trapped **IEEE** exceptions that reflect problems in the called function's numerical results. Called functions should not OR exception bits into aexc corresponding to un-trapped "gratuitous" exceptions that do not indicate any problems with the numerical results returned by those functions. The "should" aexc recommendations reflect that not all functions can economically distinguish significant from gratuitous exceptions. The **cexc** and **fcc** bits "belong" to the called function in the same sense as Y and **PSR**. Even so, functions that do not directly or indirectly execute any floating-point operations should avoid gratuitously altering **FSR**.

Low-Level System Information (64-bit psABI) -~~EXPERIMENTAL~~

Machine Interface

Processor Architecture

The SPARC™ Architecture Manual, Version 9 defines the processor architecture. Programs intended to execute directly on the processor use the instruction set, instruction encoding, and instruction semantics of the architecture. Five points deserve explicit mention.

- A SPARC 64-bit ABI conforming program may not use the **IMPDEP1** and **IMPDEP2** instructions.
- A program may assume all other documented non-privileged instructions exist.
- A program may assume all other documented non-privileged instructions work.
- A program may assume that all documented unrestricted ASI's work.
- A program may use only the non-privileged instructions defined by the architecture, with the exception of **IMPDEP1** and **IMPDEP2**.

In other words, from a program's perspective, the execution environment provides a complete and working implementation of the non-privileged part of the SPARC V9 architecture. Although the **IMPDEP1** and **IMPDEP2** instructions are part of the SPARC V9 architecture, they may not be used by 64-bit ABI conforming programs because their behavior is undefined.

This does not imply that the underlying implementation provides all instructions in hardware, only that the instructions perform the specified operations and produce the specified results. The SPARC 64-bit ABI neither places performance constraints on systems nor specifies what instructions must be implemented in hardware.

Some processors might support the SPARC 64-bit ABI as a subset, providing additional instructions or capabilities. Programs that use those capabilities explicitly do not conform to the SPARC 64-bit ABI. Executing those programs on machines without the additional capabilities gives undefined behavior.

NOTE

For performance reasons it is suggested that the **FLUSH** instruction not be used. The routine "***sync_instruction_memory***" is the preferred way to flush instruction memory.

It is suggested that the instructions marked as "deprecated" in "*The SPARC Architecture Manual, Version 9"* not be used. These instructions may exhibit poor performance in some Version 9 implementations of the architecture and may not be available in future versions of the architecture.

Data Representation

Fundamental Types

Figure 3-1 shows the correspondence between **ANSI C**'s scalar types and the SPARC V9 processor's.

Figure 3-1: Scalar Types

Type	C	sizeof	Alignment (bytes)	SPARC V9
Integral	char signed char	1	1	signed byte
	unsigned char	1	1	unsigned byte
	short signed short	2	2	signed halfword
	unsigned short	2	2	unsigned halfword
	int signed int enum	4	4	signed word
	unsigned int	4	4	unsigned word
	long signed long long long signed long long	8	8	signed extended-word
	unsigned long unsigned long long	8	8	unsigned extended-word
Pointer	*any-type* * *any-type(*)()*	8	8	unsigned extended-word
Floating-point	float	4	4	single-precision
	double	8	8 (see text)	double-precision
	long double	16	16 (see text)	quad-precision

A null pointer (for all types) has the value zero.

Within this specification, the term halfword refers to a 16-bit object, the term word refers to a 32-bit object, and the terms extended word and doubleword refer to a 64-bit object.

Double and quad-precision floating-point values occupy 1 and 2 extended words, respectively. Their natural alignment is the same, meaning their addresses are multiples of 8 and 16. Compilers should allocate independent data objects with the alignment shown in Figure 3-1; examples include global arrays of double-precision variables, **FORTRAN COMMON** blocks, and unconstrained stack objects. However, some language facilities (such as **FORTRAN EQUIVALENCE** statements) may create objects with only word alignment. Consequently, arbitrary double- and quad-precision addresses, such as pointers or reference parameters, might or might not be properly aligned. Systems should efficiently implement all **LDDF**(A), **STDF**(A), **LDQF**(A), and **STQF**(A) instructions with target addresses that are word aligned, even if they are not aligned as shown in Figure 3-1, so that compilers should emit **LDDF**(A), **STDF**(A), **LDQF**(A), and **STQF**(A) instructions unless it is known at compile time that the target address is not aligned as shown in Figure 3-1.

Aggregates and Unions

Aggregates (structures and arrays) and unions assume the alignment of their most strictly aligned component. The size of any object, including aggregates and unions, always is a multiple of the object's alignment. An array uses the same alignment as its elements. Structure and union objects can require padding to meet size and alignment constraints.

- An entire structure or union object is aligned on the same boundary as its most strictly aligned member.
- Each member is assigned to the lowest available offset with the appropriate alignment. This may require *internal padding*, depending on the previous member.

- A structure's size is increased, if necessary, to make it a multiple of the alignment. This may require *tail padding*, depending on the last member.

In the following examples, members' byte offsets appear in the upper left corners.

Figure 3-2: Structure Smaller Than a Word

```
struct {char c;};
```

Byte aligned, sizeof is 1

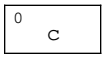


Figure 3-3: No Padding

```
struct {
    char c;
    char d;
    short s;
};
```

Halfword aligned, sizeof is 4

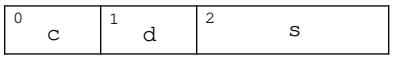


Figure 3-4: Internal Padding

Halfword aligned, sizeof is 4

```
struct{
    char c;
    short s;
};
```

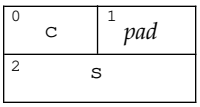


Figure 3-5: Internal and Tail Padding

Extended word aligned, sizeof is 24

```
struct {
    char c;
    long i;
    short s;
};
```

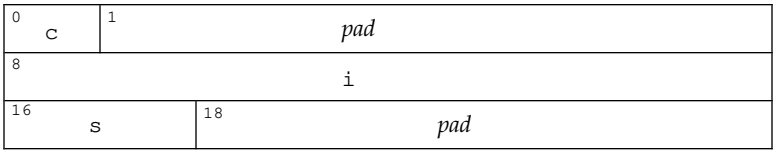
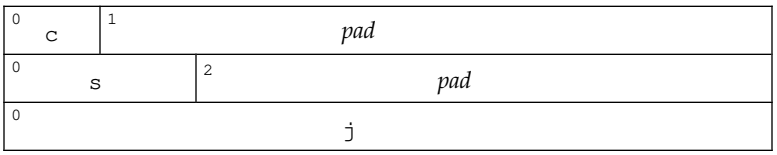


Figure 3-6: Union Allocation

Extended word aligned, sizeof is 8

```
union {
    char c;
    short s;
    long j;
};
```



Bit-Fields

C `struct` and `union` definitions may have *bit-fields*, defining integral objects with a specified number of bits.

Figure 3-7: Bit-Field Ranges

Bit-field Type	Width *w*	Range
signed char char unsigned char	1 to 8	-2^{w-1} to $2^{w-1}-1$ 0 to $2^{w}-1$ 0 to $2^{w}-1$
signed short short unsigned short	1 to 16	-2^{w-1} to $2^{w-1}-1$ 0 to $2^{w}-1$ 0 to $2^{w}-1$
signed int int unsigned int enum	1 to 32	-2^{w-1} to $2^{w-1}-1$ 0 to $2^{w}-1$ 0 to $2^{w}-1$ 0 to $2^{w}-1$
signed long long unsigned long	1 to 64	-2^{w-1} to $2^{w-1}-1$ 0 to $2^{w}-1$ 0 to $2^{w}-1$

"Plain" bit-fields always have non-negative values. Although they may have type `char` `short`, `int`, `long`, or `enum` (which can have negative values), these bit-fields are extracted into an extended word with zero fill. Bit-fields obey the same size and alignment rules as other structure and union members, with the following additions.

- Bit-fields are allocated from left to right (most to least significant).
- A bit-field must entirely reside in a storage unit appropriate for its declared type. Thus a bit-field never crosses a unit boundary. Note: changing a bit-field may involve a non-atomic read-modify-write operation affecting the entire containing storage unit. Programs which thus might concurrently access the same storage unit must take the appropriate precautions.
- Bit-fields may share a storage unit with other `struct/union` members, including members that are not bit-fields. Of course, `struct` members occupy different parts of the storage unit. (A normal member sharing a bit-field's storage unit is subject to potential conflicting updates as described above).
- Unnamed bit-field's types do not affect the alignment of a structure or union, although individual bit-fields' member offsets obey the alignment constraints.

The following examples show `struct` and `union` members' byte offsets in the upper left corners; bit numbers appear in the lower corners.

Figure 3-8: Bit Numbering

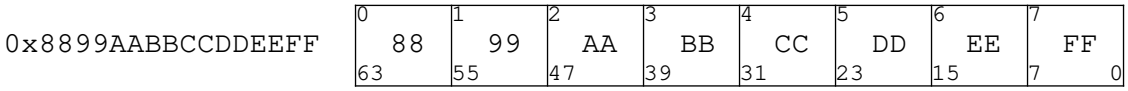


Figure 3-9: Left to Right Allocation

```
struct {
    long j:5;
    long k:6;
    long m:7;
};
```

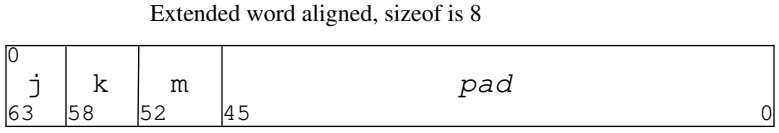


Figure 3-10: Boundary Alignment

```
struct {
    short s:9;
    long j:9;
    char c;
    short t:9;
    short u:9;
    char d;
};
```

Extended word aligned, sizeof is 16

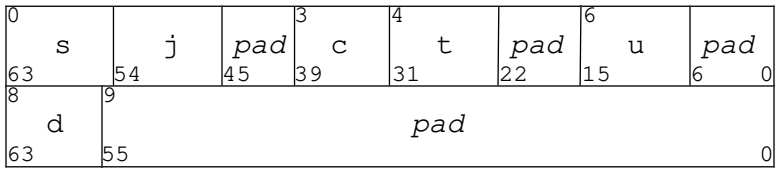


Figure 3-11: Storage Unit Sharing

```
struct {
    char c;
    short s:8;
};
```

Halfword aligned, sizeof is 2

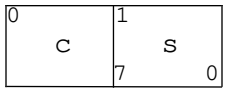


Figure 3-12: `union` Allocation

```
union {
    char c;
    short s:8;
};
```

Halfword aligned, sizeof is 2

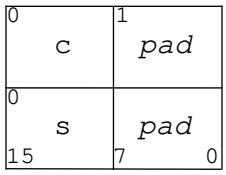
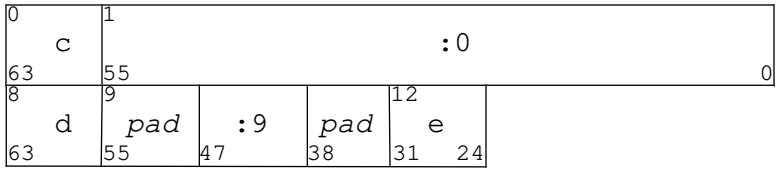


Figure 3-13: Unnamed Bit-fields

```
struct {
    char c;
    long :0;
    char d;
    short :9;
    char e;
    char :0;
};
```

Byte aligned, sizeof is 13



As the examples show, `long` bit-fields (including `signed` and `unsigned`) pack more densely than smaller base types. One can use `char`, `short`, and `int` bit-fields to force particular alignments, but `long` generally works better.

Function Calling Sequence

This section discusses the standard function calling sequence, including stack frame layout, register usage, parameter passing, etc. The system libraries described in Chapter 6 require this calling sequence.

NOTE

C programs follow the conventions given here. For specific information on the implementation of C, see “Coding Examples” in this chapter.

Registers and the Stack Frame

In the SPARC 64-bit ABI all floating-point registers and 8 integer registers are global to a running program, as the `save` and `restore` instructions do not affect them. All remaining integer registers are windowed: 24 are visible at any time, and sets of 24 overlap by 8 registers each. The `save` and `restore` instructions manipulate the windows as part of the normal function prologue and epilogue, making the caller’s 8 *out* registers coincide with the callee’s 8 *in* registers. Each window set also has 8 un-shared *local* registers. Generally, each new frame on the dynamic call stack uses a new register window. Brief register descriptions appear in Figures 3-14 and 3-15; more complete information appears later.

Figure 3-14: A Functions Window Register

Type	Name			Usage
in		%i7	%r31	return address - 8 †
	%fp	%i6	%r30	frame pointer †
		%i5	%r29	incoming param †
		%i4	%r28	incoming param †
		%i3	%r27	incoming param, † (outgoing return value)
		%i2	%r26	incoming param, † (outgoing return value)
		%i1	%r25	incoming param, † (outgoing return value)
		%i0	%r24	incoming param, † (outgoing return value)
local		%l7	%r23	local †
		%l6	%r22	local †
		%l5	%r21	local †
		%l4	%r20	local †
		%l3	%r19	local †
		%l2	%r18	local †
		%l1	%r17	local †
		%l0	%r16	local †
out		%o7	%r15	address of call instruction, ‡ temporary value
	%sp	%o6	%r14	stack pointer †
		%o5	%r13	outgoing param ‡
		%o4	%r12	outgoing param ‡
		%o3	%r11	outgoing param, ‡ (incoming return value)
		%o2	%r10	outgoing param, ‡ (incoming return value)
		%o1	%r9	outgoing param, ‡ (incoming return value)
		%o0	%r8	outgoing param, ‡ (incoming return value)

Figure 3-15: A Function's Global Registers

Type	Name			Usage
global		%g7	%r7	global (reserved for system)
		%g6	%r6	global (reserved for system)
		%g5	%r5	global ‡
		%g4	%r4	global ‡
		%g3	%r3	global (reserved for application)
		%g2	%r2	global (reserved for application)
		%g1	%r1	global ‡
		%g0	%r0	0
floating-point	%q60	%d60,d62		floating-point ‡
	%q56	%d56,d58		floating-point ‡
	%q52	%d52,d54		floating-point ‡
	%q48	%d48,d50		floating-point ‡
	%q44	%d44,d46		floating-point ‡
	%q40	%d40,d42		floating-point ‡
	%q36	%d36,d38		floating-point ‡
	%q32	%d32,d34		floating-point ‡
	%q28	%d28,d30	%f28-f31	parameter ‡
	%q24	%d24,d26	%f24-f27	parameter ‡
	%q20	%d20,d22	%f20-f23	parameter ‡
	%q16	%d16,d18	%f16-f19	parameter ‡
	%q12	%d12,d14	%f12-f15	parameter ‡
	%q8	%d8,d10	%f8-f11	parameter ‡
	%q4	%d4,d6	%f4-f7	parameter, ‡ (return value)
	%q0	%d0,d2	%f0-f3	parameter, ‡ (return value)
special			%y	Y register ‡
			%ccr	condition code register ‡
			%asi	(see below)
			%fpsr	(see below)
			%fsr	(see below)

NOTE

Registers marked † above are assumed to be preserved across a function call. Registers marked ‡ above are assumed to be destroyed (volatile) across a function call.

In addition to a register window, each function has a frame on the run-time stack. This grows downward from high addresses, moving in parallel with the current register window. Figure 3-16 shows the stack frame organization.

Figure 3-16: Standard Stack Frame

Base	Offset	Contents	Frame
		unspecified . . . variable size	*High Address*
%fp+BIAS	>+176		
%fp+BIAS	+176	(if present) additional incoming argument slots	Previous
%fp+BIAS	+128	6 extended word argument slots	
%fp+BIAS	0	16 extended word save area (see below)	
%fp+BIAS	-1	unspecified . . . variable size	
%sp+BIAS	>+176		
%sp+BIAS	+176	(if needed) additional outgoing argument slots	
%sp+BIAS	+128	6 extended word argument slots	
	+120	save area for %i7	
	+112	save area for %i6	
	+104	save area for %i5	
	+96	save area for %i4	
	+88	save area for %i3	
	+80	save area for %i2	
	+72	save area for %i1	
	+64	save area for %i0	Current
	+56	save area for %l7	
	+48	save area for %l6	
	+40	save area for %l5	
	+32	save area for %l4	
	+24	save area for %l3	
	+16	save area for %l2	
	+8	save area for %l1	
%sp+BIAS	0	save area for %l0	
%sp+BIAS %sp	-1 0	volatile memory (do not use)	*Low Address*

BIAS = 2047

Several key points about the stack frame deserve mention.

- Every stack frame must be 16-byte aligned.
- Every stack frame must have a 16-extended-word save area for the *in* and *local* registers, in case of window overflow or under-flow. This save area always must exist at %sp plus a **BIAS** of 2047 (0x7ff).
- Arguments that do not fit in the argument registers are passed on the stack.
- Other areas depend on the compiler and the code being compiled. The standard calling sequence does not restrict how a language system uses the "unspecified" areas of the standard stack frame.

NOTE

The stack pointer is offset from the stack frame by a BIAS of 2047 (0x7ff). This BIAS permits stack frame references in the range of %fp+BIAS-6143 to %fp+BIAS+2048 and %sp+BIAS to %sp+BIAS+2048 to be made with only immediate offset addressing. By making the BIAS an odd number, the least significant bit of the stack pointer will be set and the register overflow and under-flow handlers can easily distinguish a 64-bit register window from a 32-bit register window.

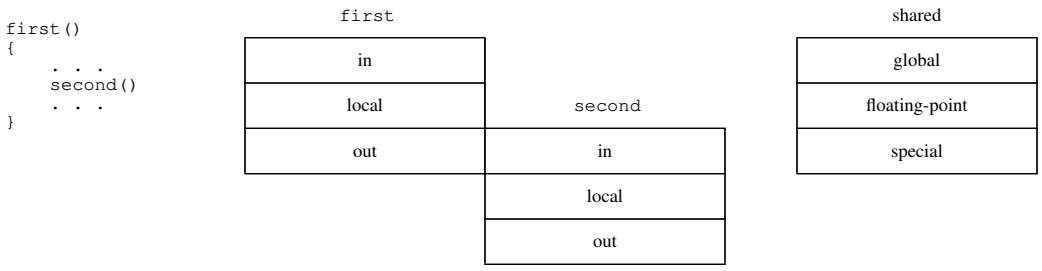
Across function boundaries, the standard function prologue shifts the register window, making the calling function's *out* registers the called function's *in* registers. It also allocates stack space, including the required areas of figure 3-16 and any private space it needs. The lowest 16 extended-words in the stack must—at all times—be reserved as the register save area. The example below illustrates this and allocates 176 bytes for the stack frame.

Figure 3-17: Function Prologue

```
second:
          save %sp, -176, %sp
```

For demonstration, assume a function named `first` calls `second`. The register windows for the two functions appear below.

Figure 3-18: Register Windows



As explained later, the function epilogue executes a restore instruction to unwind the stack and restore the register windows to their original condition.

NOTE

Strictly speaking a function does not need the save and restore instructions if it preserves the registers as described below. Although some functions can be optimized to eliminate the save and restore, the general case uses the standard prologue and epilogue.

Some registers have assigned roles.

%sp or %o6	The *stack pointer* plus the stack BIAS determines the limit of the current stack frame, which is the address of the stack's bottommost, valid word. At all times the stack pointer plus the stack BIAS must point to a 16-byte aligned, 16 extended words window save area.
%fp or %i6	The *frame pointer* plus the stack BIAS is the address of the previous stack frame, which coincides with the word immediately above the current frame. Consequently, a function has registers with which it can access both ends of its frame. Incoming overflow arguments reside in the previous frame, referenced as positive offsets from the frame pointer plus the stack BIAS.
%i0 and %o0	*Integral and pointer return values* appear in %i0. A calling function receives values in the coincident *out* register %o0.
%i0,%i1,%i2,%i3 (%o0,%o1,%o2,%o3)	*The integral fields of structure and all of the fields of union return values with a total size 32 bytes or less* appear in registers %i0, %i1, %i2 and %i3. A calling function receives values in the coincident *out* registers
%i7 and %o7	The *return address* is the location to which a function should return control. Because a calling function's *out* registers coincide with the called function's *in* registers, the calling function puts a return address in its own %o7, while the called function finds the address in %i7 (if it has established its own stack frame). Actually, the return address register holds the call instruction's address, normally making the return address %i7+8 for the called function. (Every call instruction has a delay instruction.) Between function calls, %o7 serves as a scratch register.
%f0,%f1,%f2,%f3 (%d0, %d2) (%q0)	*Floating-point return values* appear in the floating-point registers. Single-precision values occupy %f0; double-precision values occupy %d0; quad-precision values occupy %q0. (Refer to the ***SPARC™*** *Architecture Manual, Version 9* for details on the register numbering scheme). Otherwise, these are scratch registers.
%f0 through %f7 (%d0 through %d6) (%q0 and %q4)	*Floating-point fields from structure return values with a total size of 32 bytes or less* appear in the floating-point registers.
%i0 through %i5	*Incoming non-floating-point parameter slots* use up to 6 corresponding *in* registers. Arguments beyond the sixth extended-word appear on the stack.
%o0 through %o5	*Outgoing non-floating-point parameters slots* use up to 6 corresponding *out* registers. Arguments beyond the sixth extended-word appear on the stack.
%f1, %f3 through %f29, %f31 (%d0 through %d30) (%q0 through %q28)	*Floating-point arguments* are passed in the floating-point registers. Unpromoted single-precision arguments are passed in the first 16 odd-numbered %f registers. Double-precision arguments are passed in registers %d0 through %d30. Quad-precision arguments are passed in registers %q0 through %q28. These registers are assumed **volatile** across the call.
%l0 through %l7	*Local registers* have no specified role in the standard calling sequence.
%d32 through %d62 (%q32 through %q60)	These *floating-point registers* have no specified role in the standard calling sequence. They are assumed **volatile** across function calls.
%g0	*Global register* 0 has no specified role in the standard calling sequence.
%g1, %g4, %g5	*Global registers* 1, 4, and 5 have no specified role in the standard calling sequence. They are assumed **volatile** across function calls. In addition, registers %g1 and %g5 are **volatile** between caller and callee if the call is to an external function (goes through PLT).
%g2, %g3	*Global registers* 2 and 3 are reserved for the application software. Software outside the control of the application (including the libraries described in Chapter 6) should not modify these registers at any time. Software that uses these registers must indicate how it has used them; see "Symbol Table" in Chapter 4 for details. (Note: in a multi-threaded environment, these registers are thread-local. System libraries that implement thread-switching must save and restore these registers on a thread switch.)
%g6 and %g7	*Global registers* 6 and 7 are reserved for system software.
%ccr, %y	These *special registers* are **volatile** across function calls.
%asi	The *address space identifier register* by default holds the value `ASI_PRIMARY_NOFAULT`. If modified, it must be restored to the default value before calling another function or returning.
%fsr	The RD, TEM and NS fields are **preserved** across function calls; the other fields are **volatile**. The **AEXC** bits may be set by a callee, but may not be cleared.
%fprs	The *floating point register state* register has no specified role in the calling sequence. The DU and DL bits are volatile across function calls. For treatment of the FEF see "Special Registers" in Section 3.4.1.

With some exceptions given below, all registers visible to both a calling and a called function 'belong' to the called function. In other words, a called function may use all visible registers without saving their values before it changes them and without restoring their values before it returns. Registers in this category include *global* registers 1, 4, and 5,

floating-point registers, out registers (for the calling function), in registers (for the called function), the Y register, CCR, and the volatile bits of the FSR. Correspondingly, if a calling function wants to preserve such a register value across a function call, it must save the value and restore it explicitly. The exceptions are the stack pointer, %sp, %asi, global registers 2, 3, 6 and 7. A called function is obligated to preserve the stack pointer for its caller. Application programs must never change global registers 6 and 7. Local registers in each window are private. A called function should not change its calling function's local or in registers, even though the registers may be visible temporarily.

Signals can interrupt processes [see ***signal***(**BA_OS**)]. Functions called during signal handling have no unusual restrictions on their use of registers. Moreover, if a signal handling function returns, the process resumes its original execution path with registers restored to their original values. Thus programs and compilers may freely use all non-reserved registers, even *global* and *floating-point* registers, without the danger of signal handlers changing their values. The *address space identifier* register will be set to **`ASI_PRIMARY_NOFAULT`** on entry to the signal handler

NOTE

There are some routines, like ***setjmp***(), ***sigsetjmp***(), and ***vfork***(), that require the caller assume the registers %l0 through %l7, and %i0 through %i5 are **volatile** across the call.

Function Argument Passing

It is convenient to describe parameter linkage in terms of an array. Conceptually, parameters are assigned into an array of extended words, left-to-right, with an occasional "hole" to satisfy alignment restrictions. Typically, most parameter values will be "promoted" from their memory locations into registers, and most calls are expected to execute this way with less overhead.

The following diagram shows the correspondence between parameter registers and the "parameter array."

Memory	Integral	Float	Float from structure	Double	Quad
%sp+BIAS+248		%f31	%f30 and %f31	%d30	
%sp+BIAS+240		%f29	%f28 and %29	%d28	%q28
%sp+BIAS+232		%f27	%f26 and %f27	%d26	
%sp+BIAS+224		%f25	%f24 and %f25	%d24	%q24
%sp+BIAS+216		%f23	%f22 and %f23	%d22	
%sp+BIAS+208		%f21	%f20 and %f21	%d20	%q20
%sp+BIAS+200		%f19	%f18 and %f19	%d18	
%sp+BIAS+192		%f17	%f16 and %f17	%d16	%q16
%sp+BIAS+184		%f15	%f14 and %f15	%d14	
%sp+BIAS+176		%f13	%f12 and %f13	%d12	%q12
%sp+BIAS+168	%o5	%f11	%f10 and %f11	%d10	
%sp+BIAS+160	%o4	%f9	%f8 and %f9	%d8	%q8
%sp+BIAS+152	%o3	%f7	%f6 and %f7	%d6	
%sp+BIAS+144	%o2	%f5	%4 and %f5	%d4	%q4
%sp+BIAS+136	%o1	%f3	%f2 and %f3	%d2	
%sp+BIAS+128	%o0	%f1	%f0 and %f1	%d0	%q0

An "integral type" is any eight-bit char, sixteen-bit short, thirty-two bit int, sixty-four bit long, sixty-four bit long long, or a sixty-four bit pointer to any type.

A "floating type" is any thirty-two bit float, sixty-four bit double, or a one-hundred-twenty-eight bit long double.

Structures and unions up to sixteen bytes in size are passed more efficiently than structures and unions larger than sixteen bytes in size.

To call a function with parameters, a calling function allocates a "parameter array" in its stack frame (see Figure 3-16), sufficiently large to pass all parameters in memory. However, some values are not stored in this array, but are passed only in registers; see below. In the description below, *%i* and *%o* register names are used according to context. See the descriptions of the **SAVE** and **RESTORE** instructions for the relationship between these.

Every register used to pass parameter values has a corresponding location, at a fixed offset, in the parameter array.

Integral and Pointer Arguments

Argument values of all integral types will be assigned to one extended word in the parameter array. Each argument value of integral type smaller than an extended word will be widened by the caller to an extended word according to the signed-ness of the argument type. Any integral or pointer parameters assigned to locations %sp+**BIAS**+128 through %sp+**BIAS**+168 in the parameter array will be passed in registers *%o0..%o5*. The corresponding locations in the parameter array will have undefined values. The corresponding *%f*, *%d*, and *%q* register(s) will also be undefined.

.

NOTE

The type of an argument depends on whether the called function has a prototype declaration in scope at the call site. In the case where no prototype is present, the type of an argument of integral type is determined by the "integral promotions" rule of **ANSI C** and **K&R** C. The use of functions without prototypes is deprecated in **ANSI C** and may be removed from a future version of the C standard. When using a 64-bit ABI load, the address of any unpromoted integral parameter is the address of the slot in the parameter array.

Floating Arguments

Each single-precision parameter value will be assigned to one extended word in the parameter array, and right-justified within that word; the left half (even float register) is undefined. Each double-precision parameter value will be assigned to one extended word in the parameter array. Each quad-precision parameter value will be assigned to two extended words in the parameter array. Long doubles must be quad-aligned, and thus a "hole" might be introduced into the parameter array to force alignment. When a callee prototype exists, and does not indicate variable arguments, floating-point values assigned to locations *%sp+BIAS+128* through *%sp+BIAS+248* will be promoted into floating-point registers, as shown above.

When a callee prototype exists and a particular floating argument matches the "..." of a function with variable arguments, floating values assigned to locations *%sp+BIAS+128* through *%sp+BIAS+168* will be promoted to *%i0..%i5*.

When no prototype exists for a callee:

Floating values assigned to locations *%sp+BIAS+128* through *%sp+BIAS+168* will be passed simultaneously in *%i0..%i5* and *%d0..%d10* (or *%q0..%q8*).

Floating values assigned to locations *%sp+BIAS+176* through *%sp+BIAS+248* will be passed simultaneously in memory and in *%d12..%d30*.

Structure and Union arguments

Structure or union types up to eight bytes in size are assigned to one parameter array word, and align to eight-byte boundaries.

Structure or union types larger than eight bytes, and up to sixteen bytes in size are assigned to two consecutive parameter array words, and align according to the alignment requirements of the structure or at least to an eight-byte boundary.

Structure or union types are always left-justified, whether stored in registers or memory. The individual fields of a structure (or containing storage unit in the case of bit fields) are subject to promotion into registers based on their type using the same rules as apply to scalar values (with the addition that a single-precision floating-point number assigned to the left half of an argument slot will be promoted into the corresponding even-numbered float register.). Any union type being passed directly is subject to promotion into the appropriate integer register(s).

Note that a sixteen-byte structure with all integral fields assigned to locations *%sp+BIAS+168* and *%sp+BIAS+176* will be "split," as the contents of location *%sp+BIAS+168* will be promoted to *%o5*.

Structures or unions larger than sixteen bytes are copied by the caller and passed indirectly; the caller will pass the address of a correctly aligned structure value. This sixty-four bit address will occupy one word in the parameter array, and may be promoted to an %o register like any other pointer value. The callee may modify the addressed structure.

The caller can omit the copy if such omission cannot be detected. That requires (at least) that:

- the original aggregate is already properly aligned,
- the original aggregate is not aliased,
- the original aggregate is not used after the call, and
- no language-specific semantics require the copy.

Variable Argument Lists

A function that expects a variable argument list typically uses the stdarg.h mechanism to process the list. That mechanism defines a `va_list` type that can be passed to another function. Due to the use of the parameter array described above `va_list` is of type `void *`.

Function Result Passing

Functions declared to return the void type do not return a value. All other functions return their values according to the following rules.

Integral and pointer return values

Integral and pointer return types are returned in integer register *%o0*. Functions returning integral and pointer return values always return an extended-word, expanding signed and unsigned bytes, halfwords, and words as needed.

Floating return values

A return value of a floating-point type is passed in *%f0*, *%d0*, or *%q0* as appropriate.

Structure or Union return values

Structure and union return types up to thirty-two bytes in size are returned in registers. The registers are assigned as if the value was being passed as the first argument to a function with a known prototype.

For types with a larger size the caller allocates an area large enough and aligned properly to hold the return value, and passes a pointer to that area as an implicit first argument (of type pointer-to-data) to the callee. This implicit argument logically precedes the first actual argument, and is allocated according to normal argument passing rules (i.e. into %o0). The callee must store the function return value in the result area before control is returned to the caller and after the last use or definition of any variable that might overlap with the result area. If the callee is terminated through any means other than a normal function return (e.g., through a call to the longjmp function), the contents of the result area are undefined.

In the common case that the caller immediately assigns the returned value to a program variable, the caller may substitute the address of the assigned program variable in place of the allocated result area and omit the code to do the assignment, as long as this substitution does not change the program's externally visible behavior.

Note also that the caller is required to provide the implicit argument and a properly sized and aligned receiving area even if it does not wish to use the callee's function result. In that case, the caller may simply pass a pointer to a scratch area.

So that compilers are not forced to emit in-line code for structure copy, Section 6.2 defines a set of routines optimized for this purpose. In the case of a routine which had kept its first argument in *%i0* and was returning a value pointed to by *%i1*, epilogue code would take the form:

```
mov           %i0, %o0
mov           %i1, %o1
call          __align_cpy_n
mov           size, %o2
ret
restore       %o0, %g0, %o0
```

Examples of Argument Passing

All the following examples assume the caller sees a prototype for the callee.

Integral and Pointer Arguments

As mentioned, a function receives up to the first six parameter array words (those that contain integral and pointer arguments) through the *in* registers, *%i0* through *%i5*. Functions pass all integral arguments as extended-words, expanding signed or unsigned bytes, halfwords and words as needed. If a function call has more than 6 integral and pointer arguments the others go on the stack.

Figure 3-19: Integral and Pointer Arguments

Argument	Call	Caller	Callee
1	`g(char,`	%o0	%i0
2	`char,`	%o1	%i1
3	`short,`	%o2	%i2
4	`int,`	%o3	%i3
5	`char *,`	%o4	%i4
6	`int,`	%o5	%i5
7	`int,`	[%sp+BIAS+176]	[%fp+BIAS+176]
8	`void * );`	[%sp+BIAS+184]	[%fp+BIAS+184]

Floating-Point Arguments

Up to the first sixteen parameter array words (those that contain floating-point arguments) are passed in floating-point registers.

Figure 3-20: Floating-Point Arguments

Argument	Call	Caller	Callee
1	`h(float,`	%f1	%f1
2	`float,`	%f3	%f3
3	`double,`	%d4	%d4
4	`float,`	%f7	%f7
5	`double,`	%d8	%d8
6	`float,`	%f11	%f11
7	`float,`	%f13	%f13
8	`long double,`	%q16	%q16
9	`double`	%d20	%d20
10	`long double );`	%q24	%q24

An Example of Mixed Arguments

Figure 3-20a: Mixed Arguments

Argument	Call	Caller	Callee
1	`f(char,`	%o0	%i0
2	`float,`	%f3	%f3
3	`short,`	%o2	%i2
4	`double,`	%d6	%d6
5	`int,`	%o4	%i4
6	`float,`	%f11	%f11
7	`long,`	[%sp+BIAS+176]	[%fp+BIAS+176]
8	`long,`	[%sp+BIAS+184]	[%fp+BIAS+200]
9	`double );`	%d16	%d16

Examples of Result Passing

Functions Returning Scalars or No Value

A function that returns an integral or pointer value places its result in *%i0*; the calling function finds that value in *%o0*. A floating-point return value appears in the floating-point registers for both the calling and the called function. Single-precision uses *%f0*; double-precision uses *%d0*; quad-precision uses *%q0*. Functions that return no value (also called procedures or `void` functions) put no particular value in any return register. Those registers may be used as scratch registers, however. A call instruction writes its own address into *out* register *%o7*. As usual for a control transfer instruction, the call instruction takes a delay instruction that is executed before the instruction of the called function. Because every instruction is one word long, the return address is the address of the call instruction plus 8. The value is *%i7+8* for the called function and *%o7+8* for the calling function. The following example returns the value contained in *local* register *%l4*.

Figure 3-23: Function Epilogue

```
jmpl %i7 + 8, %g0
restore %l4,0,%o0
```

If a function returns no value or if the return register already contains the desired value, the next epilogue would suffice.

Figure 3-24: Alternative Function Epilogue

```
jmpl %i7 + 8, %g0
restore %g0,0,%g0
```

Operating System Interface

Virtual Address Space

Processes execute in a 64-bit ABI virtual address space; this is mapped as the primary address space. Memory management hardware translates virtual addresses to physical addresses, hiding physical addressing and letting a process run anywhere in the system's real memory. Processes typically begin with three logical segments, commonly called text, data and stack. As Chapter 5 describes, dynamic linking creates more segments during execution, and a process can create additional segments for itself with system services.

NOTE

The effects of using load and store alternate instructions with address space identifiers other than **ASI_PRIMARY**, **ASI_PRIMARY_NOFAULT**, **ASI_PRIMARY_LITTLE**, and **ASI_PRIMARY_NOFAULT_LITTLE** are undefined and/or implementation-dependent. Programs that use address space identifiers other than these four do not conform to the 64-bit ABI.

Page Size

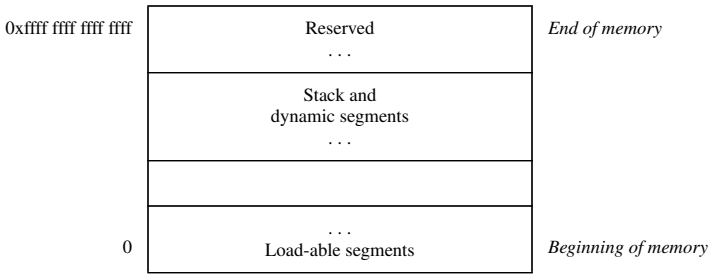
Memory is organized by pages, which are the system's smallest units of memory allocation. Page size can vary from one system to another, depending on the processor, memory management unit and system configuration. Processes may call ***sysconf***(**BA_OS**) to determine the system's current page size. The maximum page size for SPARC 64-bit ABI is 1 MB.

Virtual Address Assignments

Conceptually, processes have the full 64-bit address space available. In practice, however, several factors may limit the size of a process.

- The system may reserve a configuration-dependent amount of virtual space.
- A tunable configuration parameter may limit process size.
- The MMU can limit the process size because a given MMU may not be able to address the full range of the 64-bit address space.
- A process whose size exceeds the system's available, combined physical memory and secondary storage cannot run. Although some physical memory must be present to run any process, the system can execute processes that are bigger than physical memory, paging them to and from secondary storage. Nonetheless, both physical memory and secondary storage are shared resources. System load, which can vary from one process execution to the next, affects the available amounts.

Figure 3-26: Virtual Address Configuration



Load-able segments: Processes' load-able segments may begin at 0. The exact addresses depend on the executable file format [see Chapters 4 and 5].

Stack and dynamic segments: A process's stack and dynamic segments reside below the reserved area. Processes can control the amount of virtual memory allocated for stack space, as described below.

Reserved A reserved area may reside at the top of virtual memory.

NOTE

Although application programs may begin at virtual address 0, they conventionally begin at or above 0x100000 (1 MB), leaving the initial 1 MB with an invalid address mapping. Processes that reference this invalid memory (for example by dereferencing a null pointer) generate an access exception trap, as described in the "Trap Interface" section of this chapter. A process may, however, establish a valid mapping for this area using the ***mmap***(KE_OS) facilities.

As the figure shows, the system reserves the high end of virtual space with a process's stack and dynamic segments below that.

~~Although the exact boundary between the reserved area and a process depends on the system's configuration, the reserved area shall not consume more than 8 exabytes (EB) from the virtual address space. Thus the user virtual address range has a minimum upper bound of 0x7fff ffff ffff ffff. Individual systems may reserve less space, increasing processes' virtual memory range.~~

The exact boundary between the reserved area and a process depends on the system's configuration. Individual systems that reserve less space will increase the processes' virtual memory range.

More information follows in the section "Managing the Process Stack".

NOTE

Unlike 32-bit ABI, for 64-bit ABI the stack is mapped with read and write but not execute permissions. This change is intended to make programs more secure against buffer overflow attacks.

Although applications may control their memory assignments, the typical arrangement follows the diagram above. Loadable segments reside at low addresses; dynamic segments occupy the higher range. When applications let the system choose addresses for dynamic segments (including shared object segments), it will choose high addresses. This leaves the "middle" of the address spectrum available for dynamic memory allocation with facilities such as ***malloc***(**BA_OS**).

Managing the Process Stack

The section "Process Initialization" in this chapter describes the initial stack contents. Stack addresses can change from one system to the next--even from one process execution to the next on the same system. Processes, therefore, should not depend on finding their stack at particular virtual address. A tunable configuration parameter controls the system maximum stack size. A process also can use ***setrlimit***(**BA_OS**), to set its own maximum stack size, up to the system limit. On 64-bit ABI, the stack segment has read and write permissions.

Coding Guidelines

Operating system facilities, such as ***mmap*** (**KE_OS**), allow a process to establish address mappings in two ways. First, the program can let the system choose an address. Second, the program can force the system to use an address the program supplies. This second alternative can cause application portability problems, because the requested address might not always be available. Differences in virtual address space can be particularly troublesome between different architectures, but the same problems can arise within a single architectures.

Processes' address spaces typically have three segment areas that can change size from one execution to the next: the stack [through ***setrlimit*** (**BA_OS**), the data segment [through ***malloc*** (**BA_OS**)], and the dynamic segment area [through ***mmap*** (**KE_OS**)]. Changes in one area may affect the virtual addresses available for another. Consequently, an address that is available in one process execution might not be available in the next. A program that used ***mmap*** (**KE_OS**) to request a mapping at a specific address thus could appear to work in some environments and fail in others. For this reason, programs that wish to establish a mapping in their address space should let the system choose the address.

Despite these warnings about requesting specific addresses, the facility can be used properly. For example, a multiprocess application might map several files into the address space of each process and build relative pointers among the files' data. This could be done by having each process ask for a certain amount of memory at an address chosen by the system. After each process receives its own private address from the system, it would map the desired files into memory, at specific addresses within the original area. This collection of mappings could be at different addresses in each process but their relative positions would be fixed. Without the ability to ask for specific addresses, the application could not build shared data structures, because the relative positions for files in each process would be unpredictable.

Trap Interface

Hardware Trap Types

The operating system defines the following correspondence between hardware traps and the signals specified by ***signal***(**BA_OS**).

Figure 3-27: Hardware Traps and signals

Trap Name	Signal
instruction_access_exception	**SIGSEGV**, **SIGBUS**
instruction_access_MMU_miss	**SIGSEGV**
instruction_access_error	**SIGBUS**
illegal_instruction	**SIGILL**
privileged_opcode	**SIGILL**
fp_disabled	**SIGILL**
fp_exception_ieee_754	**SIGFPE**
fp_exception_other	**SIGFPE**
tag_overflow	**SIGEMT**
division_by_zero	**SIGFPE**
data_access_exception	**SIGSEGV**, **SIGBUS**
data_access_MMU_miss	**SIGSEGV**
data_access_error	**SIGBUS**
data_access_protection	**SIGSEGV**
mem_address_not_aligned	**SIGBUS**
privileged_action	**SIGILL**
async_data_error	**SIGBUS**
trap_instruction	see next table

The signal is sent only if no user trap handler is provided. See User Traps.

Two trap types, *instruction_access_exception* and *data_access_exception*, can generate two signals. In both cases, the "normal" signal is `SIGSEGV`. Nonetheless, if the access also causes some external memory error (such as parity error), the system generates `SIGBUS`.

Floating point instructions exist in the architecture, but they may be implemented either in hardware or software. If the *fp_disabled* or *fp_exception_other* trap occurs because of an unimplemented, valid instruction, the process receives no signal. Instead the system intercepts the trap, emulates the instruction, and returns control to the process. A process receives **`SIGILL`** for the fp_disabled trap only when the indicated floating-point instruction is illegal (invalid encoding, etc.).

Software Trap Types

The operating system defines the following correspondence between software traps and the signals specified by ***signal***(**BA_OS**).

Figure 3-28: Software Trap Types

Trap Number	Signal	Purpose
0	unspecified	Reserved to OS vendor (SunOS 4.x syscall)
1	**SIGTRAP**	Breakpoint
2	**SIGFPE**	Division by zero
3	unspecified	Reserved to OS vendor (old flush windows trap)

Figure 3-28: Software Trap Types

Trap Number	Signal	Purpose
4	none	clean windows trap
5	**SIGILL**	Range checking
6	none	Fix alignment
7	**SIGFPE**	Integer overflow
8	unspecified	Reserved to the OS vendor (32-bit ABI syscall)
9-15	unspecified	Reserved to the OS vendor
16-31	**SIGILL**	Reserved for user applications
32	unspecified	Reserved (old get condition codes)
33	unspecified	Reserved (old set condition codes)
34-47	unspecified	Reserved to the OS vendor
48-63	unspecified	Reserved to the OS vendor
64-66	**SIGSYS**	system calls (reserved for OS vendor)
67	**SIGSYS**	system calls (reserved for OS source licensee)
68	**SIGILL**	Return from deferred trap
69-79	unspecified	Reserved to SPARC International
80-95	unspecified	Reserved to SPARC International
96-111	unspecified	Reserved to the OS vendor
112-255	unspecified	Reserved to the OS vendor

0 and 8 — Trap types 0 and 8 were used in some 32-bit ABI systems to implement operating system service routines. In the SPARC 64-bit ABI they are reserved.

1 — A debugger can set a breakpoint by inserting a trap instruction whose type is 1.

2 — A process can explicitly signal division by zero with this trap.

3 — Trap type 3 was used in 32-bit ABI systems to ask the system to flush all its register windows to the stack. In the SPARC 64-bit ABI the `flushw` instruction can be used instead. The trap is reserved.

4 — Normally during process execution, **SAVE** instructions allocate new register windows with local and out registers that either all contain zeros or all contain the corresponding register contents from a currently-live function that is higher on the dynamic call stack (earlier in the call chain) than the current function. (A **SAVE** instruction can also allocate an old register window; this window will contain data from a previously-called, no-longer-active function in this address space.) This differs from the default 32-bit ABI behavior, where new register windows could have contained kernel data or data from another process. The default 64-bit behavior is adequate for most programs that need predictable register window contents. However, some programs need even cleaner windows than SPARC 64-bit ABI provides by default. Executing a type 4 trap causes the system to initialize local and out registers in all existing old windows and all subsequent new windows to zero. This behavior continues until the process terminates. Re-issuing the trap causes existing old windows to be cleaned.

5 — A process can explicitly signal a range checking error with this trap.

6 — Executing a type 6 trap makes the operating system “fix” subsequent unaligned data references. Although the references still generate *memory_address_not_aligned* traps, the operating system handles the trap, emulates the data reference, and returns control to the process without generating a signal. In this context a “data reference” is a load or store operation. Implicit memory references, such as control transfers, must always be aligned properly, and the stack must always be aligned as described elsewhere.

This trap is provided to ease porting of existing code. Its use in new code is deprecated. A user trap handler should be used instead. If a user trap handler for **UT_MEM_ADDRESS_NOT_ALIGNED** is installed, it takes precedence.

7 — A process can explicitly signal integer overflow with this trap. Either a positive or a negative value can cause overflow.

9-15 — The operating system reserves these traps for its own use. Programs that use them do not conform to the 64-bit ABI.

16-31 These traps are reserved for user applications and are subject to being handled by user trap handlers (see following section).

32 Trap type 32 was used in 32-bit ABI systems to copy the icc integer condition codes from the PSR register to global register %g1. In the 64-bit ABI the CCR register is not privileged and can be accessed directly. The trap is reserved.

33 Trap type 33 was used in 32-bit ABI systems to copy the rightmost four bits from global register *%g1* to the **PSR** *icc* integer condition codes. In 64-bit ABI the CCR register is not privileged and can be accessed directly. The trap is reserved.

34-63 The operating system reserves these traps for its own use. Programs that use them do not conform to the 64-bit ABI.

64-66 Operating system service routines defined by an OS vendor are implemented using these trap types.

67 OS source licensee specific operating system service routines are implemented using this trap type.

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NOTE

The 64-bit ABI does not define the implementation of individual system calls. Instead, programs should use the system libraries that chapter 6 describes. Programs with embedded system call trap instructions do not conform to the 64-bit ABI.

68 Trap 68 is used to return control to the system from a deferred user trap handler.

69-95 Reserved for future allocation by SPARC International.

96-127 The operating system reserves these trap types for its own use. Programs that use them do not conform to the 64-bit ABI.

User Traps

The operating system can redirect certain traps from non-privileged code back to user trap handlers. The interface for this functionality is declared in the new include file <*sys/utrap.h*> as shown in Figure 3-28a. See Figure 6-143 for the header file.

Figure 3-28a: Hardware Traps and User Traps

Trap Name	User Trap	
illegal_instruction	UT_ILLTRAP_INSTRUCTION UT_ILLEGAL_INSTRUCTION	†*
fp_disabled	UT_FP_DISABLED	†*
fp_exception_ieee_754	UT_FP_EXCEPTION_IEEE_754	†
fp_exception_other	UT_FP_EXCEPTION_OTHER	
tag_overflow	UT_TAG_OVERFLOW	†*
division_by_zero	UT_DIVISION_BY_ZERO	†
mem_address_not_aligned	UT_MEM_ADDRESS_NOT_ALIGNED	†
privileged_action	UT_PRIVILEGED_ACTION	†
privileged_opcode	UT_PRIVILEGED_OPCODE	
async_data_error	UT_ASYNC_DATA_ERROR	
trap_instruction	UT_TRAP_INSTRUCTION_16 through UT_TRAP_INSTRUCTION_31	†* †*
instruction_access_exception instruction_access_MMU_miss instruction_access_error	UT_INSTRUCTION_EXCEPTION or UT_INSTRUCTION_PROTECTION or UT_INSTRUCTION_ERROR	
data_access_exception data_access_MMU_miss data_access_error data_access_protection	UT_DATA_EXCEPTION or UT_DATA_PROTECTION or UT_DATA_ERROR	

User trap types marked with † above are required and must be provided by all 64-bit ABI-conforming implementations.

The others may not be present on every implementation; an attempt to install a user trap handler for a type not present will return **EINVAL**. User trap types marked with * above are implemented as precise traps only. Most user trap types are self-explanatory; a few require a few more words.

UT_ILLTRAP_INSTRUCTION
This trap is raised by user execution of the **ILLTRAP** instruction. It is always precise.

UT_ILLEGAL_INSTRUCTION
This trap will be raised by execution of otherwise undefined opcodes. It is implementation-dependent as to what opcodes raise this trap; the 64-bit ABI only specifies the interface. The trap may be precise or deferred.

UT_PRIVILEGED_OPCODE
All the opcodes declared to be privileged in the SPARC V9 architecture will raise this trap. It is implementation-dependent whether other opcodes will raise it as well; the 64-bit ABI only specifies the interface.

UT_DATA_EXCEPTION, **UT_INSTRUCTION_EXCEPTION**
No valid user mapping can be made to this address, for a data or instruction access, respectively.

UT_DATA_PROTECTION, **UT_INSTRUCTION_PROTECTION**
A valid mapping exists, and user privilege to it exists, but the type of access (read, write, or execute) is denied, for a data or instruction access, respectively.

UT_DATA_ERROR, **UT_INSTRUCTION_ERROR**
A valid mapping exists, and both user privilege and the type of access are allowed, but an unrecoverable error occurred in attempting the access, for a data or instruction access, respectively. *%l1* will contain either **BUS_ADDRERR** or **BUS_OBJERR**.

UT_FP_DISABLED
This trap is raised when an application issues a floating point instruction (including load or store) and **FEF** is zero. If a user handler is installed for this trap, it will be given control. Otherwise, the system will set **FEF** to one and retry the instruction.

A functional interface is provided to establish the user trap handlers and is defined Section 6.2.

For all traps, the handler executes in a new window, where the *in* registers are the *out* registers of the previous frame and have the value they contained at the time of the trap. Similarly the global registers (including the special registers `%ccr`, `%asi`, and `%y`) and the floating-point registers have their values at the time of the trap. The stack pointer register *%sp* plus the BIAS will point to a properly-aligned 128-byte register save area; if the handler needs scratch space, it should decrement the stack pointer to obtain it. If the handler needs access to the previous frame's *in* registers or *local* registers, it should execute a **FLUSHW** instruction, and then access them off of the frame pointer. If the handler calls an 64-bit ABI-conforming function, it must set the `%asi` register to **ASI_PRIMARY_NOFAULT** before the call.

Precise Traps

On entry to a precise user trap handler `%l6` contains the `%pc` and `%l7` contains the `%npc` at the time of the trap. To return from a handler and reexecute the trapped instruction, the handler would execute:

```
jmpl %l6, %g0
return %l7
```

To return from a handler and skip the trapped instruction, the handler would execute:

```
jmpl %l7, %g0
return %l7+4
```

Deferred Traps

On entry to a deferred user trap handler `%o0` contains the address of the instruction that caused the trap and `%o1` contains the actual instruction (right-justified, zero extended), if the information is available. Otherwise `%o0` contains the value -1 and `%o1` is undefined. For certain cases additional information may be made available as indicated in the following table.

Instructions	Additional Information
LD-type LDSTUB	`%o2` contains the effective address (*rs1* + *rs2* | *simm13*).

ST-type CAS SWAP	%o2 contains the effective address (*rs1* + *rs2* | *simm13*). %o3 contains the data to be stored if available.
Integer arithmetic	%o2 contains the *rs1* value. %o3 contains the *rs2* | *simm13* value. %o4 contains the contents of %*y* register.
Floating-point arithmetic	%o2 contains the address of *rs1* value. %o3 contains the address of *rs2* value.
Control-transfer	%o2 contains the target address (*rs1* + *rs2* | *simm13*).
Asynchronous data errors	%o2 contains the address that caused the error. %o3 contains the effective ASI, if available, else -1

To return from a deferred trap, the trap handler issues:

```
ta          68          !ST_RETURN_FROM_DEFERRED_TRAP
```

The instruction that causes the trap will NOT be retried.

Dispatching Traps

The following pseudo-code explains how the operating system dispatches traps.

```
if (precise_trap) {
            if (precise_handler) {
                        invoke(precise_handler);
                        /* not reached */
            } else {
                        convert_to_signal(precise_trap);
            }
} else if (deferred_trap) {
            if (deferred_handler) {
                        invoke(deferred_handler);
                        /* not reached */
            } else {
                        convert_to_signal(deferred_trap);
            }
}

if (signal)
            send(signal);
```

User trap handlers must preserve all registers except the *locals* (%*l0–7*) and *outs* (%*o0–7*), i.e. %i0–7, %g1–7, %*d0–62*, %*asi*, %*fsr*, %*fprs*, %*ccr*, and %*y*, except to the extent that modifying the registers is part of the desired functionality of the handler. For example, the handler for **UT_FP_DISABLED** may load floating-point registers.

Process Initialization

This section describes the machine state that ***exec***(**BA_OS**) creates for "infant" processes, including argument passing, register usage, stack frame layout, and so on. Programming language systems use this initial program state to establish a standard environment for their application programs. As an example, a C program begins executing at a function named main, conventionally declared in the following way.

Figure 3-39: Declaration for main

```
extern int main (int argc, char *argv[], char *envp[]);
```

Briefly, *argc* is a non-negative argument count; argv is an array of argument strings, with *argv*[*argc*] == 0; and envp is an array of environment strings, also terminated by a null pointer. Although this section does not describe C program initialization, it gives the information necessary to implement the call to *main* or the entry point for a program in any other language.

Special Registers

The architecture defines three main non-privileged state registers and one privileged register to control and monitor the processor. They are the condition code register (**CCR**), the floating-point register state register (**FPRS**), the floating-point state register (**FSR**), and the processor state register (**PSTATE**). The tables below give the initial state of these registers.

Figure 3-30a: Condition Code Register (CCR) Fields

Field	Value	Note
xcc	unspecified	Extended integer condition codes unspecified
icc	unspecified	Integer condition codes unspecified

The architecture defines floating point instructions, and those instructions work whether the processor has a hardware floating-point unit or not. (A system may provide hardware or software floating point facilities.) In either case, however, the processor presents a working floating-point implementation, including an **FPRS** and an **FSR** with the following initial values.

Figure 3-30b: Floating-point Registers State (FPRS) Fields

Field	Value	Note
FEF	0	Floating-point unit disabled
DL	0	Lower half of floating point registers are not dirty
DU	0	Upper half of floating-point registers are not dirty

If an application issues a floating-point instruction (including load or store) when **FEF** is zero, and a user-trap handler is installed for **UT_FP_DISABLED**, that trap handler is invoked. If no such user-trap handler is installed, the system sets **FEF** to one and retries the instruction.

An application may set **FEF** to 1 at any time, or may let the system set **FEF** to 1 for it. When **FEF** is 1, the system preserves floating-point state for the application over context switches.

An application may set **FEF** to 0 at any time. The system will never set **FEF** to 0 on its own, except that a multi-threading library may set **FEF** to 0 when dispatching a thread with a saved **FEF** of 0. When **FEF** is 0, the system does not preserve floating-point state for the application over context switches. The user-visible contents of the floating-point registers, including the **FSR**, become undefined when **FEF** is set to 0. An application may find it useful to set **FEF** to 0 when it no longer needs to preserve the contents of the floating-point registers, as the system will not need to save and restore them over context switches.

Figure 3-31: Floating-point State (FSR) Register Fields

Field	Value	Note
fcc3	unspecified	Floating-point condition codes unspecified
fcc2	unspecified	Floating-point condition codes unspecified
fcc1	unspecified	Floating-point condition codes unspecified
RD	0	Round to nearest
TEM	0	Floating-point traps not enabled
NS	0	Nonstandard mode off
ver	read only	Implementation version number
ftt	unspecified	Floating-point trap type unspecified
qne	0	Floating-point queue (if any) is empty
fcc0	unspecified	Floating-point condition codes unspecified
aexc	0	No accrued exceptions
cexc	0	No current exceptions

Application programs cannot access the **PSTATE** register directly; they run in the processor's non-privileged mode, and the instructions to read and write **PSTATE** are privileged. Nonetheless, a program "sees" a processor that behaves as if **PSTATE** had the following values. **PSTATE** fields not in the table either have unspecified values or do not affect user program behavior.

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Figure 3-31a: Processor State Register Fields

Field	Value	Note
CLE	0	Data reads and writes using an implicit ASI are big-Indian.
MM	unspecified	Set according to the rules in Chapter 4, ELF Header.
RED	0	Processes run in normal mode.
AM	0	Processes run in a 64-bit address space.
PRIV	0	Processes run in non-privileged mode.
IE	1	Interrupts enabled.

Other non-privileged registers and their initial states are listed in the table below.

Figure 3-31b: Other Non-privileged Registers

Register	Value	Note
%asi	`ASI_PRIMARY_NOFAULT`	Address space identifier default
%tick	positive	(see below)
%pc	--	The current program counter
%y	unspecified	Y register unspecified

The %tick register is a per-cpu register that is incremented on every cpu clock cycle. The *%tick* registers in an MP system may or may not be synchronized. While the *%tick* register is monotonically increasing on each cpu, it may appear to increase by huge amounts if an interrupt or signal occurs between instructions, and it may appear to increase *or decrease* by huge amounts if a context-switch (to another cpu) occurs between instructions.

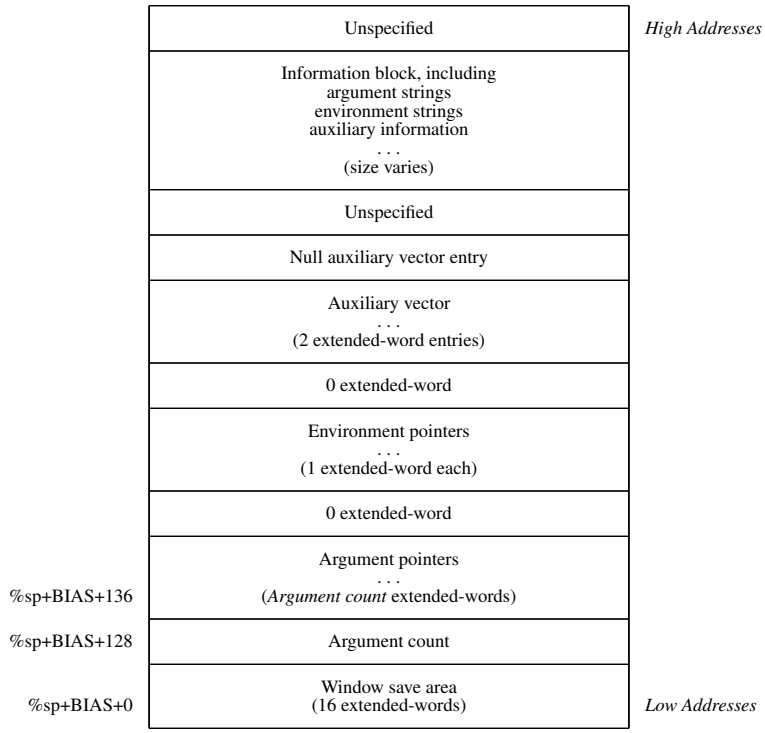
Therefore, programmers may use *%tick* directly to measure short sequences of code that have a high probability of completing execution before an interrupt (such as end of time slice) occurs. Repeated measurements should be taken, with outlier data points discarded. System vendors are encouraged to provide low-latency real and virtual timing facilities that may be used to measure longer sequences of code.

The ancillary state registers besides the **Y**, **CCR**, **ASI**, **TICK**, **PC**, and **FPRS** registers either are privileged or unspecified by the architecture. Applications thus may not execute the **RDASR** and **WRASR** instructions, with the exception of **RDY**, **RDCCR**, **RDASI**, **RDTICK**, **RDPC**, **RDFPRS**, **STBAR**, **MEMBAR**, **WRY**, **WRCCR**, **WRASI**, **WRFPRS**, and **SIR**.

Process Stack and Registers

When a process receives control, its stack holds the arguments and environment from ***exec***(**BA_OS**).

Figure 3-32: Initial Process Stack



Argument strings, environment strings, and the auxiliary information appear in no specific order within the information block; the system makes no guarantees about their arrangement. The system also may leave an unspecified amount of memory between the null auxiliary vector entry and the beginning of the information block.

Except as shown below, global, floating point, and window registers have unspecified values at process entry. Consequently, a program that requires registers to have specific values must set them explicitly during process initialization. It should *not* rely on the system to set all registers to zero.

`%g1` A non-zero value gives a function pointer that the application should register with **`atexit`**(**BA_OS**). If `%g1` contains zero, no action is required.

`%fp` The system marks the deepest stack frame by setting the frame pointer to zero. No other frame's `%fp` has a zero value.

`%sp` Performing its usual job, the stack pointer plus the stack **BIAS** gives the address of the bottom of the stack, which is guaranteed to be 16-byte aligned.

Every process has a stack, but the system defines *no* fixed stack address. Furthermore, a program's stack address can change from one system to another - even from one process invocation to another. Thus the process initialization code must use the stack address in `%sp`. Data in the stack segment at addresses below the bottom of the stack contain undefined values.

Whereas the argument and environment vectors transmit information from one application program to another, the auxiliary vector conveys information from the operating system to the program. This vector is an array of the following structures, interpreted according to the **a_type** member.

Figure 3-33:Auxiliary Vector

```
typedef struct
{
         int      a_type;
         union {
                  long     a_val;
                  void     *a_ptr;
                  void     (*a_fcn)();
         } a_un;
} auxv_t;
```

In the following example, the stack resides below 0x8000 0000 0000 0000, growing toward lower addresses. The process receives three arguments.

- `cp`
- `src`
- `dst`

It also inherits two environment strings (this example is not intended to show a fully configured execution environment).

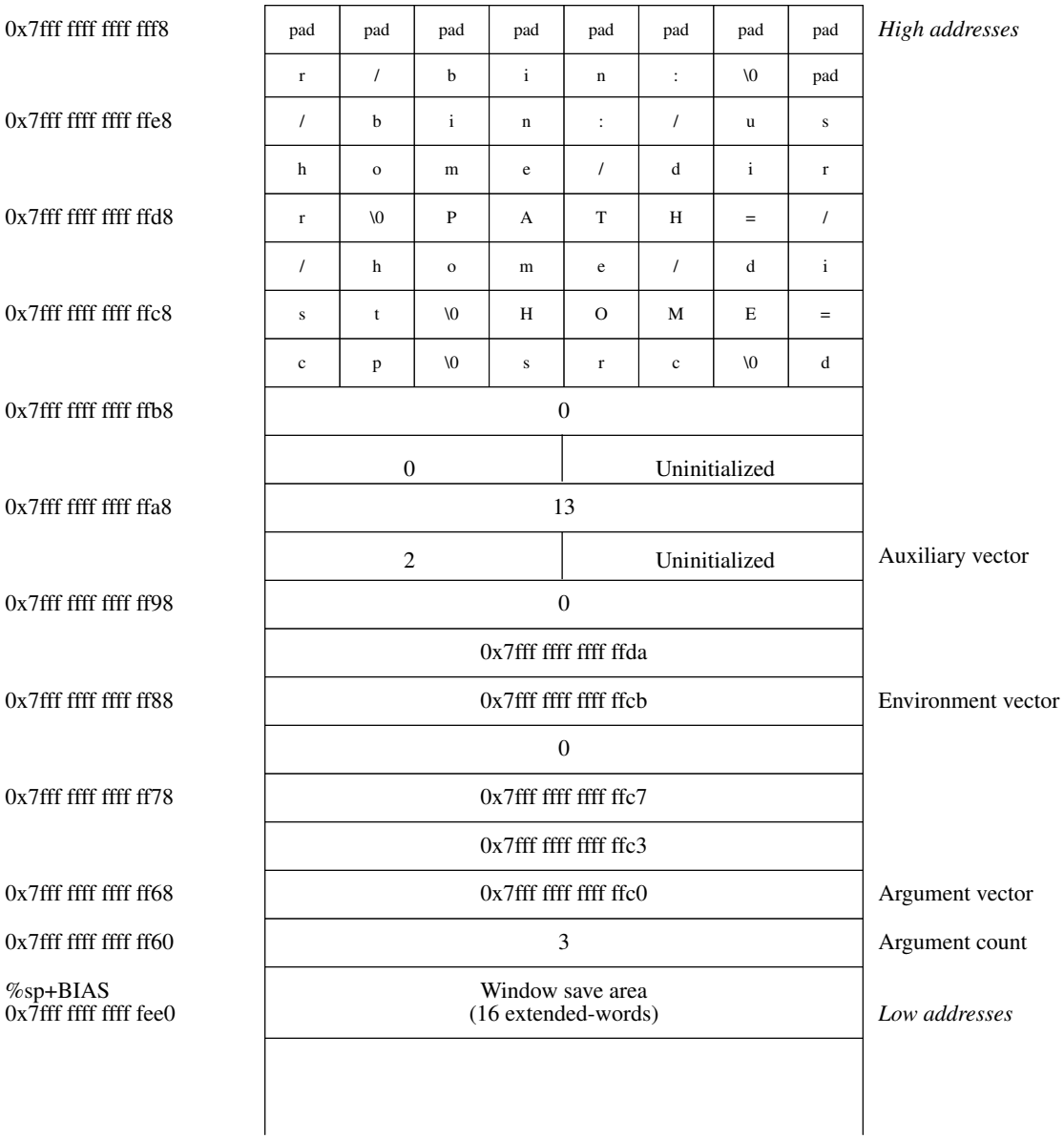
- `HOME=`*`/home/dir`*
- `PATH=`*`/home/dir/bin:/usr/bin:`*

Its auxiliary vector holds one non-null entry, a file descriptor for the executable file.

- `13`

The initialization sequence preserves the stack pointer's extended-word alignment.

Figure 3-35: Example Process Stack



Coding Examples

This section discusses example code sequences for fundamental operations such as calling functions, accessing static objects, and transferring control from one part of a program to another. Previous sections discuss how a program may use the machine or the operating system, and they specify what a program may and may not assume about the execution environment. Unlike previous material, the information here illustrates how operations *may* be done, not how they *must* be done. As before, examples use the **ANSI C** language. Other programming languages may use the same conventions displayed below, but failure to do so does *not* prevent a program from conforming to the 64-bit ABI. In the sections that follow several new relocation types will be used to demonstrate features of the SPARC V9 architecture. From a reference of %hh or %lm, for example, one will infer correspondence to relocations named **R_SPARC_HH**, **R_SPARC_LM**, respectively. See the section "Relocation Types" in Chapter 4 for all the details.

Architectural Constraints

The SPARC V9 architecture has a number of constraints that make it desirable to use several different code models for

different purposes, in order to improve performance and reduce code size. The relevant constraints are:

a) The *call* instruction has a 30 bit signed immediate value. The target address of a call instruction may thus be at most 2^{29} instructions (2^{31} bytes) before it or 2^{29}- 1 instructions (2^{31}- 4 bytes) after it.

b) Memory access instructions (e.g., *ldx* and *stx*) and arithmetic and logical instructions (e.g., *add* and *or*) have a 13-bit signed immediate value.

c) The *sethi* instruction has a 22 bit unsigned immediate value that is placed in register bits 31..10. The other register bits are cleared.

Code Positionability

There are two code positionability models of interest:

absolute — The virtual addresses of instructions and static data are known at static link time. To execute properly, the object must be loaded at a specific virtual address, making the program's absolute addresses correspond with the process's virtual addresses.

position-independent (PIC) — The virtual addresses of instructions and static data are not known until dynamic link time. PIC uses PC-relative addresses, not absolute addresses. Consequently, the code is not tied to a specific load address, allowing it to execute properly at various positions in virtual memory.

Typically, executables have absolute code and shared objects such as dynamically linked libraries have PIC.

Code Size

Because of constraint (a) and (c), there are two code size models of interest:

medium — The address range spanned by all instructions in the object is less than 2^{31} bytes (2 GB) and the distance from any instruction to the location of the label **_GLOBAL_OFFSET_TABLE_** is less than 2^{31} bytes (2 GB)

full — The only limit on address range spanned is the available virtual address space.

One limiting case is a **CALL** instruction at the beginning of the code whose target address is at the end of the procedure linkage table. A single **CALL** instruction can be used for all subroutine calls within a medium code size object, more code is needed for full code size programs.

The second limiting factor is the ability of a simple code sequence to materialize a pointer to the Global Offset Table (applies to position independent code only).

Whether or not a program has medium code size may depend on the relative ordering of sections in the program. In particular it may be important to place the procedure linkage table before the global offset table.

Location

Because of constraints (b) and (c), there are four location models of interest:

low — The executable must be in the low 4 GB of the virtual address space.

middle — The executable must be in the low 16 TB of the virtual address space.

high — The executable must be in the high 4 GB of the virtual address space.

anywhere — The executable or shared object can be placed anywhere in the virtual address space.

All except the anywhere model apply only to absolute code. The low model generates the most efficient code for accessing static objects: two instructions and one register always suffice.

External Object References

A shared object that references an object external to itself must use indirect addressing. For example, the libc function ***localtime***() references the external variable daylight. At the time the libc shared library is created, the address of daylight is not known, so references to it from libc go through a global offset table. Each shared object has its own global offset table, which is just a vector of addresses. Each object, e.g. *daylight*, is associated with an index into the global offset table. At dynamic link time, the dynamic linker fills in *daylight's* element in the global offset table with the absolute address of *daylight*.

Because of the effects of constraints (b) and (c) on addressing elements in global offset tables, there are four external object reference models. However, only the first three are of practical interest.

none no global offset table is used.

small The executable or shared object references at most 1024 external objects.

large The executable or shared object references at most 2^{29} external objects.

huge The size of the global offset table is limited only by the available virtual address space.

The limiting factor is the 13-bit signed immediate in load instructions. Assuming the address of the middle of the global offset table is already in some register, the small model can load any element with one **LDX** instruction, whereas the large model requires three instructions.

Combinations of Practical Interest

The following combinations of models might be of practical use. All models use dynamic linking.

Figure 3.35a: Code Models

Positionability	Code Size	Location	External Object Reference Model
absolute	medium	low	none
absolute	medium	middle	none
absolute	medium	anywhere	none
PIC	medium	anywhere	small
PIC	medium	anywhere	large

Integer Constant Loading

There are a number of ways to load an integer constant, c, into a register. The examples in the following table assume:

- %hi(c) is bits 31..10 of c,
- %lo(c) is the low-order 10 bits of c,
- %hix(c) is the ones complement of bits 31..10 of c (treated as a 64-bit vector),
- %lox(c) is the binary value 111 followed by the low-order 10 bits of c,
- %h44(c) is bits 43.. 22 of c,
- %m44(c) is bits 21..12 of c,
- %l44(c) is bits 11..0 of c,
- %hh(c) is bits 63..42 of c,
- %hm(c) is bits 41..32 of c,
- %lm(c) is bits 31..10 of c.

The table is not exhaustive. In the case where "c" is a symbolic address constant, each operator, e.g. %hi(), generates a specific relocation. See Section 4.3.1: Relocation Types, Figure 4-4 for a complete list of relocation types.

Figure 3.35b: Loading Integer Constants

Range	Code
$-2^{12} .. 2^{12}-1$	`or %g0, c, %o0`
$0 .. 2^{32}-1$	`sethi %hi(c), %o0` `or %o0, %lo(c), %o0`
$-2^{32} .. -1$	`sethi %hix(c), %o0` `xor %o0, %lox(c), %o0`

$0 .. 2^{44}-1$	`sethi %h44(c), %o0`
	`or %o0, %m44(c), %o0`
	`sllx %o0, 12, %o0`
	`or %o0, %l44(c), %o0`

$-2^{63} .. 2^{63}-1$	`sethi %hh(c), %o1`
	`sethi %lm(c), %o0`
	`or %o1, %hm(c), %o1`
	`or %o0, %lo(c), %o0`
	`sllx %o1, 32, %o1`
	`or %o0, %o1, %o0`

NOTE

Since the general case costs 6 instructions and two scratch registers, loading from a constant table may be more efficient in some cases.

Addressing Global Offset Tables

A subroutine in a shared object must obtain the address of the shared object's global offset table before the subroutine can access the table. Typically, this is done in a prologue. The offset between the subroutine's address and the middle of the global offset table must be known when the shared object is created. The following code examples place the address of the middle of the global offset table in `%l7`; other registers can also be used. *offset* is the offset in bytes from the `rd` instruction to the middle of the global offset table. In the medium size case it is assumed to be positive. Implementation of the 64-bit ABI may use different, more efficient code sequences.

Figure 3.35c: Addressing Global Offset Tables

Medium Size Code

```
rd      %pc, %l7
sethi   %hi(offset), %o0
or      %o0, %lo(offset), %o0
add     %l7, %o0, %l7
```

Full Size Code

```
rd      %pc, %l7
sethi   %hh(offset), %o1
sethi   %lm(offset), %o0
or      %o1, %hm(offset), %o1
or      %o0, %lo(offset), %o0
sllx    %o1, 32, %o1
or      %o0, %o1, %o0
add     %l7, %o0, %l7
```

Static Data References from Absolute Code

Figure 3.35d: Static Data References from Absolute Code

ANSI C	low	middle	anywhere
long s; long d; long *p;	.global s .global d .global p	.global s .global d .global p	.global s .global d .global p
p = &d;	sethi %hi(d),%o0 or %o0,%lo(d),%o0 sethi %hi(p),%o1 stx %o0,[%o1+%lo(p)]	sethi %h44(d),%o0 or %o0,%m44(d),%o0 sllx %o0,12,%o0 add %o0,%l44(d),%o0 sethi %h44(p),%o1 or %o1,%m44(p),%o1 sllx %o1,12,%o1 stx%o0,[%o1+%l44(p)]	sethi %hh(d),%o5 sethi %lm(d),%o0 or %o5,%hm(d),%o5 or %o0,%lo(d),%o0 sllx %o5,32,%o5 or %o0,%o5,%o0 sethi %hh(p),%o5 sethi %lm(p),%o1 or %o5,%hm(p),%o5 or %o1,%lo(p),%o1 sllx %o5,32,%o5 stx %o0,[%o1+%o5]

*p = s;	sethi %hi(s),%o0
	
	ldx [%o0+%lo(s)],%o0
	sethi %hi(p),%o1
	
	ldx [%o1+%lo(p)],%o1
	stx %o0,[%o1]
		sethi %h44(s),%o0
		or %o0,%m44(s),%o0
		sllx %o0,12,%o0
		
		ldx [%o0+l44(s)],%o0
		sethi %h44(p),%o1
		or %o1,%m44(p),%o1
		sllx %o1,12,%o1
		
		ldx[%o1+%l44(p)],%o1
		stx %o0,[%o1]
			sethi %hh(s),%o5
			sethi %lm(s),%o0
			or %o5,%hm(s),%o5
			or %o0,%lo(s),%o0
			sllx %o5,32,%o5
			ldx [%o0+%o5],%o0
			sethi %hh(p),%o5
			sethi %lm(p),%o1
			or %o5,%hm(p),%o5
			or %o1,%lo(p),%o1
			sllx %o5,32,%o5
			ldx [%o1+%o5],%o1
			stx %o0,[%o1]

Static Data References from PIC

The code sequences given below assume that *%l7* points to the Global Offset Table.

Figure 3.35e: Static Data References from Position Independent Code

ANSI C	Small Model	Large Model
extern long s; extern long d; extern long *p;	.global s .global d .global p	.global s .global d .global p

p = &d;	
	
	ldx [%l7+d],%o0
	
	ldx [%l7+p],%o1
	stx %o0,[%o1]
		sethi %hi(d),%o0
		or %o0,%lo(d),%o0
		ldx [%l7+%o0],%o0
		sethi %hi(p),%o1
		or %o1,%lo(p),%o1
		ldx [%l7+%o1],%o1
		stx %o0,[%o1]

*p = s;	
	
	ldx [%l7+s],%o0
	ldx [%o0],%o0
	
	ldx [%l7+p],%o1
	ldx [%o1],%o1
	stx %o0,[%o1]
		sethi %hi(s),%o0
		or %o0,%lo(s),%o0
		ldx [%l7+%o0],%o0
		ldx [%o0],%o0
		sethi %hi(p),%o1
		or %o1,%lo(p),%o1
		ldx [%l7+%o1],%o1
		ldx [%o1],%o1
		stx %o0,[%o1]

Function Calls

Direct function calls are those where the name of the called function is known at compile time. The following code shows the cases of interest. The `call` instruction can be used in all medium size executables and shared objects. The **PIC** example assumes use of the Global Offset Table for addressing either procedures or Procedure Linkage Table slots.

Figure 3.43a: Function Calls

ANSI C	medium	absolute/full	PIC/full
`extern void f();`	`.global f`	`.global f`	`.global f`

`f();`	`call f`
	`nop`
		`sethi %hh(f),%g5`
		`sethi %lm(f),%g1`
		`or %g5,%hm(f),%g5`
		`or %g1,%lo(f),%g1`
		`sllx %g5,32,%g5`
		`jmpl %g1+%g5,%o7`
		`nop`
			`sethi %hi(f),%g1`
			`or %g1,%lo(f),%g1`
			`ldx [%l7+%g1],%g1`
			`jmpl %g1,%o7`
			`nop`

For indirect function calls, the address of the function is in a pointer. Appropriate code is used to load the value of the pointer into a register, just as with static data. A *jmpl* instruction is then used.

Branching

Programs use branch instructions to control their execution flow. As defined by the architecture, branch instructions hold a PC-relative value with up to a 2 MB range, allowing a branch to locations up to 1 MB away in either direction.

C switch statements provide multiway selection. The best implementation of a switch statement depends on the distribution of the case label values. When they are dense, as in the C example below then the computed-jump approach shown may generate good code. The example uses several simplifying conventions to hide irrelevant details:

- The selection expression resides in local register *%l0*.
- case label constants begin at zero.
- case labels and default use assembly names **.Lcasei** and **.Ldef**, respectively.

The following example is position-independent, and can also be used in absolute code.

Figure 3-46: Position-Independent `switch` Code

ANSI C

```
switch (j)
{
case 0:
       ...
case 2:
       ...
case 3:
       ...
default:
       ...
}
```

Assembly

```
              subcc    %l0, 4, %g0
              movgu    %xcc, 1, %l0
1:
              rd       %pc, %l1
              sllx     %l0, 5, %l0
              add      %l0, (.Lcase0 - 1b), %l0
              jmpl     %l0 + %l1, %g0
              nop
.Lcase0:
              instruction 1
              instruction 2
              instruction 3
              instruction 4
              instruction 5
              instruction 6
              ba       .Lcase0_continued
              instruction 8
.Ldef:
              instruction 1
              instruction 2
              instruction 3
              instruction 4
              instruction 5
              instruction 6
              ba       .Lcase_end
              instruction 8
.Lcase2:
               ...
.Lcase0_continued:
               ...
.Lcase_end:
```

The number of instructions in the legs can be varied. If there is not enough space in a leg, a branch to additional code

can be used.

C Stack Frame

The figure below shows the C stack frame organization. It conforms to the standard stack frame with designated roles

Figure 3-47: C Stack Frame

Base	Offset	Contents	Address
%fp+BIAS	-1 -8y	y extended words local space: automatic variables . . . other address-able objects	*High addresses*
%sp+BIAS %sp+BIAS	+176 +8x-1 +176	x extended-words compiler scratch temporaries, register save area, and extra outgoing argument slots	
%sp+BIAS	+128	required outgoing argument slots	
%sp+BIAS	0	16 extended word window save area	*Low addresses*

for unspecified areas in the standard frame. A C stack frame doesn't normally change size during execution. The exception is dynamically allocated stack memory, discussed below. By convention, a function allocates automatic (local) variables in the top of its frame and references them as negative offsets from *%fp+BIAS*. Its incoming overflow arguments reside in the previous frame, referenced as positive offsets from *%fp+BIAS*.

Variable Argument List

Previous sections describe the rules for passing arguments. Unfortunately, some otherwise portable C programs depend on the argument passing scheme, implicitly assuming that 1) all arguments reside on the stack, and 2) arguments appear in increasing order on the stack. Programs that make these assumptions never have been portable, but they have worked on many machines. They do *not* work on 64-bit ABI because some of the arguments reside in integer and/or floating point registers. Portable C programs should use the facilities defined in the header files **<***stdarg.h***>** or **<***varargs.h***>** to deal with variable argument lists.

Allocating Stack Space Dynamically

Unlike some other languages, C does not need dynamic stack allocation *within* a stack frame. Frames are allocated dynamically on the program stack, depending on program execution, but individual stack frames can have static sizes. Nonetheless, the architecture supports dynamic allocation for those languages that require it, and the standard calling sequence and stack frame support it as well. Thus languages that need dynamic stack frame sizes can call C functions, and vice versa.

Figure 3-47 shows the layout of the C stack frame. The double line divides the area referenced with the frame pointer from the area referenced with the stack pointer. Dynamic space is allocated above the line as a downward growing heap whose size changes as required. Typical C functions have no space in the heap. All areas below the double line in the current frame have a known size to the compiler. Dynamic stack allocation thus takes the following steps.

1. Stack frames are 16-byte aligned; dynamic allocation should preserve this property. Thus the program rounds (up) the desired byte count to a multiple of 16.
2. The program decreases the stack pointer by the rounded byte count, increasing its frame size. At this point, the "new" space resides just above the register save area at the bottom of the stack.
3. The program copies the "bottom half" of the stack frame down into the new space, opening the middle of the frame.

Even in the presence of signals, dynamic allocation is "safe". If a signal interrupts allocation, one of the three things can

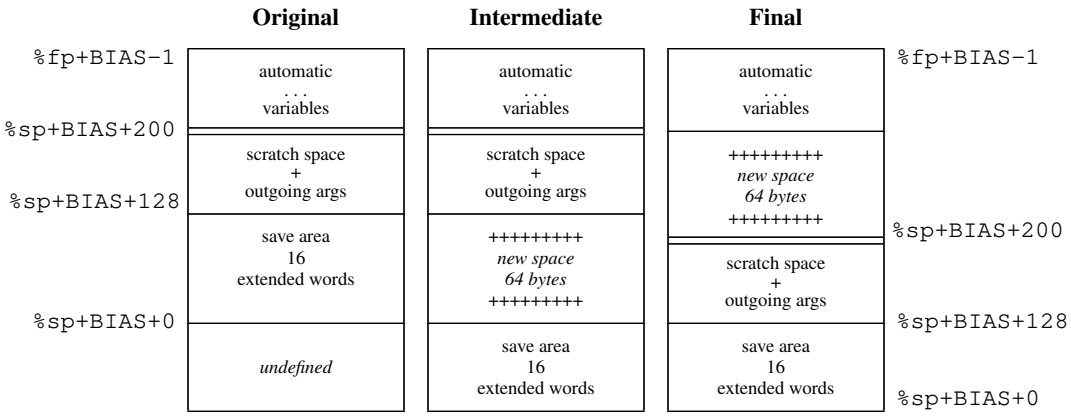
happen.

- The signal handler can return. The process then resumes the dynamic allocation from the point of interruption.
- The signal handler can execute an non-local *goto*, or ***longjmp*** [see ***setjmp***(**BA_LIB**)]. This reset the process to a new context in a previous stack frame, automatically discarding the dynamic allocation.
- The process can terminate

Regardless of when the signal arrives during dynamic allocation, the result is a consistent (though possibly dead) process.

To illustrate, assume a program wants to allocate 50 bytes; its current stack frame has 24 bytes of compiled scratch space. The first step is rounding the 50 to 64, making it a multiple of 16. Figure 3-49 shows how the stack changes.

Figure 3-49: Dynamic Stack Allocation



New space starts at *%sp+BIAS+200*. As described, every dynamic allocation in *this* function will return a new area starting at *%sp+BIAS+200*, leaving previous stack objects untouched (other functions would have different stack addresses). Consequently, the compiler should compute the absolute address for each area, avoiding relative references. Otherwise future allocations in the same frame would destroy the stack's integrity.

Existing stack objects reside at fixed offsets from the frame and stack pointers; stack heap allocation preserves those offsets. Objects relative to the frame pointer don't move. Objects relative to the stack pointer move, but their *%sp*-relative positions do not change. Accordingly, compilers arrange not to publicize the absolute address of any object in the bottom half of the stack frame (in a way that violates the scope rules). *%sp*-relative references stay valid after dynamic allocation, but absolute addresses do not.

No special code is needed to free dynamically allocated stack memory. The function return resets the stack pointer and removes the entire stack frame, including the heap, from the stack. Naturally, a program should not reference heap objects after they have gone out of scope.

SCD 2.4.1

Object Files

Introduction

This chapter is split into a 32-bit ABI, a 64-bit gABI, and a 64-bit psABI section. Processor independent descriptions of the object file format for System V Release 4 may be found in Chapter 4 of the System V ABI. Information specific to the 32-bit psABI may be found in Chapter 4 of the System V ABI, SPARC Processor Supplement. On the other hand, unless explicitly stated, information in the 64-bit psABI section of this chapter is independent of System V ABI documentation.

Processor independent descriptions of the object file format for System V Release 4 may be found in Chapter 4 of the *System V ABI*. Information specific to SPARC platforms may be found in Chapter 4 of the *System V ABI, SPARC Processor Supplement*.

Object Files Changes (32-bit ABI)

The following are changes to the *System V Application Binary Interface* as reported to SPARC International.

#	Facility	Location	Description
1	**SHT_DYNSYM**	gABI	On page 4-14 add before the last sentence: "However this minimal set of symbols will always include all symbols of **STB_GLOBAL** binding."
2	Relocation Types	psABI	page 4-5, Figure 4-4 add the types in the table below. The descriptive portions of this table are for background information only. The primary significance of the table, given the presence of these interfaces as EXPERIMENTAL is to reserve the space of relocation values indicated in the table for use in EXPERIMENTAL system implementations. No conforming application will employ these values for any purpose, and no system is required to demonstrate conformance to any interpretation of these relocation types.

Name	Value	Field	Calculation
R_SPARC_PLT32	**24**	*V-word32*	L + A
R_SPARC_HIPLT22	**25**	*T-imm22*	(L + A) >> 10
R_SPARC_LOPLT10	**26**	*T-simm13*	(L + A) & 0x3ff
R_SPARC_PCPLT32	**27**	*V-word32*	L + A – P
R_SPARC_PCPLT22	**28**	*V-disp22*	(L + A – P) >> 10
R_SPARC_PCPLT10	**29**	*V-simm12*	(L + A – P) & 0x3ff
R_SPARC_10	**30**	*V-simm10*	S + A
R_SPARC_11	**31**	*V-simm11*	S + A
R_SPARC_64	**32**	*V-xword64*	S + A
R_SPARC_OLO10	**33**	*V-simm13*	((S + A) & 0x3ff) + O
R_SPARC_HH22	**34**	*V-imm22*	(S + A) >> 42
R_SPARC_HM10	**35**	*T-simm13*	((S + A) >> 32) & 0x3ff
R_SPARC_LM22	**36**	*T-imm22*	(S + A) >> 10
R_SPARC_PC_HH22	**37**	*V-imm22*	(S + A – P) >> 42
R_SPARC_PC_HM10	**38**	*T-simm13*	((S + A – P) >> 32) & 0x3ff
R_SPARC_PC_LM22	**39**	*T-imm22*	(S + A – P) >> 10
R_SPARC_WDISP16	**40**	*V-d2/disp14*	(S + A – P) >> 2
R_SPARC_WDISP19	**41**	*V-disp19*	(S + A – P) >> 2
R_SPARC_GLOB_JMP	**42**	*V-xword64*	S + A
R_SPARC_7	**43**	*V-imm7*	(S + A)&0x7f
R_SPARC_5	**44**	*V-imm5*	(S + A)&0x1f
R_SPARC_6	**45**	*V-imm6*	(S + A)&0x3f

R_SPARC_OLO10: This relocation type resembles **R_SPARC_LO10**, except an extra offset is added to make full use of the 13-bit signed immediate field.

R_SPARC_HH22: This relocation type is used by the assembler when it sees an instruction of the form "imm22-instruction ... *%hh*(absolute) ...".

R_SPARC_HM10: This relocation type is generated by the assembler when it sees an instruction of the form "simm13-instruction ... *%hm*(absolute) ...".

R_SPARC_LM22: This relocation type is used by the assembler when it sees an instruction of the form "imm22-instruction ... *%lm*(absolute) ...". This resembles **R_SPARC_HI22**, except it truncates rather than validates.

R_SPARC_PC_HH22: This relocation type is used by the assembler when it sees an instruction of the form "imm22-instruction ... *%hh*(pc-relative) ...".

R_SPARC_PC_HM10: This relocation type is generated by the assembler when it sees an instruction of the form "simm13-instruction ... *%hm*(pc-relative) ...".

R_SPARC_PC_LM22: This relocation type is used by the assembler when it sees an instruction of the form "imm22-instruction ... *%lm*(pc-relative) ...". This resembles **R_SPARC_PC22**, except it truncates rather than validates.

R_SPARC_GLOB_JMP: This relocation type resembles **R_SPARC_GLOB_DAT**, except that it is guaranteed to be associated with a procedure call and therefore the dynamic linker may evaluate the relocation lazily.

R_SPARC_7: This relocation type is used by the assembler for 7 bit software trap numbers.

Object Files Changes (64-bit gABI) - ~~EXPERIMENTAL~~

#	Facility	Location	Description
1	Data Representation	gABI	Add to figure 4-2 (Page 4-3):

Figure 4-2: 64-Bit Data Types

Name	Size	Alignment	Purpose
Elf64_Addr	8	8	Unsigned program address
Elf64_Half	2	2	Unsigned small integer
Elf64_Off	8	8	Unsigned file offset
Elf64_Sword	4	4	Signed medium integer
Elf64_Sxword	8	8	Signed large integer
Elf64_Word	4	4	Unsigned medium integer
Elf64_Xword	8	8	Unsigned large integer

2	Data Representation	gABI	Add after the last line of the second paragraph (Page 4-3): Similarly, a structure containing an **`Elf64_Addr`** member will be aligned on a 8-byte boundary within the file.
3	ELF Headers	gABI	Add to Figure 4-3:

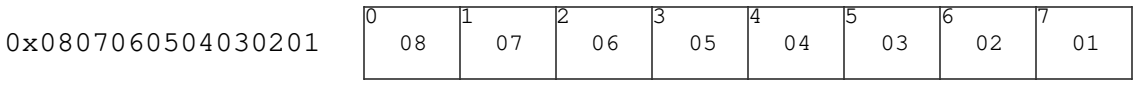
Figure 4-3: 64-bit ELF Header (`ELFCLASS64`)

```
typedef struct {
            unsigned char  e_ident[EI_NIDENT];
            Elf64_Half     e_type;
            Elf64_Half     e_machine;
            Elf64_Word     e_version;
            Elf64_Addr     e_entry;
            Elf64_Off      e_phoff;
            Elf64_Off      e_shoff;
            Elf64_Word     e_flags;
            Elf64_Half     e_ehsize;
            Elf64_Half     e_phentsize;
            Elf64_Half     e_phnum;
            Elf64_Half     e_shentsize;
            Elf64_Half     e_shnum;
            Elf64_Half     e_shstrndx;
} Elf64_Ehdr;
```

4	ELF Identification	gABI	add the following line to the end of the first paragraph on page 4-8: Class `ELFCLASS64` supports machines with files and virtual address spaces up to 16 exabytes.
5	ELF Identification	gABI	Change last paragraph on page 4-8 to: A file's data encoding specifies how to interpret the basic objects in a file. As described above, ELF files use objects that occupy 1, 2, 4 and 8 bytes. Under defined encodings, objects are represented as shown below. Byte numbers appear in the upper left corners.

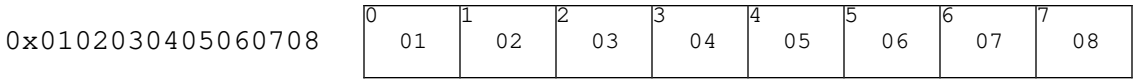
6 ELF Identification gABI Add the following data encoding to figure 4-5:

Figure 4-5: Data Encoding `ELFDATA2LSB`



7 ELF Identification gABI Add the following data encoding to figure 4-6:

Figure 4-6: Data Encoding `ELFDATA2MSB`



8 Sections gABI Change first line of page 4-10 to: An object file's section header table lets one locate all the file's sections. The section header table is an array of `Elf32_Shdr` or `Elf64_Shdr` structures as described below.

9 Sections gABI Add to Figure 4-8 page 4-12:

Figure 4-8: Section Header (`ELFCLASS64`)

```
typedef struct {
        Elf64_Word       sh_name;
        Elf64_Word       sh_type;
        Elf64_Xword      sh_flags;
        Elf64_Addr       sh_addr;
        Elf64_Off        sh_offset;
        Elf64_Xword      sh_size;
        Elf64_Word       sh_link;
        Elf64_Word       sh_info;
        Elf64_Xword      sh_addralign;
        Elf64_Xword      sh_entsize;
} Elf64_Shdr;
```

10 Symbol table gABI Add to Figure 4-15 page 4-22:

.

Figure 4-15: Symbol Table Entry (`ELFCLASS64`)

```
typedef struct {
        Elf64_Word       st_name;
        unsigned char    st_info;
        unsigned char    st_other;
        Elf64_Half       st_shndx;
        Elf64_Addr       st_value;
        Elf64_Xword      st_size;
} Elf64_Sym;
```

11 Relocation gABI Add to Figure 4-19 page 4-27:

Figure 4-19: Relocation Entries (`ELFCLASS64`)

```
typedef struct {
            Elf64_Addr   r_offset;
            Elf64_Xword  r_info;
} Elf64_Rel;

typedef struct {
            Elf64_Addr   r_offset;
            Elf64_Xword  r_info;
            Elf64_Sxword r_addend;
} Elf64_Rela;
```

12 Relocation gABI

Change last sentence under r_info page 4-27 to:

"When the text in the processor supplement refers to a relocation entry's relocation type it means the result of applying **ELF32_R_TYPE** or **ELF64_R_TYPE** to an entry's r_info member. When the text refers to a relocation entry's symbol table index it means the result of applying **ELF32_R_SYM** or **ELF64_R_SYM** to the entry's r_info member.

13 Relocation gABI

Add the following (which apply to the 64-bit relocation types) to the figure at the top of page 4-28:

```
#define ELF64_R_SYM(info)      (info)>>32)
#define ELF64_R_TYPE(info)     ((Elf64_Word)(info))
#define ELF64_R_INFO(sym,type)(((Elf64_Xword)(sym)<<32)+(Elf64_Xword)(type))
```

14 Relocation gABI

Change the first two sentences of the paragraph that begins "As shown above, only **`ELF32_Rela`** `entries ...", to:`

As shown above, only **`ELF32_Rela`** and **`ELF64_Rela`** entries contain an explicit addend. Entries of type **`Elf32_Rel`** and **`Elf64_Rel`** store an implicit addend in the location to be modified.

Object Files (64-bit psABI) - ~~EXPERIMENTAL~~

ELF Header

Machine Information

For file identification in *e_ident*, SPARC 64-bit ABI requires the following values.

Figure 4-1: SPARC 64bit Identification, e_ident

Position	Value
e_ident[EI_CLASS]	ELFCLASS64
e_ident[EI_DATA]	ELFDATA2MSB

Processor identification resides in the ELF header's *e_machine* member and must have the value 43, defined as the name **EM_SPARC64**. The ELF header's *e_flags* member holds bit flags associated with the file. The SPARC 64-bit ABI defines the following flags:

.

Figure 4-2: SPARC 64-bit Flags, e_flags

Name	Value	Meaning
EF_SPARC64_MM	0x3	Mask for Memory Model
EF_SPARC64_TSO	0x0	Total Store Ordering
EF_SPARC64_PSO	0x1	Partial Store Ordering
EF_SPARC64_RMO	0x2	Relaxed Memory Ordering
EF_SPARC_EXT_MASK	0xffff00	Reserved for vendor extensions
EF_SPARC_SUN_US1	0x000200	Sun UltraSPARC1 extensions
EF_SPARC_HAL_R1	0x000400	HAL R1 extensions
EF_SPARC_SUN_US3	0x000800	Sun UltraSPARC III extensions

All unspecified bits are reserved and should be set to zero. The compilation system sets the **EF_SPARC64_MM** field to the value required for the correct execution of the object. Typically, the programmer specifies what value to use for compiling a given source unit. **TSO** is the most restrictive memory model, followed by **PSO**, followed by **RMO**, in that order.

It is recommended that the default compilation model should be **RMO** to realize the performance advantages of this memory model. A binder that statically links input objects into a single output object will set **EF_SPARC64_MM** to the most restrictive model specified by any of the input objects.

At execution time, the dynamic linker will inform the operating system of the most restrictive model required by any of the objects that are part of the execution environment. The operating system will use this information to provide the memory order semantics of that model to the application, if available, or a more restrictive one.

The memory model flag expresses a requirement that the program has on the memory model semantics of the execution environment, but does *not* constrain the implementation in how it provides that model. For example, on a uniprocessor, the implementation can usually ignore the memory model flags, and set the processor into **RMO** mode because the program can only observe **TSO** memory ordering semantics.

Bits in **EF_SPARC_EXT_MASK** are assigned by SPARC International to vendors who implement user-accessible extensions to the *SPARC V9 instruction set*, and want to prevent accidental execution of binaries that use those extensions on machines that do not have them. The compilation system sets these bits according to the extensions used and the static linker propagates these bits into the objects it creates. The kernel and the dynamic linker cooperate to prohibit execution of objects that use specific extensions on systems that do not provide those extensions.

Note that objects that use vendor extensions are not portable and do not conform to the 64-bit ABI.

Sections

Special Section Indices

Two additional section index values are defined.

- **SHN_BEFORE** (0xff00) is used in conjunction with the **SHF_ORDERED** flag (see below).
- **SHN_AFTER** (0xff01) is used in conjunction with the **SHF_ORDERED** flag (see below).

Special Section Flags

Two new section flags are defined.

- The **SHF_EXCLUDE** flag specifies that the link editor is to exclude this section from executable and shared objects that it builds when those objects are not to be further relocated. **SHF_EXCLUDE** has the value `0x80000000`.
- The **SHF_ORDERED** flag specifies that the *sh_link* and *sh_info* fields of the section header are to be interpreted specially (see below). **SHF_ORDERED** has the value `0x40000000`.

For sections with the **SHF_ORDERED** flag set, a non-zero value of the *sh_link* field of the section header indicates that the data in this section should be combined into the section pointed at when the output file is constructed by the link editor (a section is allowed to point to itself). In the absence of alternate ordering information (see below), sections from a single object file collected into one section in the output shall be contiguous and have the same relative ordering as they did in the input file and the contributions from each input file shall appear in command-line order.

The **SHF_ORDERED** flag when applied to a set of sections all of whose *sh_link* fields point to the same section (within one object file) or to sections having the same name (across object files) specifies that the link editor is to sort the sections when it combines them (see above) based on the relative ordering in the output file of the sections pointed at by the *sh_info* field of each section in the set. In each original object file input to the link editor, the relative ordering shall be correct so that the link editor is not required to do any special processing unless it explicitly re-orders the sections which are the targets of the *sh_info* fields.

When used in conjunction with the **SHF_ORDERED** flag *sh_info* values of **SHN_BEFORE** and **SHN_AFTER** imply that those sections are to proceed or follow, respectively, all other sections in the set being ordered. File/command-line order is preserved when multiple sections in an ordered set each have the same *sh_info* value.

Special Sections

Various sections hold program and control information. Sections in the list below are used by the system and have the indicated types and attributes.

A special relocation section is used to initialize register symbols.

Figure 4-2: Special Sections

Name	Type	Attributes
.rela (*)	**SHT_RELA**	None
.got	**SHT_PROGBITS**	**SHF_ALLOC + SHF_WRITE**
.plt	**SHT_PROGBITS**	**SHF_ALLOC + SHF_WRITE + SHF_EXECINSTR**

.rela sh_link contains the section header index of the associated symbol table. sh_info is 0; this indicates that this section only contains register relocations. See **R_SPARC_REGISTER** in "Relocation Types" for more information.
(*) Note that the actual name doesn't matter; it's the type that counts.

.got This section holds the global offset table. See "Coding Examples" in Chapter 3 and "Global Offset Table" in Chapter 5 for more information

.plt This section holds the procedure linkage table. See "Procedure Linkage Table" in Chapter 5 for more information.

Symbol Table

Usage of a global register reserved to the application is indicated by a SPARC 64-bit specific Symbol Type.

Figure 4.2b: Symbol Type for Register Symbols

Name	Value
STT_SPARC_REGISTER	13

A symbol table entry for a register symbol contains the following:

Figure 4.2c: Symbol Table Entry

Field	Meaning
st_name	Index into the string table of the name of the symbol (*1).
st_value	Register number (*2).
st_size	unused (0).
st_info	**ELF64_ST_INFO**(bind, type) bind is typically **STB_GLOBAL**, but does reflect the actual declared scope of the name (that is, it could be **STB_WEAK** or **STB_LOCAL**). type must be **STT_SPARC_REGISTER**.
st_other	unused (0).
st_shndx	**SHN_ABS** if this object initializes this register symbol; **SHN_UNDEF** otherwise. (*3)

(*1) An index value of 0, which points to the null name in the string table, indicates that the register is used for scratch. A scratch register must have binding **STB_GLOBAL**.

(*2) Register numbers correspond to the assignments in *The SPARC Architecture Manual, Version 9* for integer registers. For example:

Figure 4.2d: Sample Register Numbers

Name	Value	Meaning
STO_SPARC_REGISTER_G2	0x2	%g2
STO_SPARC_REGISTER_G3	0x3	%g3

(*3) An initializer for a **SHN_ABS** register symbol is specified with a special register relocation type; See "Relocation Types" for details.

Absence of an entry for a particular global register means that the particular global register is not used at all by the object. An object that uses one or more of the application-reserved global registers but does not indicate this with an appropriate symbol-table entry does not conform to the 64-bit ABI. System objects may, but are not required to, use the same mechanism to indicate how they have used the global registers reserved for system software (%g6, %g7).

If an executable file contains a reference to a function defined in one of its associated shared objects, the symbol table section for that file will contain an entry for that symbol. The *st_shndx* member of that symbol table entry contains **SHN_UNDEF**. This informs the dynamic linker that the symbol definition for that function is not contained in the executable file itself. If that symbol has been allocated a procedure linkage table entry in the executable file, and the *st_value* member for that symbol table entry is non-zero, the value will contain the virtual address of the first instruction of that procedure linkage table entry. Otherwise, the *st_value* member contains zero. This procedure linkage table entry address is used by the dynamic linker in resolving references to the address of the function. See "Function Addresses" in Chapter 5 for details.

Relocation

The *r_info* field is composed of two 32-bit parts, the symbol table index and the relocation type. The relocation type on SPARC 64-bit ABI systems is further decomposed into an 8-bit type identifier and a 24-bit type dependent data field. For the existing ELF-32 relocation types, that data field is zero. New relocation types, however, may make use of these bits.

Figure 4-3a: Relocation Macros

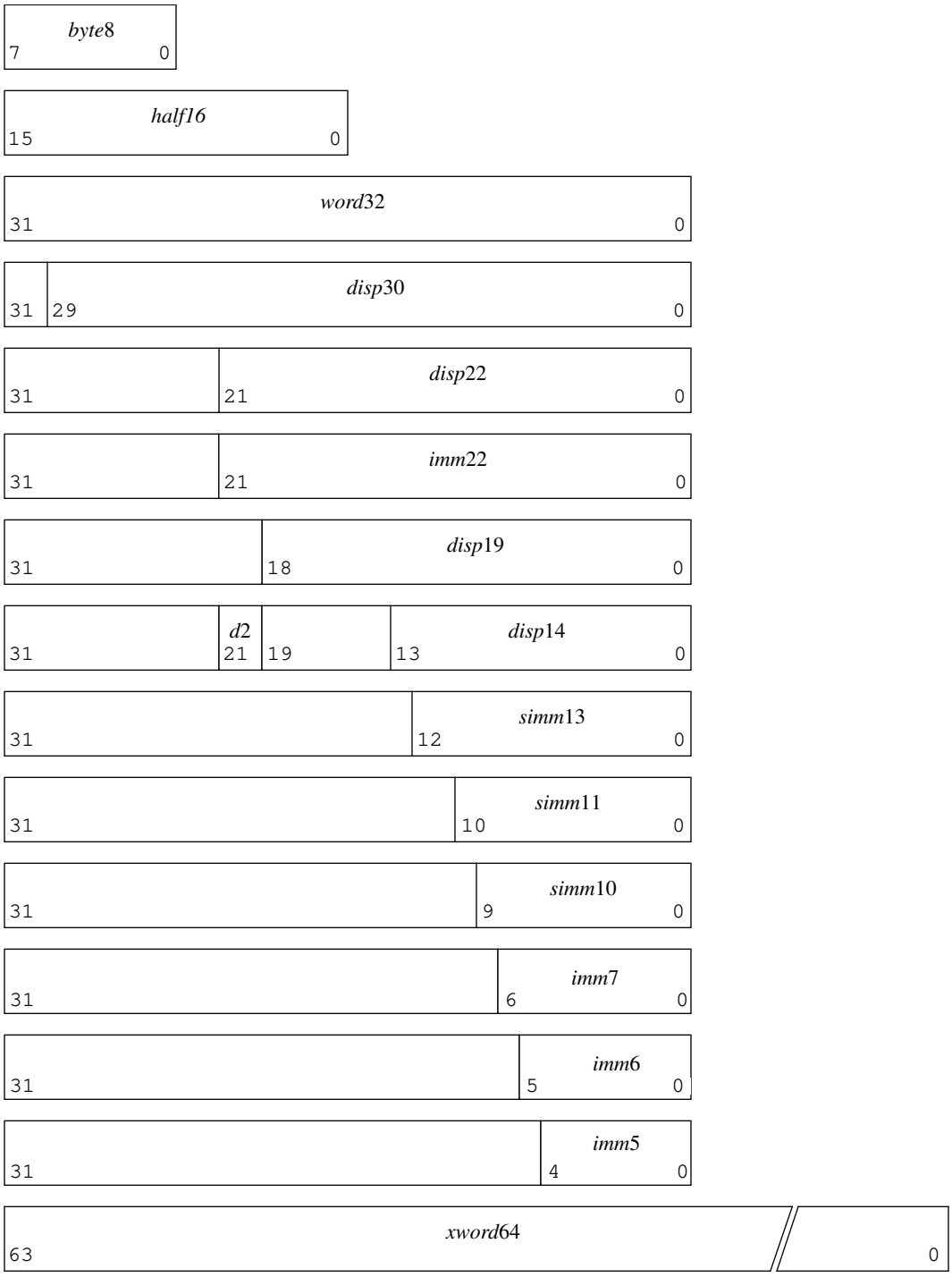
```
#define ELF64_R_TYPE_DATA(info)        (((Elf64_Xword)(info) << 32) >> 40)
#define ELF64_R_TYPE_ID(info)          (((Elf64_Xword)(info) << 56) >> 56)
#define ELF64_R_TYPE_INFO(data, type)  (((Elf64_Xword)(data) << 8) + (Elf64_Xword)(type))
```

Relocation Types

An overview of the instruction and data formats from *The SPARC^{TM} Architecture Manual, Version 9* makes relocation easier to understand. Relocation entries describe how to alter the following instruction and data fields (bit numbers

appear in the lower box corners).

Figure 4-3: Relocatable Fields



Calculations below assume the actions are transforming a relocatable file into either an executable or a shared object file. Conceptually, the link editor merges one or more relocatable files to form the output. It first decides how to combine and relocate the input files, then updates the symbol values, and finally performs the relocation. Relocations applied to executable or shared object files are similar and accomplish the same result. Descriptions below use the following

notation.

A — This means the addend used to compute the value of the relocatable field.

B — This means the base address at which a shared object has been loaded into memory during execution. Generally a shared object file is built with a 0 base virtual address, but the execution address will be different. See "Program Header" in the *System V ABI* for more information about base addresses.

G — This means the offset into the global offset table at which the address of the relocation entry's symbol will reside during execution. See "Coding Examples" in Chapter 3 and "Global Offset Table" in Chapter 5 for more information.

L — This means the place (section offset or address) of the procedure linkage table entry for a symbol. A procedure linkage table entry redirects a function call to the proper destination. The link editor builds the initial procedure linkage table, and the dynamic linker modifies the entries during execution. See "Procedure Linkage Table" in Chapter 5 for more information.

O — This means the secondary addend used to compute the value of the relocation field. The secondary addend is extracted from the `r_info` field in the relocation entry by applying the **`ELF64_R_TYPE_DATA`** macro.

P — This means the place (section offset or address) of the storage unit being relocated (computed using `r_offset`).

S — This means the value of the symbol whose index resides in the relocation entry.

Relocation entries apply to bytes (*byte*8), halfwords (*half*16), extended-words, (*xword*64), or words (the others). In any case, the `r_offset` value designates the offset or virtual address of the first byte of the affected storage unit. The relocation type specifies which bits to change and how to calculate their values. SPARC 64-bit ABI uses only `Elf64_Rela` relocation entries with explicit addends. Thus the `r_addend` member serves as the relocation addend.

NOTE

Field names in the following tables tell whether the relocation type checks for "overflow". A calculated relocation value may be larger than the intended field, and a relocation type may verify (V) the value fits or truncate (T) the result. As an example, V-*imm*22 means the computed value may not have significant, non-zero bits outside the *imm*22 field.

Figure 4-4: Relocation Types

Name	Value	Field	Calculation
R_SPARC_NONE	0	*none*	none
R_SPARC_8	1	*V-byte8*	S + A
R_SPARC_16	2	*V-half16*	S + A
R_SPARC_32	3	*V-word32*	S + A
R_SPARC_DISP8	4	*V-byte8*	S + A - P
R_SPARC_DISP16	5	*V-half16*	S + A - P
R_SPARC_DISP32	6	*V-disp32*	S + A - P
R_SPARC_WDISP30	7	*V-disp30*	(S + A - P) >> 2
R_SPARC_WDISP22	8	*V-disp22*	(S + A - P) >> 2
R_SPARC_HI22	9	*V-imm22*	(S + A) >> 10
R_SPARC_22	10	*V-imm22*	S + A
R_SPARC_13	11	*V-simm13*	S + A
R_SPARC_LO10	12	*T-simm13*	(S + A) & 0x3ff
R_SPARC_GOT10	13	*T-simm13*	G & 0x3ff
R_SPARC_GOT13	14	*V-simm13*	G
R_SPARC_GOT22	15	*T-imm22*	G >> 10
R_SPARC_PC10	16	*T-simm13*	(S + A - P) & 0x3ff
R_SPARC_PC22	17	*V-imm22*	(S + A - P) >> 10
R_SPARC_WPLT30	18	*V-disp30*	(L + A - P) >> 2
R_SPARC_COPY	19	*none*	none
R_SPARC_GLOB_DAT	20	*V-xword64*	S + A
R_SPARC_JMP_SLOT	21	*none*	see below
R_SPARC_RELATIVE	22	*V-xword64*	B+ A
R_SPARC_UA32	23	*V-word32*	S + A
R_SPARC_PLT32	24	*V-word32*	L + A
R_SPARC_HIPLT22	25	*T-imm22*	(L + A) >> 10
R_SPARC_LOPLT10	26	*T-simm13*	(L + A) & 0x3ff
R_SPARC_PCPLT32	27	*V-disp32*	L + A - P
R_SPARC_PCPLT22	28	*V-disp22*	(L + A - P) >> 10
R_SPARC_PCPLT10	29	*V-simm13*	(L + A - P) & 0x3ff
R_SPARC_10	30	*V-simm10*	S + A
R_SPARC_11	31	*V-simm11*	S + A
R_SPARC_64	32	*V-xword64*	S + A
R_SPARC_OLO10	33	*V-simm13*	((S + A) & 0x3ff) + O
R_SPARC_HH22	34	*V-imm22*	(S + A) >> 42
R_SPARC_HM10	35	*T-simm13*	((S + A) >> 32) & 0x3ff
R_SPARC_LM22	36	*T-imm22*	(S + A) >> 10
R_SPARC_PC_HH22	37	*V-imm22*	(S + A - P) >> 42
R_SPARC_PC_HM10	38	*T-simm13*	((S + A - P) >> 32) & 0x3ff
R_SPARC_PC_LM22	39	*T-imm22*	(S + A - P) >> 10
R_SPARC_WDISP16	40	*V-d2/disp14*	(S + A - P) >> 2
R_SPARC_WDISP19	41	*V-disp19*	(S + A - P) >> 2
R_SPARC_7	43	*V-imm7*	(S + A) & 0x7f
R_SPARC_5	44	*V-imm5*	(S + A) & 0x1f
R_SPARC_6	45	*V-imm6*	(S + A) & 0x3f
R_SPARC_DISP64	46	*V-xword64*	S + A - P
R_SPARC_PLT64	47	*V-xword64*	L + A
R_SPARC_HIX22	48	*V-imm22*	((S + A) ^ 0xffffffffffffffff) >>10
R_SPARC_LOX10	49	*T-simm13*	((S + A) & 0x3ff) | 0x1c00
R_SPARC_H44	50	*V-imm22*	(S + A) >> 22
R_SPARC_M44	51	*T-imm10*	((S + A) >>12) & 0x3ff
R_SPARC_L44	52	*T-imm13*	(S + A) & 0xfff
R_SPARC_REGISTER	53	*V-xword64*	S + A
R_SPARC_UA64	54	*V-xword64*	S + A
R_SPARC_UA16	55	*V-half16*	S + A

Some relocation types have semantics beyond simple calculation.

R_SPARC_GOT10 This relocation type resembles **R_SPARC_LO10**, except it refers to the address of the symbol's global offset table entry and additionally instructs the link editor to build a global offset table.

R_SPARC_GOT13 This relocation type resembles **R_SPARC_13**, except it refers to the address of the symbol's global offset table entry and additionally instructs the link editor to build a global offset table.

R_SPARC_GOT22 This relocation type resembles **R_SPARC_22**, except it refers to the address of the symbol's global offset table entry and additionally instructs the link editor to build a global offset table.

R_SPARC_WPLT30 This relocation type resembles **R_SPARC_WDISP30**, except it refers to the address of the symbol's procedure linkage table entry and additionally instructs the link editor to build a procedure linkage table.

R_SPARC_COPY The link editor creates this relocation type for dynamic linking. Its offset member refers to a location in a writable segment. The symbol table index specifies a symbol that should exist both in the current object file and in a shared object. During execution, the dynamic linker copies data associated with the shared object's symbol to the location specified by the object.

R_SPARC_GLOB_DAT This relocation type resembles **R_SPARC_64**, except it is used to set a global offset table entry to the address of the specified symbol. The special relocation type allows one to determine the correspondence between symbols and global offset table entries.

R_SPARC_JMP_SLOT The link editor creates this relocation type for dynamic linking. Its offset member gives a location of a procedure linkage table entry. The dynamic linker modifies the procedure linkage table entry to transfer control to the designated symbol's address [See "Procedure Linkage Table" in chapter 5].

R_SPARC_RELATIVE The link editor creates this relocation type for dynamic linking. Its offset member gives a location within a shared object that contains a value representing a relative address. The dynamic linker computes the corresponding virtual address by adding the virtual address at which the shared object was loaded to the relative address. Relocation entries for this type must specify 0 for the symbol table index.

R_SPARC_UA32 This relocation type resembles **R_SPARC_32**, except it refers to an unaligned word. That is the "word" to be relocated must be treated as four separate bytes with arbitrary alignment, not as a word aligned according to the architecture requirements.

R_SPARC_OLO10 This relocation type resembles **R_SPARC_LO10**, except an extra offset is added to make full use of the 13-bit signed immediate field.

R_SPARC_HH22 This relocation type is used by the assembler when it sees an instruction of the form "*imm22-instruction ... %hh*(*absolute*) *...*".

R_SPARC_HM10 This relocation type is generated by the assembler when it sees an instruction of the form "*simm13-instruction ... %hm*(*absolute*) *...*".

R_SPARC_LM22 This relocation type is used by the assembler when it sees an instruction of the form "*imm22-instruction ... %lm*(*absolute*) *...*". This resembles **R_SPARC_HI22**, except it truncates rather than validates.

R_SPARC_PC_HH22 This relocation type is used by the assembler when it sees an instruction of the form "*imm22-instruction ... %hh*(*pc-relative*) *...*".

R_SPARC_PC_HM10 This relocation type is generated by the assembler when it sees an instruction of the form "*simm13-instruction ... %hm*(*pc-relative*) *...*".

R_SPARC_PC_LM22 This relocation type is used by the assembler when it sees an instruction of the form "*imm22-instruction ... %lm*(*pc-relative*) *...*". This resembles **R_SPARC_PC22**, except it truncates rather than validates.

R_SPARC_7 This relocation type is used by the assembler for 7 bit software trap numbers.

R_SPARC_HIX22 This relocation type is used with **R_SPARC_LOX10** for executables that will be confined to the uppermost 4GB of the 64-bit address space. Similar to **R_SPARC_HI22**, but supplies ones complement of linked value.

R_SPARC_LOX10 Used with **R_SPARC_HIX22**. Similar to **R_SPARC_LO10**, but always sets bits 10..12 of the linked value.

R_SPARC_H44 This relocation type is used by the assembler when it sees an instruction of the form "*imm44-instruction ... %h44*(*absolute*) ..". For example, see the code in Section 3.5.1.6, Figure 3.35b.

R_SPARC_M44 This relocation type is generated by the assembler when it sees an instruction of the form "*imm44-instruction ... %m44*(*absolute*) ...". For example, see the code in Section 3.5.1.6, Figure 3.35b.

R_SPARC_L44 This relocation type is used with the **R_SPARC_H44** and **R_SPARC_M44** relocation types to generate a 44-bit absolute addressing model. The assembler will generate this type when it sees an instruction of the form "*imm44-instruction ... %l44*(*absolute*) ...". For example, see the code in Section 3.5.1.6, Figure 3.35b.

R_SPARC_REGISTER This relocation type is used to initialize a register symbol. Its offset member contains the register number to be initialized. There must be a corresponding register symbol for this register of type **SHN_ABS**.

R_SPARC_UA64 This relocation type resembles **R_SPARC_64**, except it refers to an unaligned extended word. That is the "*xword*" to be relocated must be treated as eight separate bytes with arbitrary alignment, not as an extended word aligned according to architecture requirements.

R_SPARC_UA16 This relocation type resembles **R_SPARC_16**, except it refers to an unaligned halfword. That is the "*halfword*" to be relocated must be treated as two separate bytes with arbitrary alignment, not as a halfword aligned according to architecture requirements.

CHAPTER 5: Program Loading and Dynamic Linking

SCD 2.4.1

Program Loading & Dynamic Linking

Introduction

This chapter is split into a 32-bit ABI, a 64-bit gABI, and a 64-bit psABI section. Processor independent descriptions of program loading and linking for System V Release 4 may be found in Chapter 5 of the System V Application Binary Interface. Information specific to the 32-bit psABI may be found in Chapter 5 of the *System V Application Binary Interface, SPARC Processor Supplement*. On the other hand, unless explicitly stated, information in the 64-bit psABI section of this chapter is independent of *System V ABI* documentation.

Program Loading and Dynamic Linking Changes (32-bit ABI)

The following are changes to the *System V Application Binary Interface*, and the *System V Application Binary Interface, SPARC Processor Supplement* as reported to SPARC International.

#	Facility	Location	Description
1	**LD_LIBRARY_PATH**	gABI	Change the order of the first and the second bullets in page 5-20 such that the influence of **LD_LIBRARY_PATH** takes precedence over **DT_RPATH** specifications.
2	Dynamic Linking	gABI	Add a new third bullet to the entries on page 5-20: "**DT_RPATH** specifications influence search operations for their own **DT_NEEDED** objects. Each evaluation of a given object's set of **DT_NEEDED** specification uses *that object's* **DT_RPATH**. Thus, if an executable specifies a set of **DT_NEEDED** objects (e.g., **a**, **b**, and **c**) and a **DT_RPATH** specification of **x:y**, then the search for **a**, **b**, and **c** will involve the paths **x** and **y**. If, when later evaluating the **DT_NEEDED** object for **a** (e.g., **d**), then **x** and **y** will not be used for that search unless **a** also specifies a **DT_RPATH** containing them."
3	Initialization and Termination Functions	gABI	Add the following new third paragraph on page 5-22: "Initialization and Termination functions can expect to use all libsys and libc ABI-defined services in their execution."
4	Shared Object Dependencies	gABI	In page 5-20, the **gABI** specifies in a "NOTE" that for set-user and set-group ID programs, **LD_LIBRARY_PATH** is ignored and **DT_RPATH** entries are used. This statement is incomplete. **DT_RPATH** entries should be used only to the extent that components beginning with "/" are acceptable (not relative path), in particular, relative path names are not used as these constitute a security hazard. Further, the prohibition against **LD_LIBRARY_PATH** is unnecessarily restrictive and conflicts with at least some widespread existing practice, in which those items contained in **LD_LIBARY_PATH** which are also acceptable **DT_RPATH** entries or are "*/usr/lib*" are also used.
5	Dynamic linking	psABI	Add a section entitled "Dynamic Linker" as the first subsection of the "Dynamic Linking" section, which is: "The value of the program header element **PT_INTERP** in an ABI-conforming program is the reference name for the runtime linker. As a special case, the reference name for version 1 of the C library reference name is also accepted as a legitimate **PT_INTERP** specification."

6	Dynamic Linking	psABI	Change page 5-5 from:

DT_PLTGOT In SPARC, this entry's *d_ptr* member gives the address of the first entry in the procedure linkage table. As described below, the first entry is special, and the dynaminc linker must know its address.

to:

DT_PLTGOT In SPARC, this entry's *d_ptr* member gives the address of either the first entry in the procedure linkage table, or the first entry of the global offset table.As described below, the first entry is special, and the dynaminc linker must know its address.

Program Load. & Dyn. Linking (64-bit gABI) ~~- EXPERIMENTAL~~

Program Loading & Dynamic Linking Changes

#	Facility	Location	Description

1	Program Header	gABI	page 5-2, add to figure 5-1 the following header:
			
			`typedef struct {`
			`  Elf64_Word  p_type;`
			`  Elf64_Word  p_flags;`
			`  Elf64_Off  p_offset;`
			`  Elf64_Addr  p_vaddr;`
			`  Elf64_Addr  p_paddr;`
			`  Elf64_Xword  p_filesz;`
			`  Elf64_Xword  p_memsz;`
			`  Elf64_Xword  p_align;`
			`} Elf64_Phdr;`

2	Dynamic Structure	gABI	page 5-15, add to figure 5-9 the following structure:
			
			`typedef struct {`
			`  Elf64_Xword  d_tag;`
			`  union {`
			`  Elf64_Xword  d_val;`
			`  Elf64_Addr  d_ptr;`
			`  } d_un;`
			`} Elf64_Dyn;`
			
			`extern Elf64_Dyn _DYNAMIC[];`

3	Shared Object	gABI	page 5-20: Add: A processor supplement may specify additional Dependencies environment variables to be used instead of or in addition to **LD_LIBRARY_PATH**. A processor supplement may specify additional or different default directories to be searched for shared objects.

Program Load. & Dyn. Linking (64-bit psABI) ~~- EXPERIMENTAL~~

Program Loading

As the system creates or augments a process image, it logically copies a file's segment to a virtual memory segment. When—and if—the system physically reads the file depends on the program's execution behavior, system load, etc. A process does not require a physical page unless it references the logical page during execution, and processes typically leave many pages unreferenced. Therefore delaying physical reads frequently obviates them, improving system performance. To obtain this efficiency in practice, executable and shared object files must have segment images whose file offsets and virtual addresses are congruent, modulo the page size. Virtual addresses and file offsets for SPARC 64-bit ABI segments are congruent modulo 1 MB (0x100000) or larger powers of 2. Because 1 MB is the maximum page size, the files will be suitable for paging regardless of physical page size.

Figure 5-1: Executable File

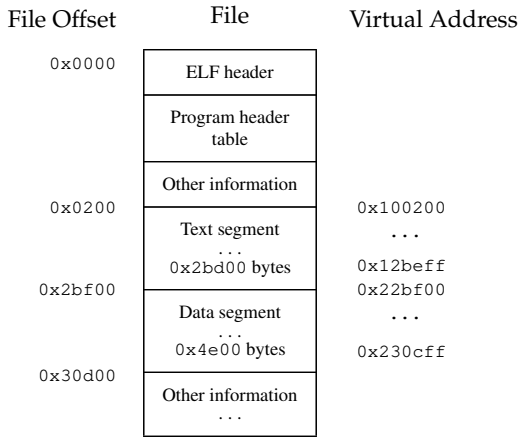


Figure 5-2: Program Header Segments

Member	Text	Data
p_type	PT_LOAD	PT_LOAD
p_offset	0x200	0x2bf00
p_vaddr	0x100200	0x22b000
p_paddr	unspecified	unspecified
p_filesz	0x2bd00	0x4e00
p_memsz	0x2bd00	0x6b24
p_flags	PF_R+PF_X	PF_R + PF_W + PF_X
p_align	0x100000	0x100000

Although the example's file offsets and virtual addresses are congruent modulo 1MB for both text and data, up to four file pages hold impure text or data (depending on page size and file system block size).

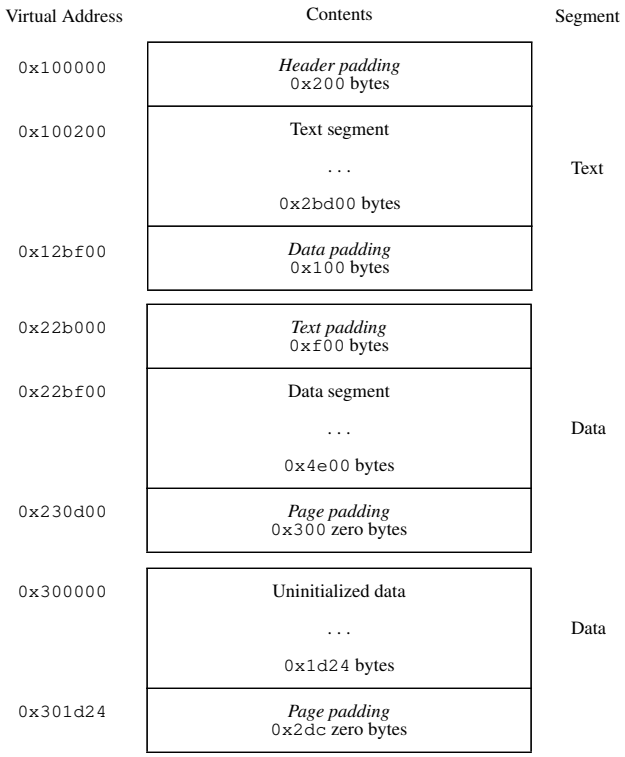
- The first text page contains the ELF header, the program header table, and other information
- The last text page holds a copy of the beginning of data.
- The first data page has a copy of the end of text.
- The last data page may contain file information not relevant to the running process.

Logically, the system enforces the memory permissions as if each segment were complete and separate; segments' addresses are adjusted to ensure each logical page in the address space has a single set of permissions. In the example

above, the region of the file holding the end of text and the beginning of data will be mapped twice: at one virtual address for text and at a different virtual address for data.

The end of the data segment requires special handling for uninitialized data, which the system defines to begin with zero values. Thus if a file's last data page includes information not in the logical memory page, the extraneous data must be set to zero, not the unknown contents of the executable file. "Impurities" in the other three pages are not logically part of the process image; whether the system expunges them is unspecified. The memory image for this program follows, assuming 4 KB (0x1000) pages.

Figure 5-3: Process Image Segments (4K page size)



Dynamic Section

Dynamic section entries give information to the dynamic linker. Some of this information is processor-specific, including the interpretation of some entries in the dynamic structure.

DT_PLTGOT On **SPARC**, this entry's *d_ptr* member gives the address of the first entry in the procedure linkage table. As described below, the first entry is special, and the dynamic linker must know its address.

DT_JMP_REL As explained in the *System V ABI*, this entry is associated with a table of relocation entries for the procedure linkage table. For the **SPARC** processor, this entry is mandatory both for executable and shared object files. Moreover, the relocation table's entries must have a one-to-one correspondence with the procedure linkage table. See "Procedure Linkage Table", below for more information.

Figure 5-5a: Dynamic Array Tags

Name	Value	d_un	Executable	Shared Object
DT_SPARC_REGISTER	0x70000001	d_val	optional	optional

DT_SPARC_REGISTER This element contains the index of an **STT_SPARC_REGISTER** symbol. There is one of these entries for every **STT_SPARC_REGISTER** symbol table entry in the symbol table.

Shared Object Dependencies

If the **LD_LIBRARY_PATH_64** variable is set in the process environment, its value is used (instead of the value of **LD_LIBRARY_PATH**) as an ordered list of directory locations to be searched for those shared objects upon which an application executable object depends. If the **LD_LIBRARY_PATH_64** variable is not set, the value of **LD_LIBRARY_PATH** (if set) is used. **LD_LIBRARY_PATH_64** follows the same syntactic convention as for **LD_LIBRARY_PATH** (i.e. it is a colon-separated ordered list of directory names).

In the SPARC 64-bit ABI (i.e. when the loading and dynamic linking of object files of **ELFCLASS64** takes place), the default (and last) directory location searched in order to locate shared objects needed by an executable object is */usr/lib/sparcv9*. The directory */usr/lib*, which is used as the default and last search location in the SPARC 32-bit ABI (i.e. when the runtime loading and linking of **ELFCLASS32** object files takes place) is not searched to locate shared objects in the SPARC 64-bit ABI.

Global Offset Table

Position-independent code cannot, in general, contain absolute virtual addresses. Global offset tables hold absolute addresses in private data, thus making the addresses available without compromising the position-independence and sharability of a program's text. A program references its global offset table using position-independent addressing and extracts absolute values, thus redirecting position-independent references to absolute locations.

Initially, the global offset table holds information as required by its relocation entries [see "Relocation" in chapter 4]. After the system creates memory segments for a loadable object file, the dynamic linker processes the relocation entries, some of which will be type **R_SPARC_GLOB_DAT** referring to the global offset table. The dynamic linker determines the associated symbol values, calculates their absolute addresses, and sets the appropriate memory table entries to the proper values. Although the absolute addresses are unknown when the link editor builds an object file, the dynamic linker knows the addresses of all memory segments and can thus calculate the absolute addresses of the symbols contained therein.

If a program requires direct access to the absolute address of a symbol, that symbol will have a global offset table entry. Because the executable file and shared objects have separate global offset tables, a symbol's address may appear in several tables. The dynamic linker processes all the global offset table relocations before giving control to any code in the process image, thus ensuring the absolute addresses are available during execution.

The table's entry zero is reserved to hold the address of the dynamic structure, referenced with the symbol **_DYNAMIC**. This allows a program, such as the dynamic linker, to find its own dynamic structure without having yet processed its relocation entries. This is especially important for the dynamic linker, because it must initialize itself without relying on other programs to relocate its memory image.

The system may choose different memory segment addresses for the same shared object in different programs; it may even choose different library addresses for different executions of the same program. Nonetheless, memory segments do not change addresses once the process image is established. As long as a process exists, its memory segments reside at fixed virtual addresses.

A global offset table's format and interpretation are processor-specific. For 64-bit ABI, the symbol **_GLOBAL_OFFSET_TABLE_** may be used to access the table.

Figure 5-5: Global Offset Table

```
extern Elf64_Addr          _GLOBAL_OFFSET_TABLE_[];
```

The symbol **_GLOBAL_OFFSET_TABLE_** may reside in the middle of the .got section, allowing both negative and non-negative "subscripts" into the array of addresses.

Function Addresses

References to the address of a function from an executable file and the shared objects associated with it might not resolve to the same value. References from within shared objects will normally be resolved by the dynamic linker to the virtual address of the function itself. References from within the executable file to a function defined in shared object will normally be resolved by the link editor to the address of the procedure linkage table entry for that function within the executable file.

To allow comparisons of function addresses to work as expected, if an executable file references a function defined in a shared object, the link editor will place the address of the procedure linkage table entry for that function in its associated symbol table entry. [See "Symbol Values" in Chapter 4]. The dynamic linker treats such symbol table entries specially. If the dynamic linker is searching for a symbol, and encounters a symbol table entry for that symbol in the executable file, it normally follows the rules below.

1. If the *st_shndx* member of the symbol table entry is not **SHN_UNDEF**, the dynamic linker has found a definition for the symbol and uses its *st_value* member as the symbol's address
2. If the *st_shndx* member is **SHN_UNDEF** and the symbol is of type **STT_FUNC** and the *st_value* member is not zero, the dynamic linker recognizes this entry as special and uses the *st_value* member as the symbol's address.
3. Otherwise, the dynamic linker considers the symbol to be undefined within the executable file and continues processing.

Some relocation are associated with procedure linkage table entries. These entries are used for direct function calls rather than for references to function addresses. These relocations are not treated in the special way described above because the dynamic linker must not redirect procedure linkage table entries to point to themselves.

Procedure Linkage Table

Much as the global offset table redirects position-independent address calculations to absolute locations, the procedure linkage table redirects position-independent function calls to absolute locations. The link editor cannot resolve

execution transfers (such as function calls) from one executable or shared object to another. Consequently, the link editor arranges to have the program transfer control to entries in the procedure linkage table. For the 64-bit ABI, procedure linkage tables reside in private data. The dynamic linker determines the destinations' absolute addresses and modifies the procedure linkage table's memory image accordingly. The dynamic linker thus can redirect the entries without compromising the position-independence and sharability of the program's text. Executable files and shared object files have separate procedure linkage tables.

The first four procedure linkage table entries are reserved. (The original contents of these entries are unspecified, despite the example below.) Each of the first 32,768 entries in the table occupies 8 instructions (32 bytes) and must be aligned on a 32-byte boundary (the table as a whole must be aligned on a 256-byte boundary). In the unlikely event that more than 32,764 entries are needed, the remaining entries consist of 6 instructions (24 bytes) and 1 pointer (8 bytes). The instructions are collected together in blocks of 160 entries followed by 160 pointers. (The last group of entries and pointers may contain less than 160 items. No padding is required.)

NOTE

The numbers 32,768 and 160 are based on the limits of branch and load displacements respectively with the second rounded down to make the divisions between code and data fall on 256-byte boundaries so as to improve cache performance.

Figure 5-6a below shows three of the initial 32,768 entries together with possible resolved forms that might apply if the target address was with +/- 2 Gb of the entry, within the lower 4 Gb of the address space, or anywhere respectively. The 64-bit ABI specifies the code sequence in the file. However, the only requirement placed on the resolved form is that the first instruction has no effect on the execution of the subsequent instructions of the entry. Figure 5-6b below shows 2 of

Figure 5-6a: Procedure Linkage Table - Example Early Entries

File	Memory Segment
.PLT101:	.PLT101
sethi (. - .PLT0), %g1	nop
ba,a %xcc,.PLT1	mov %o7, %g1
nop	call name101
nop	mov %g1, %o7
nop	nop
nop	nop
nop	nop
nop	nop
.PLT102:	.PLT102:
sethi (. - .PLT0), %g1	nop
ba,a %xcc,.PLT1	sethi %hi(name102), %g1
nop	jmpl %g1+%lo(name102), %g0
nop	nop
nop	nop
nop	nop
nop	nop
nop	nop
.PLT103:	.PLT103:
sethi (. - .PLT0), %g1	nop
ba,a %xcc,.PLT1	sethi %hh(name103), %g1
nop	sethi %lm(name103), %g5
nop	or %hm(name103), %g1
nop	sllx %g1, 32, %g1
nop	or %g1, %g5, %g5
nop	jmpl %g5+%lo(name103),%g0
nop	nop

the later entries. In this case, both the file and resolved forms (which differ only in the value of the pointer) are defined by the 64-bit ABI.

Figure 5-6b: Procedure Linkage Table - Example Later Entries

File	Memory Segment
.PLT32768:	.PLT32768:
mov %o7, %g5	<unchanged>
call . + 8	<unchanged>
nop	<unchanged>

Figure 5-6b: Procedure Linkage Table - Example Later Entries

File	Memory Segment
`   ldx   [%o7+.PLTP32768-(.PLT32768+4)], %g1`	`   <unchanged>`
`   jmpl  %o7+%g1, %g1`	`   <unchanged>`
`   mov   %g5, %o7`	`   <unchanged>`
`.............`	`.............`
`.PLT32927:`	`.PLT32927:`
`   mov   %o7, %g5`	`   <unchanged>`
`   call  . + 8`	`   <unchanged>`
`   nop`	`   <unchanged>`
`   ldx   [%o7+.PLTP32927-(.PLT32927+4)], %g1`	`   <unchanged>`
`   jmpl  %o7+%g1, %g1`	`   <unchanged>`
`   mov   %g5, %o7`	`   <unchanged>`
`.PLTP32768:`	`.PLTP32768:`
`   .xword .PLT0-(.PLT32768+4)`	`   .xword name32768-(.PLT32768+4)`
`.............`	`.............`
`.PLTP32927:`	`.PLTP32927:`
`   .xword .PLT0-(.PLT32927+4)`	`   .xword name32927-(.PLT32927+4)`

Figure 5-6c below shows an example (not required by the 64-bit ABI) of the layout of the reserved entries at the beginning of the table.

Figure 5-6c: Procedure Linkage Table - Reserved Entries

File	Memory Segment
`.PLT0:`	`.PLT0:`
`    illtrap 0`	`    save    %sp, -176, %sp`
`    illtrap 0`	`    sethi   %hh(dynamic_linker_0), %l0`
`    illtrap 0`	`    sethi   %lm(dynamic_linker_0), %l1`
`    illtrap 0`	`    or      %l0, %hm(dynamic_linker_0), %l0`
`    illtrap 0`	`    sllx    %l0, 32, %l0`
`    illtrap 0`	`    or      %l0, %l1, %l0`
`    illtrap 0`	`    jmpl    %l0+%lo(dynamic_linker_0),%o1`
`    illtrap 0`	`    mov     %g1, %o0`
`.PLT1`	`.PLT1:`
`    illtrap 0`	`    save    %sp, -176, %sp`
`    illtrap 0`	`    sethi   %hh(dynamic_linker_1), %l0`
`    illtrap 0`	`    sethi   %lm(dynamic_linker_1), %l1`
`    illtrap 0`	`    or      %l0, %hm(dynamic_linker_1), %l0`
`    illtrap 0`	`    sllx    %l0, 32, %l0`
`    illtrap 0`	`    or      %l0, %l1, %l0`
`    illtrap 0`	`    jmpl    %l0+%lo(dynamic_linker_1),%o1`
`    illtrap 0`	`    mov     %g1, %o0`
`.PLT2`	`.PLT2:`
`    illtrap 0`	`    .xword  identification`
`........`	`............`

In this example the two entry points to the dynamic linker receive arguments as if they were normal C procedures. There are two entry points because the Procedure Linkage Table may contain two different kinds of unresolved entries. The unresolved form of any of the first 32,768 entries must branch to **.PLT1** and thus is in this example resolved by:

```
dynamic_linker_1(long  x,  long  y)
```

which computes the table index as:

```
n  =  x  >>  15;
```

The unresolved form of any later entries must jump to .PLT0 and thus is in this example resolved by:

```
dynamic_linker_0(long  x,  long  y)
```

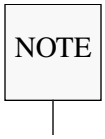
which computes the table index as

```
i  =  x  -  y  -  1048596;
n  =  32768  +  (i/5120)*160  +  (i%5120)/24;
```

As mentioned before, a relocation table entry is associated with the procedure linkage table. The **DT_JMP_REL** entry in the **_DYNAMIC** array gives the location of the first relocation entry. The relocation table's entries parallel the procedure

linkage table in a one-to-one correspondence. That is, relocation table entry 0 applies to procedure linkage table entry 0, and so on.

For slots 4 through 32,767, the relocation type will be **R_SPARC_JMP_SLOT**, the relocation offset will specify the address of the first byte of the associated table entry, the addend field will be zero, and the symbol table index will reference the appropriate symbol. For slots 32,768 and beyond, the relocation type will be **R_SPARC_JMP_SLOT**, the relocation offset will specify the address of the first byte of the associated pointer, the addend field will contain the (un-relocated) value -(**.pltN**+4), and the symbol table index will reference the appropriate symbol.



The pointer value generated by a **R_SPARC_JMP_SLOT** relocation with a non-zero addend is given by the formula
`S + A - B`

Following the steps below, the dynamic linker and the program "cooperate" to resolve symbolic references through the global offset table and the procedure linkage table. Again, the steps described below are for explanation only. The precise execution-time behavior of the dynamic linker is not specified.

1. When first creating the memory image of the program, the dynamic linker changes the initial procedure linkage table entries, making them transfer control to one of the dynamic linker's own routines as described above. It also stores an extended word of *identification* information in the third entry. When it receives control, it can examine this extended word to determine what object called it.
2. All other procedure linkage table entries initially transfer to the first or second entry. Those entries establish a stack frame and call the dynamic linker.
3. Using the *identification* value, the dynamic linker finds its data structures associated with the object in question, including the relocation table.
4. The dynamic linker computes the index of the relocation entry for the table slot.
5. Knowing this, the dynamic linker finds the symbols "real" value, unwinds the stack, modifies the procedure linkage table entry, and transfers control to the desired destination.

Whenever the dynamic linker is modifying the instructions of a procedure table entry it must do so "carefully".

- To make the code re-entrant, the procedure linkage table's instructions must be changed in a particular sequence. That is, if the dynamic linker is "resolving" a function's procedure linkage table entry and a signal arrives, the signal handling code must be able to call the original function with predictable (and correct) results.
- The dynamic linker may change up to eight words to convert an entry. Since it can update only a single word atomically with regard to instruction execution, re-entrancy must be achieved by first overwriting the `nop` instructions with their replacement instructions and then patching the `ba,a` (and the `sethi` instruction if using a 64-bit ABI store). If a re-entrant function call occurs just prior to the last patch, the dynamic linker gains control a second time. Although both invocations of the dynamic linker modify the same procedure linkage table entry, their changes do not interfere with each other.
- If the initial *`sethi`* instruction is changed, it can only be replaced by a `nop`.

Changing the pointer for the second form of entry is done using a single atomic 64-bit store.

The **LD_BIND_NOW** environment variable can change dynamic linking behavior. If its value is non-null, the dynamic linker evaluates all global offset table and procedure linkage table entries before transferring control to the program. That is, the dynamic linker processes relocation entries of type **R_SPARC_JMP_SLOT** during process initialization. Otherwise, the dynamic linker has the option of evaluating these entries lazily, delaying symbol resolution and relocation until the first execution of the related function.

NOTE

Lazy binding generally improves overall application performance, because unused symbols do not incur the dynamic linking overhead. Nevertheless, two situations make lazy binding undesirable for some applications. First, the initial reference to a shared object function takes longer than subsequent calls, because the dynamic linker intercepts the call to resolve the symbol. Some applications cannot tolerate this unpredictability. Second, if an error occurs and the dynamic linker cannot resolve the symbol, the dynamic linker will terminate the program. Under lazy binding, this might occur at arbitrary times. Once again, some applications cannot tolerate this unpredictability. By turning off lazy binding, the dynamic linker forces the failure to occur during process initialization, before the application receives control.

Program Interpreter

There is one (and only one) valid program interpreter for programs conforming to the SPARC 64-bit ABI. It is:

```
/usr/lib/sparcv9/ld.so.1
```

SCD 2.4.1

Libraries

Introduction

This chapter describes the libraries making up the SPARC 32-bit ABI, and those constituting the SPARC 64-bit ABI, and then describes the interface sets represented by each of those libraries. In addition, this chapter provides overviews of certain aspects of the ABI which either span several libraries, or relate to the management of the library interfaces in general.

This chapter is split into three sections: a common section, followed by a 64-bit gABI section, and a 64-bit psABI section. The common section applies to both the 32-bit ABI and 64-bit ABI, except where explicitly noted otherwise. Processor independent information relevant to libraries for System V Release 4 may be found in Chapter 6 of the *System V Application Binary Interface, SPARC Processor Supplement*. Information relevant to libraries for the 32-bit psABI and 64-bit psABI may be found in Chapter 6 of the *System V Application Binary Interface, SPARC Processor Supplement*. Windowing and Terminal Interface libraries are defined in detail in Chapter 10. All other libraries are defined in detail in this chapter.

Individual sections in this chapter list changes to the base System V ABI documents, give a large files support interfaces overview (32-bit ABI only), and define non-windowing and terminal interface libraries.

This chapter provides the following overviews:

- Support for Large Files (32-bit ABI)
- SCD “native” threads vs. POSIX threads
- Conventions and Techniques for Library Versioning

The libraries corresponding to the 32-bit and 64-bit SPARC ABIs are as follows:

Libraries constituting the SPARC 32-bit ABI:

- Asynchronous I/O Library — ***libaio (32-bit ABI)***
- C Library — ***libc (32-bit ABI)***

  Includes what was previously known as the System Library[1]— ***libsys (32-bit ABI)***
- Dynamic Shared Object Handling Interfaces — ***libdl (32-bit ABI)***
- ELF Object Utilities Interfaces — ***libelf (32-bit ABI)***
- Internationalization Interfaces — ***libintl (32-bit ABI)***
- Math Library — ***libm (32-bit ABI)***
- NIS DataBase library — ***libnisdb (32-bit ABI)***
- Network Services Library — ***libnsl (32-bit ABI)***
- POSIX real-time and aio interfaces (POSIX 1003.4) — ***libposix4 (32-bit ABI)***
- POSIX threads interfaces (POSIX 1003.1a) — ***libpthread (32-bit ABI)***
- The Domain Name Service Interfaces — ***libresolv(32-bit ABI)***

1. In version 2.3 of the SCD (and earlier specifications), a proper subset of interfaces present in libc was also offered via the libsys library. It has been observed that no real applications have exploited this more minimal low-level C runtime support interface (preferring to use the full libc), and therefore libsys as a library interface distinct from libc has been removed.

- The RPC Services library — ***librpcsvc (32-bit ABI)***
- Socket Library — ***libsocket (32-bit ABI)***
- Multithreading Library — ***libthread (32-bit ABI)***
- UCB BSD dynamic-compatibility interfaces — ***libucb (32-bit ABI)***

  Provides runtime compatibility for earlier applications which use dynamic binding to the University of California Berkeley's BSD-system programming interface

- Multi-byte Characters (wide char) Interfaces — ***libw (32-bit ABI)***

Libraries constituting the SPARC 64-bit ABI:

- Asynchronous I/O Library — ***sparcv9/libaio (64-bit ABI)***
- C Library — ***sparcv9/libc (64-bit ABI)***
- Dynamic (64-bit) Shared Object Handling Interfaces — ***sparcv9/libdl (64-bit ABI)***
- ELF 64-bit Object Utilities Interfaces — ***sparcv9/libelf(64-bit ABI)***
- Math Library — ***sparcv9/libm (64-bit ABI)***
- Network Services Library — ***sparcv9/libnsl (64-bit ABI)***
- POSIX real-time and aio interfaces (POSIX 1003.4) — ***sparcv9/libposix4 (64-bit ABI)***
- POSIX threads interfaces (POSIX 1003.1a) — ***sparcv9/libpthread (64-bit ABI)***
- The Domain Name Service Interfaces — ***sparcv9/libresolv(64-bit ABI)***
- Socket Library — ***sparcv9/libsocket (64-bit ABI)***
- Multithreading Library — ***sparcv9/libthread (64-bit ABI)***
- Multi-byte Characters (wide char) Interfaces — ***sparcv9/libw (64-bit ABI)***

Some of the entries in the tables which define the function interfaces provided by various libraries have a superscript. All entries with a superscript have an entry in the changes table describing differences between the SCD definition and the System V gABI, psABI, or *System V Interface Definition, Third Edition* definition of the function.

The first part of this chapter is the changes to the *System V Application Binary Interface, SPARC Processor Supplement*, and the *System V Interface Definition* as reported to SPARC International.

C library Changes

#	Facility	Location	Description
1	***__dtou***	psABI	Change - On page 6-6, replace the description of exceptions for *__dtou* with "If $-2^{31} \le a < 2^{32}$ then the operation is successful. If *a* is not a whole number, the inexact exception is raised. Otherwise, the value returned by *__dtou* is unspecified, and the invalid exception is raised. Note that negative values of *a*, in a successful operation, are first converted to integer and then cast to an unsigned integer."
2	***__ftou***	psABI	Change - On page 6-7, replace the description of exceptions for *__ftou* with "If $-2^{31} \le a < 2^{32}$ then the operation is successful. If *a* is not a whole number, the inexact exception is raised. Otherwise, the value returned by __ftou is unspecified, and the invalid exception is raised. Note that negative values of *a*, in a successful operation, are first converted to integer and then cast to an unsigned integer."
3	***_Q_qtou***	psABI	Change - On page 6-5, replace the description of exceptions for *_Q_qtou* with "If $-2^{31} \le a < 2^{32}$ then the operation is successful. If *a* is not a whole number, the inexact exception is raised. Otherwise, the value returned by _Q_qtou is unspecified, and the invalid exception is raised. Note that negative values of *a*, in a successful operation, are first converted to integer and then cast to an unsigned integer."
4	***_environ***	gABI	Addition - On page 6.6, add the symbol _environ to Figure 6-5.
5	**Additional Entry Points**	psABI	Page 6-5 of the *System V Application Binary Interface* states "ABI-conforming systems must provide a libsys entry point for each of [fstat, lstat, mknod, stat, and uname]. The name and syntax of [these entry points] may be the same as those characteristics of the source-level service or they may vary across processor architectures. The actual names of the entry points are specified in each processor's supplement to the ABI, together with the entry points' syntax information if names differ from those of the source-level services." The *System V Application Binary Interface, SPARC Processor Supplement* (psABI) is missing the required specification. A section titled *Additional Entry Points (Processor -Specific)* should be added to the beginning of chapter 6 of the psABI which states "The binary entry points for fstat, lstat, mknod, stat, uname exist with these names and with the same calling sequence as described in their source-level interface. Synonyms exist for each of these entry points."
6	***errno***	gABI	Addition - On page 6-6, add the symbol errno to Figure 6-5.
7	***fcntl(BA_OS)***	SVID, Vol. 1	Add a description of the command **F_FREESP** which reads: "Free storage space associated with a section of the ordinary file *fildes*. The section is specified by a variable of data type struct flock pointed to by the third argument *arg*. *l_whence* is **SEEK_SET**, **SEEK_CUR**, or **SEEK_END** to indicate that the relative offset *l_start* will be measured from the start of the file, the current position, or the end of the file, respectively. *l_start* is the offset from the position specified in *l_whence*. *l_len* is the size of the section. An *l_len* of 0 frees up to the end of the file; in this case, the end of file (i.e., file size) is set to the beginning of the section freed. Any data previously written into this section is no longer accessible."
8	***fcntl*(BA_OS)**	SVID, Vol. 1	Change - The **EAGAIN** error return value only applies to files for which mandatory locking is enabled.

9	***getcwd*(BA_OS)**	SVID, Vol.1	Change - For POSIX conformance, the type of the second argument size should be size_t rather than int.
10	***getgrent*(BA_LIB)**	gABI	Add the functions getgrent, setgrent, endgrent and fgetgrent to Figure 6-2 on page 6-4.
11	***getgrent*(BA_LIB)**	SVID, Vol. 1	The description that the information in the group structure comes from the */etc/group* file is too restrictive; the information may come from other sources. These sources are collectively called "group database". Applications should not depend on the implementation of the group database.
12	***getpwent*(BA_LIB)**	gABI	Add the functions getpwent, setpwent, endpwent and fgetpwent to Figure 6-2 on page 6-4.
13	***getpwent*(BA_LIB)**	SVID, Vol. 1	The description that the information in the passwd structure comes from */etc/passwd* file is too restrictive; the information may come from other sources. These sources are collectively called "user database". Applications should not depend on the implementation of the user database.
14	**Global Data Symbols**	gABI	Change the description of *_altzone*. Replace "***tzset*(BA_LIB)**" with "***tzset*()**. See ***ctime*(BA_LIB)**."
15	***mmap*(KE_OS)**	SVID, Vol. 1	Add to the paragraph which begins "Not all implementations..." insert "No implementation will permit an access to succeed where **PROT_NONE** has been set." after "... where **PROT_WRITE** has not been set.".
16	***read*, *readv*(BA_OS)**	SVID, Vol. 1	Addition - The SVID specifies that the write, ***writev*(BA_OS)**length of the struct *iov*[] in calls to ***readv*()/*writev*()** must be in the range 0 =< iovcnt =< **IOV_MAX**. However, **IOV_MAX** is never defined. SCD compliant systems will support a minimum of 16 elements in a struct iov[].
17	***rename***	gABI	Change - On page 6-4, move rename from Figure 6-2 to Figure 6-3.
18	***sbrk***	SVID, Vol. 1	Add description of the function sbrk. See the man page for this function in the SCD 2.4 Interface Semantics.
19	***sbrk***	gABI	Add the function sbrk to Figure 6-2 on page 6-4.
20	***symlink*(BA_OS)**	SVID, Vol. 1	Change description of **ENAMETOOLONG** to "if the length of *path2* exceeds {**PATH_MAX**}, or pathname component of *path2* is longer than {NAME_MAX} while {**_POSIX_NO_TRUNC**} is in effect."
21	***system*(BA_OS)**	SVID, Vol.1	Change - For POSIX conformance, system() will ignore **SIGINT** and SIGQUIT, and block **SIGCHLD** while waiting for the command it invokes to terminate. Receipt of these signals will not result in system() returning with a -1 result and with errno set to **EINTR**.
22	***waitid*(BA_OS)**	SVID, Vol. 1	Change - The flag **WTRACED** should be replaced with **WTRAPPED**.
23	***crypt*(BA_LIB)**	gABI	Add the function ***crypt*** to Figure 6-7 on page 6-10.
24	***crypt*(BA_LIB)**	gABI	Add the function ***encrypt*** to Figure 6-7 on page 6-10.
25	***crypt*(BA_LIB)**	gABI	Add the function ***setkey*** to Figure 6-7 on page 6-10.
26	***fdopen*(BA_OS)**	SVID, Vol. 1	Change - The requirement that the *fildes* argument be open is incorrect.
27	***getitimer*(RT_OS)**	SVID, Vol.3	Change - The description of canonical form is incorrect. The

microsecond value can be zero. Hardware platforms must provide at least 60 Hz resolution. Platforms may provide greater than 60 Hz resolution, but applications that rely on a faster clock will not be portable.

28	***getitimer*(RT_OS)**	gABI	Add the function setitimer to Figure 6-7 on page 6-10.
29	***gettimeofday*(RT_OS)**	gABI	Add the function gettimeofday to Figure 6-7 on page 6-10.
30	***lockf*(BA_OS)**	SVID, Vol. 1	Addition - The **EAGAIN** error return value only applies to files for which mandatory locking is enabled.
31	***sysinfo***	gABI	Add the function sysinfo to Figure 6-7 on page 6-1
32	***termios*(BA_OS)**	SVID, Vol.1	Change - On page 6-152, in the description of tcsendbreak(), "If duration is not zero, zero-valued bits are not transmitted" is incorrect. Zero valued bits will be sent forimplementation dependent period of time.
33	***elf_hash***	gABI	p5-22 Figure 5-12: Hashing Function The elf_hash(3E) routine has 'unsigned long' as a return type, and two 'unsigned long' variables are used as automatic variables. Change: These should all be 'unsigned int'. [64 bit sparc]
34	***scalb*(BA_LIB)**	gABI	Move the function logb from Figure 6-6 on page 6-9 to Figure 6-7 on page 6-10. logb is non-ANSI function.
35	***signal.h***	psABI	change structure sigaltstack figure 6-33 page 6-41 from

```
struct sigaltstack {
 char    *ss_sp;
 int     ss_size;
 int     ss_flags;
};
```

to

```
struct sigaltstack {
 void                    *ss_sp;
 size_t                  ss_size;
 int                     ss_flags;
};
```

36	***signal.h***	SVID,Vol.1	Delete ***abort***(), ***exit***(), and ***longjmp***() from the list on page 5-68.

Rationale:

Async-signal-safe function list in SVID3 is different from XPG4.2/XPG5/POSIX. The three functions above are only on SVID3 and also not on both UXP/DS and Solaris2.5.1 manuals. So these differences could be a problem for applications. the Async-signal-safe function list for SVID3 is different than that for XPG4.2/XPG5/POSIX.

From POSIX Part 1, section 3.3.1.3, page 78, : "All POSIX.1 functions not in the preceding table and all functions defined in the C Standard not stated to be callable from a signal-catching function are considered to be unsafe with respect to signals. In the presence of signals, all functions defined by this part of ISO/IEC 9945 or by the C Standard shall behave as defined (by the defining standard) when called from or interrupted by a signal-catching function, with a single exception: when a signal interrupts an unsafe function and the

signal-catching function calls an unsafe function, the behavior is undefined." The language from XPG5 (under sigaction of volume 2) is basically a subset of this and includes a similar table, with ***abort***(), ***exit***() and ***longjmp***() removed from the table.

37 ***stdlib.h*** psABI add to figure 6-40 (page 6-48), definition of *wchar_t*:

```
typedef long wchar_t;
```

38 ***sys/ticlts.h*** psABI Page 6-55, remove all interfaces: The interfaces in <sys/ticlts.h> are private; the header should not be required.

39 ***sys/ticots.h*** psABI Page 6-55, remove all interfaces: The interfaces in <sys/ticots.h> are private; the header should not be required.

40 ***sys/ticotsord.h*** psABI Page 6-55, remove all interfaces: The interfaces in <sys/ticotsord.h> are private; the header should not be required.

41 ***tiuser.h*** psABI Page 6-59. Remove the following interfaces, they are obsolete:

```
#define T_ACCEPT1
#define T_ACCEPT2
#define T_ACCEPT3
#define T_CLOSE
#define T_CONNECT1
#define T_CONNECT2
#define T_LISTN
#define T_OPEN
#define T_PASSCON
#define T_RCV
#define T_RCVCONNECT
#define T_RCVDIS1
#define T_RCVDIS2
#define T_RCVDIS3
#define T_RCVREL
#define T_RCVUDATA
#define T_RCVUDERR
#define T_SND
#define T_SNDDIS1
#define T_SNDDIS2
#define T_SNDREL
#define T_SNDUDATA
#define T_UNBIND
```

Network Services Library Changes

#	Facility	Location	Description
1	***netconfig*(RS_ENV)**	SVID, Vol. 3	Change - On page 17-20 the type declaration of *nc_flag* should be changed from char * to unsigned long.
2	***rpc_broadcast_exp***	gABI	Add the function rpc_broadcast_exp to Figure 6-11 on page 6-13.
3	***rpc_clnt_calls*(RS_LIB)**	SVID, Vol. 3	Change - On page 18-11 the function prototype of ***rpc_call***() should be: `rpc_call (char *host, u_long prognum, u_long versnum, u_long procnum, xdrproc_t inproc, char *in, xdrproc_t outproc, char *out, char *nettype)`

4	***rpc_svc_err*(RS_LIB)**	SVID, Vol. 3	Change - Description of the function ***svcerr_progvers***() is missing its last two arguments in the function prototype. Prototype should be:
			`void svcerr_progvers(`
			` const SVCXPRT *xprt,`
			` ulong_t low,`
			` ulong_t high`
			`)`
			where *low* and *high* represent the lowest and highest, respectively, of the versions of the service provided.

5	***svc_fdset***	gABI	*svc_fds* in Figure 6-12 should be changed to *svc_fdset*.
6	***t_alloc*(BA_LIB)**	SVID, Vol. 1	Change the sentence starting with “If the size value associated with any specified field is -1 or -2...” to “If the size value associated with any specified field is -1, t_alloc() will allocate the buffer with the size of 1024 bytes. If the size value is -2, t_alloc() will set the buffer pointer to NULL and the buffer maximum size to 0 and will return with success.”
7	***t_getstate*(BA_LIB)**	SVID, Vol. 1	Delete the phrase beginning with “or ***t_getstate***() was called...”.

System Data Interface Changes

#	Facility	Location	Description

1	***dirent.h***	psABI	Change the declaration of DIR, in Figure 6-5, to be an opaque type. Application programs can know neither the size nor the layout of this type.:
			`typedef struct{`
			`  /* unspecified */`
			`} DIR;`

2	***fcntl.h***	psABI	The following manifest constant is needed for implementing ftruncate() and truncate() operations but is missing from Figure 6-7: `#define F_FREESP  11`
3	***rpc.h***	psABI	page 6-31, The identity of this header file is incorrect, it is specified in the SVID (and in existing practice) to be <rpc/rpc.h>.
4	***rpc.h***	psABI	Change - Delete the definition of **RPC_ANYSOCK**, and change the definition of **RPC_ANYFD** to be -1
5	***signal.h***	psABI	Change - On page 6-41, in Figure 6-33 for the struct sigaction type declaration change *sigdisp_t sa_disp* to void (**sa_handler*)().

```
struct sigaction {
 int                    sa_flags;
 void                   (*sa_handler)();
 sigset_t               sa_mask;
 int                    sa_resv[2];
};
```

6	***signal.h***	psABI	page 6-41, The values “28” (**SIGVTALRM**) and “29” (SIGPROF) are missing from <*signal.h*> in the psABI. These are needed now that ***getitimer***() and ***setitimer***() are part of the SCD 2.4 (figure 6-33).
7	***signal.h***	psABI	page 6-41, The signal of values 32 and above are reserved to the system implementation and must not be used by an SCD-compliant application.
8	***sys/param.h***	psABI	Remove definition of **HZ** from Figure 6-23.
9	***sys/tiuser.h***	psABI	Change - In Figure 6-52 through 6-58 on page 6-59 through 6-63, header name <*sys/tiuser.h*> should be changed to <*tiuser.h*>.
10	***sys/types.h***	psABI	Addition - On page 6-63, in Figure 6-59, add the following type definitions:

```
typedef unsigned int    u_int;
typedef unsigned long   u_long;
typedef unsigned short  u_short;
typedef char            caddr_t;
```

11	***wait.h***	psABI	Change - In Figure 6-66 on page 6-68, header name <*wait.h*> should be changed to <*sys/wait.h*>.

Miscellaneous ABI Changes

#	Facility	Location	Description
1	**Shared Library Names**	psABI	Addition - A section should be inserted that identifies the actual version numbers and reference names for shared objects on a SPARC system.

Table 6-2 Library Logical and Reference Names

Library	Reference Name
(runtime linker)	/usr/lib/ld.so.1
libaio	/usr/lib/libaio.so.1
libc	/usr/lib/libc.so.1
libdl	/usr/lib/libdl.so.1
libelf	/usr/lib/libelf.so.1
libintl	/usr/lib/libintl.so.1
libm	/usr/lib/libm.so.1
libnisdb	/usr/lib/libnisdb.so.1
libnsl	/usr/lib/libnsl.so.1
libposix4	/usr/lib/libposix4.so.1
libpthread	/usr/lib/libpthread.so.1
libresolv	/usr/lib/libresolv.so.1
librpcsvc	/usr/lib/librpcsvc.so.1
libsocket	/usr/lib/libsocket.so.1
libucb	/usr/lib/libucb.so.1
libw	/usr/lib/libw.so.1
libthread	/usr/lib/libthread.so.1

2	**Dependencies Among**	gABI	Change - On page 6-2, at the statement which begins “Application Libraries executable and shared object files...” replace to the end of the paragraph with “Application executables must provide a complete list of those shared objects which the application uses directly. Each system library must supply a complete dependency graph for its own execution as **DT_NEEDED** entries. Rationale: No application should be required to know what secondary dependencies any platform system library may have. Such dependencies may vary from system to system.
3	**Shared Library Names**	gABI	Deletion - Delete Table 6-1 on page 6-2. Addition - Actual full path names (reference names) of these shared libraries are specified in the appropriate processor supplement.

4 **Shared Library Names** gABI

Addition page 6-2 - A second paragraph should be inserted to this section that states: "The version numbers of shared objects are set on a per-processor basis with the constraint that they are derived from a Generic ABI 'reference version number' for each interface and must change their current value whenever that reference version number changes. In this manner, the reference names can reflect the often combined generic and processor specific portions of the interface in a consistent manner."A shared object version number must change whenever one or more of the following occurs:

- an entry point is deleted,
- an entry point is added,
- an entry point is changed,
- program visible semantic properties change, or
- changes to exported data objects change in size, type, or name."

5 ***resource.h*** psABI

Change the declaration of rlim_t, in Figure 6-27, as follows:

```
#if _FILE_OFFSET_BITS == 64
 typedef unsigned long longrlim_t;
#else
 typedef unsigned long  rlim_t;
#endif
```

6 ***resource.h*** psABI

Change the constant value **RLIM_INFINITY**, in Figure 6-27, as follows:

```
#if _FILE_OFFSET_BITS == 64
#define RLIM_INFINITY   ((rlim_t) -3)
#else
#define RLIM_INFINITY   0x7fffffff
#endif
```

7 ***stdio.h*** psABI

Change the declaration of *fpos_t*, in Figure 6-39, as follows:

```
#if _FILE_OFFSET_BITS == 64
 typedef long long       fpos_t;
#else
 typedef long            fpos_t;
#endif
```

8 ***stat.h*** psABI

Change -On page 6-43, in Figure 6-35 for the struct *stat* type declaration change as follows:

```
struct stat {
 dev_t                   st_dev;
 long                    st_pad1[3];
 ino_t                   st_ino;
 mode_t                  st_mode;
 nlink_t                 st_nlink;
 uid_t                   st_uid;
 gid_t                   st_gid;
 dev_t                   st_rdev;
 long                    st_pad2[2];
 off_t                   st_size;
#if _FILE_OFFSET_BITS != 64
 long                    st_pad3;
#endif
 timestruc_t             st_atim;
 timestruc_t             st_mtim;
 timestruc_t             st_ctim;
 long                    st_blksize;
```

```
 blkcnt_t              st_blocks;
 char                  st_fstype[_ST_FSTYPSZ];
 long                  st_pad4[8];
};
```

9 ***statvfs.h*** psABI Change -On page 6-45, in Figure 6-36 for the struct *statvfs* type declaration change as follows:

```
typedef struct statvfs {
 unsigned long         f_bsize;
 unsigned long         f_frsize;
 isblkcnt_t            f_blocks;
 fsblkcnt_t            f_bfree;
 fsblkcnt_t            f_bavail;
 fsfilcnt_t            f_files;
 fsfilcnt_t            f_ffree
 fsfilcnt_t            f_favail;
 unsigned long         f_fsid;
 char                  f_basetype[FSTYPSZ];
 unsigned long         f_flag;
 unsigned long         f_namemax;
 char                  f_fstr[32];
 unsigned long         f_filler[16];
} statvfs_t;
```

10 ***sys/types.h*** psABI Change the declaration of *off_t*, in Figure 6-59, as follows:

```
#if _FILE_OFFSET_BITS == 64
 typedef long long     off_t;
#else
 typedef long          off_t;
#endif
```

11 ***termios.h*** psABI Delete from page 6-52 Figure 6-42 the following definition

```
#define CINTR          0177
#define CEARSE         '#'
#define CKILL          '@'
```

12 ***nl_types.h*** psABI Change in Page 6-27 Figure 6-22 :

```
    typedef short nl_item;
```

to

```
    typedef int nl_item;
```

13 ***limits.h*** psABI Change in Page 6-21 Figure 6-14 the following definition:

```
    #define NL_TEXTMAX  255
```

to

```
    #define NL_TEXTMAX  2048
```

14 ***math.h*** psABI Change in Page 6-22 Figure 6-16 _i in the _h_val definition from:

```
    unsigned long          i[2];
    double                 d;
```

to:

```
    unsigned long _i[sizeof(double)/sizeof(unsigned long)];
    double        _d;
```

15 ***float.h*** psABI Change in Page 6-17 Figure 6-8 :

```
    extern int          __flt_rounds;
    #define FLT_ROUNDS  __flt_rounds
to:
    extern int          __flt_rounds(void);
    #define FLT_ROUNDS  __flt_rounds()
```

16 ***sys/sem.h*** psABI Change in Page 6-39 Figure 6-30 :

```
struct sem {
    unsigned short      semval;
    pid_t               sempid;
    unsigned short      semncnt;
    unsigned short      semzcnt;
};
to:
struct sem {
    ushort_t            semval;
    pid_t               sempid;
    ushort_t            semncnt;
    ushort_t            semzcnt;
    ushort_t            semncnt_cv;
    ushort_t            semzcnt_cv;
};
```

17 ***signal.h*** psABI Change in Page 6-21 Figure 6-33:

```
    typedef struct {unsigned int  sigbits[4]} sigset_t;
```

to:

```
    typedef struct {unsigned int  __sigbits[4]; } sigset_t;
```

18 ***sys/mman.h*** psABI Change in Page 6-23:

```
#define     MS_SYNC         0x0     /* flags to msync */
```

to:

```
#define     MS_OLDSYNC      0x0 /* old value of MS_SYNC */
                    /* modified for UNIX98 compliance */
#define     MS_SYNC         0x4     /* wait for msync */
```

Overview of Large Files Support (32bit-ABI)

Overview

This section of the SCD defines a set of interfaces introduced within the 32-bit ABI in order to support the use of large files (i.e. files larger than 2^{31} bytes in length). This is essentially a transitional interface which allows developers to use large files in a SPARC 32-bit ABI application. This facility is provided through the addition of a set of large file-specific interfaces with specially-qualified names (e.g. open64, readdir64, etc.), to complement the historical unqualified names (e.g. open, readdir, etc.) already in the 32-bit ABI, which operate on small files (those smaller than 2^{31} bytes). Interfaces with these qualified names do not apply within the 64-bit ABI, since the interfaces with the historical unqualified names (e.g. open, readdir, etc.) all provide access to large files.

The table below summarizes the large file support interfaces and specifies those interface members which are REQUIRED and those which are EXPERIMENTAL.

SCD Extensions to the System V ABI

The SCD includes additional functions which are not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available in the SCD Interface Semantics document. Structures and manifest constants pertaining to these functions are as specified further below.

Library Contents

The following table (Table 6-3) lists the complete set of interfaces added to the 32-bit ABI to support access to large files. The table also indicates the library within which each respective interface is found.

Table 6-3 Large files Interface content (in libc, libaio, libthread, libposix4, and libucb)

alphasort64 (5E)	freopen64 (1R)	lstat64 (1R)	tmpfile64 (1R)
aioread64 (3E)	fseeko64 (1R)	mkstemp64 (1E)	truncate64 (1R)
aio_cancel64 (4E)	fsetpos64 (1R)	mmap64 (1R)	
aio_error64 (4E)	fstat64 (1R)	nftw64 (1R)	
aio_fsync64 (4E)	fstatvfs64 (1R)	open64 (1R) (2E)	(1) libc
aio_read64 (4E)	ftello64 (1R)	pread64 (1E)	(2) libthread
aio_return64 (4E)	ftruncate64 (1R)	pwrite64 (1E)	(3) libaio
aio_suspend64(4E)	ftw64 (1R)	readdir64 (1R)(5E)	(4) libposix4
aio_write64 (4E)	getdents64 (1E)	readdir64_r (1E)	(5) libucb
aiowrite64 (3E)	getrlimit64 (1R)	scandir64 (5E)	(E) EXPERIMENTAL
creat64 (1R) (2E)	lio_listio64 (4E)	setrlimit64 (1R)	(R) REQUIRED
fgetpos64 (1R)	lockf64 (1R)	stat64 (1R)	
fopen64 (1R)	lseek64 (1R)	statvfs64 (1R)	

Structures and Manifest Constants

The following table summarizes binary-level data types and data structures for the small file (standard, 32-bit) ABI's and the types for the corresponding large file (64-bit) interfaces. The absence of an entry in the Small File Definition column indicates that there is no existing small file (32-bit) type corresponding to the type listed in the Large File Definition column.

Table 6-4 Data structures and types—Standard vs. Large Files (32-bit ABI only)

Standard Definition	Large Files Definition	Header File
struct aiocb *off_t aio_offset;*	*struct aiocb64* *off64_t aio_offset;*	*<aio.h>*
Note: *off_t* is a 32-bit scalar indicating an offset within a small file	**Note:** *off64_t* is a 64-bit scalar indicating an offset within a large file	
struct dirent *ino_t d_ino;* *off_t d_off;*	*struct dirent64* *ino64_t d_ino;* *off64_t d_off;*	*<sys/dirent.h>*
struct flock *off_t l_start;* *off_t l_len;*	*struct flock64* *off64_t l_start;* *off64_t l_len;*	*<sys/fcntl.h>*
F_SETLK, F_SETLKW, F_GSTLK, F_FREESP	**F_SETLK64,F_SETLKW64, F_GETLK64, F_FREESP64, O_LARGEFILE**	
fpos_t	*fpos64_t*	*<sys/stdio.h>*
rlim_t rlim_t rlim_max;	rlim64_t rlim64_t rlim_max;	*<sys/resource.h>*
struct rlimit rlim_t rlim_cur;	struct rlimit64 rlim64_t rlim_cur;	
RLIM_INFINITY, RLIM_SAVED_MAX, RLIM_SAVED_CUR	**RLIM64_INFINITY, RLIM64_SAVED_MAX, RLIM64_SAVED_CUR**	
struct stat	*struct stat64*	*<sys/stat.h>*
ino_t st_ino; *off_t st_size;* *blkcnt_t st_blocks*	*ino64_t st_ino;* *off64_t st_size;* *blkcnt64_t st_blocks;*	
struct statvfs *fsblkcnt_t f_blocks;* *fsblkcnt_t f_bfree;* *fsblkcnt_t f_bavial;* *fsfilcnt_t f_files;* *fsfilcnt_t f_ffree;* *fsfilcnt_t f_favail;*	*struct statvfs64* *fsblkcnt64_t f_flocks;* *fsblkcnt64_t f_bfree;* *fsblkcnt64_t f_bavial;* *fsfilcnt64_t f_files;* *fsfilcnt64_t f_ffree;* *fsfilcnt64_t f_favail;*	*<sys/statvfs.h>*

Table 6-4 Data structures and types—Standard vs. Large Files (32-bit ABI only)

Standard Definition	Large Files Definition	Header File
off_t; *ino_t;* *blkcnt_t;* *fsblkcnt_t;* *fsfilcnt_t;*	*off64_t;* *ino64_t;* *blkcnt64_t;* *fsblkcnt64_t;* *fsfilcnt64_t;*	*<sys/types.h>*
	LFS64_LARGEFILE **LFS64_STDIO**	*<unistd.h>*
	_CS_LFS64_CFLAGS **_CS_LFS64_LDFLAGS** **_CS_LFS64_LIBS** **_CS_LFS64_LINTFLAGS**	*<sys/unistd.h>*

Figure 6-1 Manifest Constants and Data Types from <dirent.h>

```
struct dirent64 {
       ino64_t             d_ino;
       off64_t             d_off;
       unsigned short      d_reclen;
       char                d_name[1];
};
```

Figure 6-2 Manifest Constants and Data Types from <fcntl.h>

```
#define F_SETLK64                       34
#define F_SETLKW64                      35
#define F_GETLK6                        33
#define F_FREESP64                      27
#define O_LARGEFILE                     0x2000
#if _FILE_OFFSET_BITS == 64
#define F_SETLK                         F_SETLK64
#define F_SETLKW                        F_SETLKW64
#define F_GETLK                         F_GETLK64
#define F_FREESP                        F_FREESP64
#else
#define F_SETLK                         6
#define F_SETLKW                        7
#define F_GETLK                         14
#define F_FREESP                        11
#endif
struct flock64 { short l_type; short l_whence; off64_t l_start; off64_t l_len; long l_sysid; pid_t l_pid; long l_pad[4];} ;
```

Figure 6-3 Manifest Constants and Data Types from <stdio.h>

```
typedef long long       fpos64_t;
```

Figure 6-4 Manifest Constants and Data Types in <sys/resource.h>

```
#define RLIM64_INFINITY                 ((rlim64_t) -3)
#define RLIM64_SAVED_MAX                ((rlim64_t) -2)
#define RLIM64_SAVED_CUR                ((rlim64_t) -1)
#if _FILE_OFFSET_BITS == 64
#define RLIM_SAVED_MAX                  ((rlim_t) -2)
#define RLIM_SAVED_CUR                  ((rlim_t) -1)
#else
#define RLIM_SAVED_MAX                  0x7ffffffe
#define RLIM_SAVED_CUR                  0x7fffffd
#endif
typedef unsigned long longrlim64_t;
struct rlimit64 {       rlim64_t        rlim_cur;       rlim64_t        rlim_max;};
```

Figure 6-5 Manifest Constants and Data Types from <sys/stat.h>

```
struct stat64{
        dev_t           st_dev;         long            st_pad1[3];
        ino64_t         st_ino;         mode_t          st_mode;
        nlink_t         st_nlink;       uid_t           st_uid;
        gid_t           st_gid;         dev_t           st_rdev;
        long            st_pad2[2];     off64_t         st_size;
        timestruc_t     st_atim;        timestruc_t     st_mtim;
        timestruc_t     st_ctim;        long            st_blksize;
        blkcnt64_t      st_blocks;      char            st_fstype[16];
        long            st_pad4[8];
};
```

Figure 6-6 Manifest Constants and Data Types from <sys/statvfs.h>

```
typedef struct statvfs64 {
        unsigned int    f_bsize;        unsigned int    f_frsize;
        fsblkcnt64_t    f_blocks;       fsblkcnt64_t    f_bfree;
        fsblkcnt64_t    f_bavail;       fsfilcnt64_t    f_files;
        fsfilcnt64_t    f_ffree;        fsfilcnt64_t    f_favail;
        unsigned int    f_fsid;         char            f_basetype[16];
        unsigned int    f_flag;         unsigned int    f_namemax;
        char            f_fstr[32];     unsigned long   f_filler[16];
} statvfs64_t;
```

Figure 6-7 Manifest Constants and Data Types from <sys/types.h>

```
        typedef long long               off64_t;
        typedef unsigned long long      ino64_t;
        typedef long long               blkcnt64_t;
        typedef unsigned long long      fsblkcnt64_t;
        typedef unsigned long long      fsfilcnt64_t;
        #if _FILE_OFFSET_BITS == 64
        typedef unsigned long long      ino_t;
        typedef long long               blkcnt_t;
        typedef unsigned long long      fsblkcnt_t;
        typedef unsigned long long      fsfilcnt_t;
        #else
        typedef unsigned long           ino_t;
        typedef long                    blkcnt_t;
        typedef unsigned long           fsblkcnt_t;
        typedef unsigned long           fsfilcnt_t;
        #endif
```

Figure 6-8 Manifest Constants and Data types defined in <unistd.h>

```
#define _PC_FILESIZEBITS                67
#define _CS_LFS_CFLAGS                  68
#define _CS_LFS_LDFLAGS                 69
#define _CS_LFS_LIBS                    70
#define _CS_LFS_LINTFLAGS               71
#define _CS_LFS64_CFLAGS                72
#define _CS_LFS64_LDFLAGS               73
#define _CS_LFS64_LIBS                  74
#define _CS_LFS64_LINTFLAGS             75
```

Conventions and Techniques for Library Versioning

Overview

This section of the SCD describes the policies ascribed to by the SCD for versioning of the system libraries and interfaces which define the SPARC ABI. Specifically, the policies apply to conventions for naming and numbering of the shared libraries, so as to indicate a successive, upward-compatible evolution of the runtime interface for applications offered by SCD-conformant system implementations.

Standard Syntax for Library Names and Version Numbers

Each library identified by the SCD has a *full-name*, consisting of a *name part* and a *version part*. The name part always commences with the string "lib". This initial string is followed by one or more other alphanumeric characters that typically give some idea of the logical interface content contained within the library. To conclude the name part, and to separate it from the version part, is the string ".so.". The ".so" in the name indicates that the library is a dynamically-linked shared object of the sort that SCD-compliant applications may safely depend upon. After the separating ".so.", is the version part, which indicates the *major version* number (major revision level) of the library.

In the SCD, the convention is for library names to have only a single-level revision number following the name (e.g. libc.so.1, libnsl.so.1, as compared to libc.so.1.3 or libnsl.so.1.4), and this number indicates the major revision level of the library. Minor revision levels on SCD-conformant systems are indicated by a library-internal labelling technique described below. In certain exceptional cases SCD libraries have both a major and minor number (each number separated by a period following the name part). This situation, which is a departure from the standard naming convention, is the case for example, when the library names have been prescribed earlier and/or by some other standard, and it was either necessary or most practical to preserve that specific name for compatibility with existing applications or other existing usage in the field (e.g. libXm.so.1.2). In such cases, the SCD will typically also offer another name for the same library which conforms to the SCD's standard naming convention (i.e. the two names will be aliases—e.g. *libXm.so.1.2* and *libXm.so.3* in this specification are equivalent names for the same library).

The *full-name* of each given library is also recorded as the library's *so-name* recorded as the **DT_SONAME** within the shared object (i.e. the ELF binary) which implements the library, so that this name can be recorded in application binaries which depend upon it (see below under "Application Binary Objects Record Library Names They Depend On").

Purpose of Versions

The purpose of versioning of the SCD's shared libraries is to allow an SCD-conformant system implementation to locate the correct library and interface content needed by an application executable (or other shared object) when the application is run. Since there may be more than one revision level of a library present on the number of system implementations and/or releases available in the field at any point in time, or even on the number of revision levels of a library present on a single system implementation, it is important that the application be associated with the correct one at runtime if its interface content and functionality needs are to be met.

Versioning of the libraries has the purpose of indicating one or more of the following properties:

- Additions to the interface content contained within the library.
- Introduction of an entirely new instance of a library which is incompatible with a preceding version of a library by the same name
- Indication of the content level present in the libraries found on a given system implementation
- Indication of the content level depended upon by an SCD-compliant application or other executable

Revision levels (versions)—Major and Minor

Different revision levels (versions) of a library, be they a difference in *major* or *minor* revision, indicate different interface

content within the library. Successive minor revisions of a library contain strictly upward compatible changes to the interface content and/or function within the library. For example minor revision 4 of libc.so.1 has strictly upward compatible content to that which is present in minor revision 3 of libc.so.1. This might mean, for example that minor revision 4 of libc has some additional interface content, beyond what is present in minor revision 3, or that some of the interfaces that were present in revision 3 have had their functionality extended in minor revision 4, or both. Successive major revisions have no specific relation to one another. They might, other than being related to one another in the general sort of functional content they contain, have been given entirely different names. For example libc.so.1 and libc.so.2 would indicate two different major revisions of the C library (libc.so). The presumption is that the two are incompatible in the interface content and/or behavior of the the interfaces contained within them, and that an application may depend on one or the other, but *not* both.

Managing major revisions

In the case that a major revision of a library takes place, system implementations will continue to carry (offer) the earlier major revision of the library (as a complete and separate ELF object with the appropriate major version number) so that applications which were built earlier and depend on that major revision level can continue to be run. For example if a new major revision of libc were to be introduced, it would be libc.so.2, and SCD-conformant systems would also continue to offer the earlier major revision of libc as libc.so.1.

Such a situation would be viewed as the practical technique and basis for dealing with a DEPRECATED set of interfaces. Earlier major revision levels of a library could be removed from a system implementation at the point at which there were no longer sufficiently many application binaries in the field.

In some cases the name part of the library might also be changed to indicate an incompatible departure in the semantics of the interface elements contained within its successor (or alternate). In SCD2.4 we observe this in respect of libpthread.so.1 (the multi-threading interfaces conforming to the POSIX standard) vs. libthread.so.1 (the SCD-native multi-threading interfaces introduced earlier, prior to the POSIX standard). Note that both (incompatible) library interfaces are present in SCD2.4: the former in order to support earlier application binaries based upon SCD's native threads interfaces, the latter in order to support later and current application binaries based upon the POSIX threads standard. A similar situation exists with libaio.so.1 and libposix4.so.1—successive but incompatible versions of the programming interface for asynchronous i/o and real-time programming.

Managing minor revisions

In the case that a minor revision of a library takes place (and this is the most common evolutionary change to the SCD), system implementations continue to carry (offer) the library with the same name and major revision number as before, but with additional interface content and/or functionality in that library. The additional interface content from one minor release of a library to the next is indicated by a library-internal versioning technique described below.

Application Binary Objects Record Library Names They Depend On

An important aspect of library names is that they are recorded in the binary (ELF object) of any executable object or other shared object that depends directly upon the library. This is described in the Extensible Linking Format specification of the System V ABI specification. A set of DT_NEEDED entries recorded within the application's object file (ELF object) indicate the names of any depended-upon shared objects and a DT_RPATH entry indicates any runtime directories (beyond the default /usr/lib) in which the system implementation is to search for them.

It is important to note that the *full-name* described above (in the case of SCD-conformant systems a string containing both a name part and version part: e.g. "libc.so.1") is recorded in a DT_NEEDED entry within the application's executable object, for each library (shared object) it was linked with when it was built. This is a way of recording the library dependency information within the application binary. This both allows and requires that exact matches in the names of the shared library be able to be found at runtime on the system implementation in question if the application is to be dynamically linked with the library and thus given the chance to run.

Library-Internal Minor Versioning—EXPERIMENTAL

In SCD-conformant systems, shared libraries may contain internal definitions indicating minor revision levels of the library. This minor versioning technique relies upon and exploits a *versioning section* within the shared library's ELF object which allows a collection of symbols within the library to be associated with a named set. Several such named sets may be defined within a versioned shared library, and one named set may absorb the content of ("inherit") that of another named set to keep track of an upward-compatible evolution of the interface-member content of a library as interface members were added from one minor release of the library to the next. Library-internal named sets can thus be used for minor versioning and such named sets are referred to as version definitions.

A shared library can have associated with it one or more internal *version definitions*. Each version definition is commonly associated with one or more symbol names. Each symbol name can only be associated with *one* version definition, however a version definition can inherit the symbols from other version definitions. Thus, a structure exists to define one or more independent, or related, version definitions within the object being created. As new changes are made to the object, new version definitions can be added to express these changes.

There are two consequences of providing version definitions within a shared object:

- Dynamic objects that are built using this shared object can record their dependency on the version definitions (interface content) they rely upon. These version dependencies will be verified at runtime (on those system implementations containing versioned shared libraries) to ensure that the appropriate interfaces, or functionality, are available for the correct execution of an application.
- Dynamic objects can select (during their link-edit) only those version definitions of a shared object that they wish to bind to. This mechanism allows developers to control their dependencies on a shared library to the interfaces, or functionality, that provide them the most flexibility (i.e. their desired minor revision level).

Creating a Shared LIbrary with Minor Version Definitions

Version definitions consist of an association of symbol names to a unique version *name*. These associations are established within the shared libraries offered by SCD-conformant system implementations by the vendors of these implementations when they construct the shared libraries at build-time. Such shared libraries are constructed with the use of a versioning `mapfile` supplied to the final link-edit of an object using the link-editor's `-M` option. A version definition is established whenever a version name is specified as part of the `mapfile` directive.

Overview of Support for Multi-threaded Applications

Overview

This section of the SCD describes the SPARC ABI's handling of the interfaces for multi-threaded programs. In particular, there are two semantically distinct interface sets provided—libthread.so.1, providing the original SCD "native" interface for multi-threaded applications (those written prior to the POSIX 1003.1c threads standard), and a subsequent one—libpthread.so.1, providing a runtime interface for multi-threaded applications which conform to the POSIX threads standard.

Specifically, this section describes certain constraints on applications' use of the threads interfaces, and also the techniques used in SCD-conformant system implementations to decide on and select the correct interface semantics to use (for certain shared interfaces) in a multi-threaded application.

Identification of a Multi-threaded Application and its MT type

A multi-threaded (MT) application is identified by the fact that it depends upon either libthread.so.1 or libpthread.so.1. Specifically, the loading of of either libthread.so.1 or libpthread.so.1 as a result of the application's dependence upon it, or its loading as needed by any other shared object used by the application causes the multi-threaded interfaces to be present, and the multi-threaded semantics of certain interfaces within libc to be in effect for that process. In the case of an MT application, certain interfaces in libc have additional thread-specific behaviors which are not required in a non-threaded application.

SCD-native threads vs. POSIX threads—Differing Interface Semantics

The following table (Table 6-5) lists the set of interfaces whose signature or semantics is different in the native threads case (use of libthread.so.1) vs. the POSIX threads case (use of libpthread.so.1). All the interfaces indicated are found in libc.

Table 6-5 Interfaces with Signature or Semantic Behavior Dependent on MT Choice (in libc)

```
native:  char *           asctime_r (const struct tm *tm, char *buf, int buflen);
POSIX:   char *           __posix_asctime_r (const struct tm *tm, char *buf);

native:  char *           ctime_r (const time_t *clock, char *buf, int buflen);
POSIX:   char *           __posix_ctime_r (const time_t *clock, char *buf);

native:  int              fork ()       /* Fork all threads in the process */
POSIX:   int              fork ()       /* Fork just the current thread */

native:  struct group *   getgrgid_r (gid_t gid, struct group *result,
                           char *buffer, int buflen);
POSIX:   int              __posix_getgrgid_r (gid_t gid, struct group *grp,
                           char *buffer, size_t bufsize,
                           struct group **result);

native:  struct group *   getgrnam_r (const char *name, struct group *result,
                           char *buffer, int buflen);
POSIX:   int              __posix_getgrnam_r (const char *name, struct group *grp,
                           char *buffer, size_t bufsize,
                           struct group **result);

native:  char *           getlogin_r (char *name, int namelen);
POSIX:   int              __posix_getlogin_r (char *name, size_t namesize);

native:  struct passwd *  getpwnam_r (const char *name, struct passwd *result,
                           char *buffer, int buflen);
POSIX:   int              __posix_getpwnam_r (const char *name, struct passwd *pwd,
                           char *buffer, size_t bufsize,
                           struct passwd **result);

native:  struct passwd *  getpwuid_r (uid_t uid, struct passwd *pwd,
                           char *buffer, int buflen);
POSIX:   int              __posix_getpwuid_r (uid_t uid, struct passwd *pwd,
                           char *buffer, size_t bufsize,
                           struct passwd **result);

native:  struct dirent *  readdir_r (DIR *dirp, struct dirent *entry);
POSIX:   int              __posix_readdir_r (DIR *dirp, struct dirent *entry,
                           struct dirent **result);

native:  int              sigwait (sigset_t *setp);
POSIX:   int              __posix_sigwait (sigset_t *setp, int *signo)

native:  char *           ttyname_r (int fildes, char *name, int namelen);
POSIX:   int              __posix_ttyname_r (int fildes, char *name,
                           size_t namesize);
```

To deal with the fact that the interface signature (number and/or types of arguments), and/or the interface semantics (behavior) are different in the native threads mode vs. the POSIX threads mode, two different techniques are used: For the interface fork(1), a runtime decision is made as to the appropriate semantics. For sigwait(1) and the reentrant interfaces whose signature is different in the two cases, one of the two possible binary level interface names is selected (typically at compile-time). Each of these is described further below.

Runtime Semantic Dispatch

For fork(1), in which a single binary interface name is provided, SCD conformant system implementations select one or the other semantic variant at runtime. This choice is made on a per-application (i.e. per-process) basis depending on whether the application has linked with libthread.so.1 or libpthread.so.1.

Compile-time Dispatch

For the reentrant interfaces (all but fork(1) above), two distinct sets of binary level interfaces (ABI's) are provided. Those ABI's providing the native semantics have the same name as the source level interface, those ABI's providing the POSIX

semantics have a name which is the same as the source name prefixed with "__posix_". It is the expectation that the software generation system (header files and/or compilation system) maps the source level interface to the correct binary interface.

The following table (Table 6-6) provides an indication of the mapping from the source-level interfaces to the respective binary-level interfaces in the case of native threads and POSIX threads usage[1].

.

Table 6-6 Mapping from API to ABI

Header File	API	Native Threads ABI	POSIX Threads ABI
unistd.h	fork	fork[a]	fork[b]
	getlogin_r	getlogin_r	__posix_getlogin_r
	ttyname_r	ttyname_r	__posix_ttyname_r
signal.h	sigwait	sigwait	__posix_sigwait
dirent.h	readdir_r	readdir_r	__posix_readdir_r
grp.h	getgrgid_r	getgrgid_r	__posix_getgrgid_r
	getgrnam_r	getgrnam_r	__posix_getgrnam_r
pwd.h	getpwuid_r	getpwuid_r	__posix_getpwuid_r
	getpwnam_r	getpwnam_r	__posix_getpwnam_r
time.h	ctime_r	ctime_r	__posix_ctime_r
	asctime_r	asctime_r	__posix_asctime_r

a. Native semantics apply at runtime (all threads of the current process are duplicated in the fork)
b. POSIX semantics apply at runtime (just the current thread is duplicated in the fork)

MT type is exclusive

A single SCD compliant application may not combine the use of native threads and POSIX threads, as the result is undefined behavior. That is, no single application may link both libthread.so.1 and libpthread.so.1. However SCD conformant system implementations do support the simultaneous execution of applications which use native threads (libthread only) and those which use POSIX-threads (libpthread only).

Summary of the Threads-related Interfaces

The following tables (Table 6-7, Table 6-8), and Table 6-21, on page 6-61 (in the POSIX threads interface section later in this chapter), list the complete set of interfaces within the 32-bit ABI to support multi-threaded applications. The tables also indicate the library within which each respective interface is found.

1. Note that native interfaces were available as the development (build-time) interface on earlier systems, and POSIX-style interfaces are available on more recent systems. On system implementations which offer the POSIX build-time interface, the earlier interface is typically unavailable, in favor of the newer POSIX threads interface.

Table 6-7 Interfaces to support multi-threaded applications (in libc)

__posix_asctime_r	2.4 E	getpwuid_r	*, E, 2.3	putc_unlocked	2.3
__posix_ctime_r	2.4 E	getpwnam_r	*, E, 2.3	putchar_unlocked	2.3
__posix_getgrgid_r	2.4 E	readdir_r	E,2.3	rand_r	2.3
__posix_getgrnam_r	2.4 E	sigwait	E, R, 2.3	strtok_r	2.3
__posix_getlogin_r	2.4 E	ttyname_r	E, 2.3		
__posix_getpwuid_r	2.4 E	getc_unlocked	2.3		
__posix_getpwnam_r	2.4 E	funlockfile	2.3		
__posix_readdir_r	2.4 E	flockfile	2.3		
__posix_sigwait	2.4 E	___errno	2.3		
__posix_ttyname_r	2.4 E	fgetgrent_r	2.3		
asctime_r	2.3 E	fgetpwent_r	2.3		
ctime_r	2.3 E	getchar_unlocked	2.3		
fork E,R*	2.3 E	getgrent_r	2.3		
getgrgid_r	2.3 E	getpwent_r	2.3		
getgrnam_r	*, 2.3, E	gmtime_r	2.3		
getlogin_r	*, 2.3, E	localtime_r	2.3		

2.3 - Interfaces added in SCD2.3

2.4 - Interfaces added in SCD2.4

* Two versions of fork

E - EXPERIMENTAL Interface

Table 6-8 Interfaces to support multi-threaded applications (in libc, libthread, libpthread)

cond_broadcast	(1,2)	setcontext	(1)	
cond_destroy	(1,2)	sigaction	(1,2)	
cond_init	(1,2)	siglongjmp	(1,2)	
cond_signal	(1,2)	sigprocmask	(1,2)	
cond_timedwait	(1,2)	sigsetjmp	(1,2)	
cond_wait	(1,2)	sigsuspend	(1,2)	
creat64	(1, LE) 2.4	sigwait	(1,2)	
fork1	(1)	sleep	(1,2)	
mutex_destroy	(1,2)	thr_continue	(1,2)	
mutex_init	(1,2)	thr_create	(1,2)	
mutex_lock	(1,2)	thr_exit	(1,2)	
mutex_trylock	(1,2)	thr_getconcurrency	(1,2)	
mutex_unlock	(1,2)	thr_getprio	(1,2)	
open64	(1, LE) 2.4	thr_getspecific	(1,2)	
rw_rdlock	(1,2)	thr_join	(1,2)	
rw_tryrdlock	(1,2)	thr_keycreate	(1,2)	
rw_trywrlock	(1,2)	thr_kill	(1,2)	
rw_unlock	(1,2)	thr_main	(1,2)	
rw_wrlock	(1,2)	thr_min_stack	(1,2)	
rwlock_destroy	(1)	thr_self	(1,2)	
rwlock_init	(1,2)	thr_setconcurrency	(1,2)	
sema_destroy	(1,2)	thr_setprio	(1,2)	
sema_init	(1,2)	thr_setspecific	(1,2)	
sema_post	(1,2)	thr_sigsetmask	(1,2)	
sema_trywait	(1,2)	thr_suspend	(1,2)	
sema_wait	(1,2)	thr_yield	(1,2)	

(1) libthread
(2) libpthread

L - 32-bit ABI Large file support routine.
E - EXPERIMENTAL interfaces.

2.4 - Interfaces added in SCD2.4.

Note: Each interface in this table also has a corresponding interface by the same name in libc.so.1, which provides the non-threaded (stub) implementation.

libaio - Asynchronous I/O Library - DEPRECATED

Overview

The services specified in this section provide applications with the ability to invoke a number of file operations asynchronously with the execution of the application program.

The interface set described here resides entirely in the OPTIONAL and DEPRECATED dynamic library */usr/lib/libaio.so.1*. Interface members of this library, listed in the table below, are OPTIONAL and DEPRECATED unless explicitly noted otherwise.

This interface set is DEPRECATED effective August 1995. This interface set will not be removed from the SCD before August 1998.

Rationale:

> These interfaces are DEPRECATED as they may eventually be replaced by POSIX 1003.4 Asynchronous I/O interfaces.

SCD Extensions to the System V ABI

The SCD specifies a new library: */usr/lib/libaio.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available in the SCD 2.4 Interface Semantics document. Structures and manifest constants pertaining to these functions are as specified further below.

Library Contents

Table 6-9 libaio Contents

aiocancel		2.3	L – 32-bit ABI Large File Support interface. See Large File Support Interfaces Overview section. E – EXPERIMENTAL interfaces.	2.3 – Interfaces added in SCD2.3. 2.4 – Interfaces added in SCD2.4. Note: All interfaces defined in the SCD Interface Semantics document.
aioread		2.3		
aioread64	L(E)	2.4		
aiowait		2.3		
aiowrite		2.3		
aiowrite64	L(E)	2.4		

Structures and Manifest Constants

Figure 6-9 Manifest Constants and Data Types from <sys/asynch.h>

```
#define AIO_INPROGRESS -2  /* values not set by the system */

typedef struct aio_result_t {
       int           aio_return; /* return value of read or write */
       int           aio_errno; /* errno generated by the IO */
} aio_result_t;
```

libc - The C Library

Overview

This section contains the REQUIRED libc and former libsys interfaces to basic system services listed in the *System V Application Binary Interface* and described in sections **BA_OS**, **BA_LIB**, **BA_ENV**, **KE_OS**, and RT_OS of the *System V Interface Definition, Third Edition*, along with additional ABI extensions.

The interface set described here resides entirely in the REQUIRED dynamic library: */usr/lib/libc.so.1*. Interface members of this library, listed in the tables below, are REQUIRED unless explicitly noted otherwise. Effective November 1st, 1993 the ***sbrk*** function interface is DEPRECATED. This interface may be removed as early as November 1st, 1996.

The libc ABI Interfaces

The ABI interfaces listed in the tables further below have been included in the SCD because they are REQUIRED to be present in the dynamic library: */usr/lib/libc.so.1*. Issues regarding synonyms and global data symbols associated with this library can be found in the *System V Application Binary Interface*.

SCD Extensions to the System V ABI

The SCD requires */usr/lib/libc.so.1*, which has functions which are either not specified by, or are different from, the gABI. These functions are either not defined in the SVID, or are defined differently in the SCD than the SVID. The semantics pages for these additional/modified function definitions are available in the SCD Interface Semantics document. Structures and manifest constants pertaining to these functions are as specified further below.

Long Long Intrinsics Support

long long intrinsics are routines for the support of operations on a 64-bit integer type (“long long”) for both signed and unsigned quantities. Their descriptions are available in the SCD 2.4 Interface Semantics document. Calling sequence for 64-bit integer arguments and return value is described in Low-level System Information Changes in Chapter 3. The long long type is supported in ***printf***(**BA_LIB**) and ***scanf***(**BA_LIB**) as follows: In format string, conversion specifiers d, i, o, u, x, and X may be preceded by ll (ell ell) to indicate that corresponding argument is of type long long integer (printf) or pointer to long long integer (scanf).

Exported Data

The exported data in the following table is REQUIRED to be present in */usr/lib/libc.so.1*. The format of these entriesis:data[size], where size is a hexadecimal byte count.

Table 6-10 Exported Data for libc

__iob[0x140]	daylight[0x4] +1, 2	+ – Previously found in the libsys system library.
__huge_val[0x8] +	environ[0x4] +1, 2	
_altzone[0x4] +	errno[0x4] +1, 2, 3	1 – See C Library Changes section at the beginning of this chapter.
_ctype[0x209] +	getdate_err[0x4]	
_daylight[0x4] +	optarg[0x4]	2 – Conforming systems are required to reserve space to _environ in libc. It is the responsibility of either the compilation system or the application to ensure that _environ is properly initialized.
_environ[0x4]+1,2,3	opterr[0x4]	
_getdate_err[0x4]	optind[0x4]	
_numeric[0x2] +	optopt[0x4]	
_timezone[0x4] +	timezone[0x4] +	
_tzname[0x8] +	tzname[0x8] +	
altzone[0x4] +		

3 – New interfaces added to SCD2.3.

Table 6-11 libc SPARC Support Routines (32-Bit ABI)

.div +	__rem64 +,*2,3	_Q_lltoq +*2,3	+ – Previously found in the libsys system library.
.mul +	__udiv64 +*2,3	_Q_mul +	
.rem +	__umul64 +*2,3	_Q_neg +	* – Found in the SCD IS.
.stret1 +	__urem64 +*2,3	_Q_qtod +	
.stret2 +	_Q_add +	_Q_qtoi +	1 – See C Library Changes section at the beginning of this chapter.
.stret4 +	_Q_cmp +	_Q_qtos +	
.stret8 +	_Q_cmpe +	_Q_qtoll +*2,3	
.udiv +	_Q_div +	_Q_qtou+ 1	
.umul +	_Q_dtoq +	_Q_qtoull +*2,3	2 – Long long intrinsics support routines – routines supporting operations on a 64-bit integer (“long long”) for both signed and unsigned quantities. Calling sequence for 64-bit integer arguments and return value is described in Low-Level System Information Changes in Chapter 3.
.urem +	_Q_feq +	_Q_sqrt +	
__div64 +*2,3	_Q_fge +	_Q_stoq +	
__dtoll +*2,3	_Q_fgt +	_Q_sub +	
__dtoull +*2,3	_Q_fle +	_Q_ulltoq *2,3	
__ftoll +*2,3	_Q_flt +	_Q_utoq +	
__ftoull +*2,3	_Q_fne +	__dtou +1	
__mul64 +*2,3	_Q_itoq +	__ftou +1	

3 – New interfaces added to SCD2.3.

Library Contents

Table 6-12 libc content

___errno	*,2.3	chdir	+	fattach	+
__assert		chmod	+	fchdir	+
__errno		chown	+	fchmod	+
__filbuf		chroot	+	fchown	+
__flsbuf		clearerr		fclose	
__posix_asctime_r	2.4,E	clock		fcntl	+
__posix_ctime_r	2.4,E	close	+	fconvert	*,2.4,E
__posix_getgrgid_r	2.4,E	closedir	+	fcvt	*,2.4
__posix_getgrnam_r	2.4,E	closelog	*,2.4	fdetach	+
__posix_getlogin_r	2.4,E	creat	+	fdopen	++
__posix_getpwuid_r	2.4,E	creat64	*,2.4,L	feof	
__posix_getpwnam_r	2.4,E	crypt	++	ferror	
__posix_readdir_r	2.4,E	ctermid		fflush	
__posix_sigwait	2.4,E	ctime		ffs	*,2.4
__posix_ttyname_r	2.4,E	ctime_r	*,2.3,E	fgetc	
_cleanup	*	cuserid		fgetgrent	+,++
_exit	+	dbm_close	*,2.4	fgetgrent_r	*,2.3
_priocntl	*,2.4	dbm_delete	*,2.4	fgetpos	
_tolower		dbm_fetch	*,2.4	fgetpos64	*,2.4 L
_toupper		dbm_firstkey	*,2.4	fgetpwent	+,++
_xftw		dbm_nextkey	*,2.4	fgetpwent_r	2.3
abort		dbm_open	*,2.4,E	fgets	
abs		dbm_store	*,2.4	fgetspent	*,2.4,E
access	+	decimal_to_double	*,2.4,E	file_to_decimal	*,2.4,E
acct	+	decimal_to_extended	*,2.4,E	fileno	
addsev	E	decimal_to_quadruple	*,2.4,E	finite	*,2.4,E
addseverity	*	decimal_to_single	*,2.4,E	flockfile	*
adjtime		difftime		fmtmsg	
alarm	+	div		fopen	
ascftime	*,2.4,E	double_to_decimal	*,2.4,E	fopen64	*,2.4,L
asctime		dup	+	fork	+,E,R
asctime_r	*,2.3,E	econvert	*,2.4,E	fpathconf	+
atexit		ecvt	*,2.4	fpclass	*,2.4,E
atof		encrypt	*,++	fpgetmask	*,2.4,E
atoi		endgrent	+,++	fpgetround	*,2.4,E
atol		endpwent	+,++	fpgetsticky	*,2.4,E
bsearch		endspent	*,2.4,E	fprintf	
calloc	+,*	endutxent	*,2.4	fpsetmask	*,2.4,E
catclose	+	execl	+	fpsetround	*,2.4,E
catgets	+	execle	+	fpsetsticky	*,2.4,E
catopen		execlp	+	fputc	
cfgetispeed	+	execv	+	fputs	
cfgetospeed		execve	+	fread	
cfsetispeed		execvp	+	free	+,*
cfsetospeed		exit	+	freopen	
cftime	*,E	extended_to_decimal	+*,2.4,E	freopen64	*,2.4 L
				frexp	

Table 6-12 (cont'd) libc content

fscanf		getmsg	+	isalnum	
fseek		getopt		isalpha	
fseeko		getpass		isascii	
fseeko64	*,2.4,L	getpgid	+	isastream	+
fsetpos		getpgrp	+	isatty	
fsetpos64	*,2.4,L	getpid		iscntrl	
fstat	+	getpmsg		isdigit	
fstat64	*,2.4,L	getppid		isgraph	
fstatvfs	+	getpw	*,2.4,E	islower	
fstatvfs64	*,2.4,L	getpwent	+,++	isnan	*
fsync	+	getpwent_r	*,2.3	isnand	*
ftell		getpwnam	+	isnanf	*,2.4,E
ftello		getpwnam_r	*,2.3, E	isprint	
ftello64	*,2.4,L	getpwuid	+	ispunct	
ftok	+	getpwuid_r	*,2.3,E	isspace	
ftruncate	*,2.4	getrlimit	+	isupper	
ftruncate64	*,2.4,L	getrlimit64	*,2.4,L	isxdigit	
ftw64	*,2.4,L	gets		kill	+
func_to_decimal	*,2.4,E	getsid	+	labs	
funlockfile		getspent	*,2.4,E	lchown	+
fwrite		getspnam	*,2.4	lckpwdf	E
gconvert	*,2.4,E	getsubopt		ldexp	
gcvt	*,2.4	gettimeofday	++	ldiv	
getc		gettxt	+	lfind	
getc_unlocked	*,2.3	getuid	+	lfmt	E
getchar		getutmp	*,2.4,E	link	+
getchar_unlocked	*,2.3	getutmpx	*,2.4,E	llseek	+
getcontext	+	getutxent	*,2.4	localeconv	+
getcwd	+	getutxid	*,2.4	localtime	
getdate		getutxline	*,2.4	localtime_r	*,2.3
getdents	*,2.4,E	getvfsany	*,2.4	lockf	
getdents64	*,2.4,L,E	getvfsent	*,2.4,E	lockf64	*,2.4,L
getegid	+	getvfsfile	*,2.4,E	logb	
getenv		getvfsspec	*,2.4	longjmp	
geteuid	+	getw		lsearch	
getgid	+	gmtime		lseek	+
getgrent	+,++	gmtime_r	*,2.3	lseek64	*,2.4,L
getgrent_r	*,2.3	grantpt	+	lstat	+
getgrgid	+	hasmntopt	*,2.4,E	lstat64	*,2.4,L
getgrgid_r	*,2.3,E	hcreate		madvise	*,2.4,E
getgrnam	+	hdestroy		makecontext	+,*
getgrnam_r	*,2.3,E	hsearch		malloc	+,*
getgroups	+	iconv	*	mblen	
getitimer	++	iconv_close	*	mbstowcs	
getlogin	+	iconv_open	*	mbtowc	
getlogin_r	*,2.3,E	initgroups	+	memalign	*,2.4,E
getmntany	*,2.4	insque	*,2.4		
getmntent	*,2.4,E	ioctl	+		

Table 6-12 (cont'd) libc content

memccpy		pread	*,2.4,E	scalb	
memchr		pread64	*,2.4,L,E	scanf	
memcmp		printf		seconvert	*,2.4,E
memcntl	+	priocntl		seekdir	+
memcpy		processor_bind	*,2.4,E	select	*,2.4
memmove		processor_info	*,2.4,E	semctl	+
memset		profil		semget	+
mincore	*,2.4,E	psiginfo	*,2.4,E	semop	+
mkdir	+	psignal	*,2.4,E	setbuf	
mkfifomknod	+	ptrace	+	setcat	E
mkstemp64	*,2.4,L,E	ptsname	+	setcontext	+
mktemp		putc		setegid	*,2.4
mktime		putc_unlocked	*,2.3	seteuid	*,2.4
mlock	+	putchar		setgid	+
mlockall		putchar_unlocked	*,2.3	setgrent	+,++
mmap		putenv		setgroups	+
mmap64	*,2.4,L	putmsg	+	setitimer	++
modf	*	putpmsg	+	setjmp	
modff	*,2.4,E	puts		setkey	++
monitor		putspent	E	setlabel	
mount		pututxline		setlocale	+
mprotect	+	putw		setlogmask	*,2.4
msgctl	+	pwrite	*,2.4,E	setpgid	+
msgget	+	pwrite64	*,2.4,L,E	setpgrp	+
msgrcv	+	qeconvert	*,2.4,E	setpwent	+
msgsnd	+	qfconvert *	2.4 (E)	setrlimit	+
msync	+	qgconvert *	2.4 (E)	setrlimit64	*,2.4,L
munlock	+	qsort		setsid	+
munlockall		quadruple_to_decimal	*,2.4,E	setspent	*,2.4,E
munmap	+	raise		settimeofday	E
nextafter		rand		setuid	+
nftw		rand_r	*,2.3	setutxent	*,2.4
nftw64	*,2.4,L	read	+,++	setvbuf	
nice	+	readdir	+	sfconvert	*,2.4,E
nl_langinfo		readdir64	*,2.4,L	sgconvert	*,2.4,E
open	+	readdir64_r	*,2.4,L,E	shmat	+
open64	*,2.4,L	readdir_r	*,2.3,E	shmctl	+
opendir	+	readlink	+	shmdt	+
openlog	*,2.4	readv	+,++	shmget	+
p_online	*,2.4,E	realloc	+	sigaction	+
pathconf	+	realpath	*,2.4	sigaddset	+
pause	+	remove	+	sigaltstack	+
pclose		remque	*,2.4	sigdelset	+
perror		rename	+,++	sigemptyset	+
pfmt	E	rewind		sigfillset	+
pipe	+	rewinddir	+	sighold	+
poll	+	rmdir	+	sigignore	+
popen		sbrk	+,++		

Table 6-12 (cont'd) libc content

sigismember	+	strtol		uname	+
siglongjmp	+	strtoul		ungetc	
signal	+	strxfrm	+	unlink	
sigpause	+	swab		unlockpt	+
sigpending	+	swapcontext	+,*	unordered	*,E
sigprocmask	+	swapctl		updwtmp	*,E
sigrelse	+	symlink	+,++	updwtmpx	*,2.4,E
sigsend	+	sync	+	utime	+
sigsendset	+	sysconf	+	utmpxname	*,2.4,E
sigset	+	sysfs	*,2.4,E	valloc	*,2.4
sigsetjmp	+	sysinfo	++	vfork	*,2.4
sigsuspend	+	syslog	*,2.4	vfprintf	
sigwait	+,2.3,E,R	system	+,++	vhangup	*,E
single_to_decimal	*,2.4,E	tcdrain		vlfmt	E
sleep		tcflow		vpfmt	E
sprintf		tcflush		vprintf	
srand		tcgetattr		vsprintf	
sscanf		tcgetpgrp		vsyslog	*,2.4,E
stat	+	tcgetsid		wait	+
stat64	*,2.4,L	tcsendbreak		waitid	+,++
statvfs	+	tcsetattr		waitpid	+
statvfs64	*,2.4,L	tcsetpgrp		wcstombs	
stime	+	tdelete		wctomb	
strcasecmp	*,2.4	tell		write	+,++
strcat		telldir	+	writev	+,++
strchr		tempnam			
strcmp		tfind			
strcoll	+	time	+		
strcpy		times			
strcspn		tmpfile			
strdup		tmpfile64	*,2.4,L		
strerror	+	tmpnam			
strftime	+	toascii			
string_to_decimal	*,2.4,E	tolower			
strlen		toupper			
strncasecmp	*,2.4	truncate	*,2.4		
strncat		truncate64	*,2.4,L		
strncmp		tsearch			
strncpy		ttyname	+,*		
strpbrk		ttyname_r	*,2.3,E		
strptime		ttyslot	*,2.4		
strrchr		twalk			
strsignal	*,2.4,E	tzset			
strspn		uadmin	*,2.4,E		
strstr		ulckpwdf	E		
strtod		ulimit	+		
strtok		umask	+		
strtok_r	*,2.3	umount	+		

+ – previously in libsys

++ – see C Library Changes Section at the beginning of this chapter

* – Defined in the SCD IS

L– 32–bit ABI large files interface

E – EXPERIMENTAL interface

R – REQUIRED interface

2.3 – Interface added in SCD2.3

2.4 – Interface added in SCD2.4

Structures and Manifest Constants

Figure 6-10 Manifest Constants and Data Types from <alloca.h>

```
#define alloca(x)       __builtin_alloca(x)
```

Figure 6-11 Manifest Constants and Data Types from <floatingpoint.h>

```
typedef float              single;
typedef unsigned long      extended[3];
typedef long double        quadruple;
typedef unsigned           fp_exception_field_type;
#define DECIMAL_STRING_LENGTH 512
typedef char decimal_string[DECIMAL_STRING_LENGTH];
typedef struct {
       enum fp_class_type     fpclass;
       int                    sign;
       int                    exponent;
       decimal_string         ds;
       int                    more;
       int                    ndigits;
} decimal_record;

enum decimal_form {fixed_form, floating_form};

typedef struct {
       enum fp_direction_type rd;
       enum decimal_form      df;
       int                    ndigits;
} decimal_mode;

enum decimal_string_form {
       invalid_form,              whitespace_form,           fixed_int_form,
       fixed_intdot_form,         fixed_dotfrac_form,        fixed_intdotfrac_form,
       floating_int_form,         floating_intdot_form,      floating_dotfrac_form,
       floating_intdotfrac_form,  inf_form,                  infinity_form,
       nan_form,                  nanstring_form
};
enum fp_direction_type {
       fp_nearest = 0,
       fp_tozero   = 1,
       fp_positive = 2,
       fp_negative = 3
};
enum fp_class_type {
       fp_zero       = 0,
       fp_subnormal = 1,
       fp_normal      = 2,
       fp_infinity   = 3,
       fp_quiet      = 4,
       fp_signaling   = 5
};
```

Figure 6-12 Manifest Constants and Data Types from <ftw.h>

```
#define FTW_SLN       7
#define _XFTWVER        2
#define ftw(p, f, d)    _xftw(_XFTWVER, p, f, d)
```

Figure 6-13 Manifest Constants and Data Types from <iconv.h>

```
typedef void    *iconv_t;
```

Figure 6-14 Manifest Constants and Data Types from <ieeefp.h>

```
typedef enum fpclass_t {
       FP_SNAN = 0, FP_QNAN = 1, FP_NINF = 2,
       FP_PINF = 3, FP_NDENORM = 4, FP_PDENORM = 5,
       FP_NZERO = 6, FP_PZERO = 7, FP_NNORM = 8,FP_PNORM = 9
} fpclass_t;
typedef enum    fp_rnd {FP_RN = 0,FP_RZ = 1,FP_RP = 2,FP_RM = 3} fp_rnd;
#define fp_except       int
#define FP_X_INV        0x10
#define FP_X_OFL        0x08
#define FP_X_UFL        0x04
#define FP_X_DZ         0x02
#define FP_X_IMP        0x01
```

Figure 6-15 Manifest Constants and Data Types from <limits.h>

```
#define LOGNAME_MAX     8
#define LLONG_MIN       (-9223372036854775807LL-1LL)
#define LLONG_MAX       9223372036854775807LL
#define ULLONG_MAX      18446744073709551615ULL
```

Figure 6-16 Manifest Constants and Data Types from <ndbm.h>

```
#define PBLKSIZ           1024
#define DBLKSIZ           4096
#define _DBM_IOERR        0x2
#define DBM_INSERT        0
#define DBM_REPLACE       1
typedef struct{
       int     dbm_dirf;   int     dbm_pagf;   int     dbm_flags;
       long    dbm_maxbno; long    dbm_bitno;  long    dbm_hmask;
       long    dbm_blkptr; int     dbm_keyptr; long    dbm_blkno;
       long    dbm_pagbno; char    dbm_pagbuf[PBLKSIZ];long    dbm_dirbno;
       char    dbm_dirbuf[DBLKSIZ];
} DBM;
#define dbm_error(db)         ((db)->dbm_flags & _DBM_IOERR)
#define dbm_clearerr(db)      ((db)->dbm_flags &= ~_DBM_IOERR)
typedef struct {
       char         *dptr;
       int          dsize;
} datum;
```

Figure 6-17 Manifest Constants and Data Types from <pfmt.h>

```
#define MM_STD              0
#define MM_NOSTD        0x100
#define MM_GET          0
#define MM_NOGET        0x200
#define MM_ACTION       0x400
#define MM_NOCONSOLE    0
#define MM_CONSOLE      0x800
#define MM_HARD         0x1000
#define MM_SOFT         0x2000
#define MM_FIRM         0x4000
#define MM_APPL         0x8000
#define MM_UTIL         0x10000
#define MM_OPSYS        0x20000
#define MM_ERROR        0
#define MM_HALT         1
#define MM_WARNING      2
#define MM_INFO         3
```

Figure 6-18 Manifest Constants and Data Types from <search.h>

```
struct qelem {
       struct qelem *q_forw;
       struct qelem *q_back;
};
```

Figure 6-19 Manifest Constants and Data Types from <shadow.h>

```
struct spwd {
       char *sp_namp;
       char *sp_pwdp;
       long sp_lstchg;
       long sp_min;
       long sp_max;
       long sp_warn;
       long sp_inact;
       long sp_expire;
       unsigned long sp_flag;
};
```

Figure 6-20 Manifest Constants and Data Types from <siginfo.h>

```
union sigval        {
       int                  sival_int;
       void                 *sival_ptr;
};
struct sigevent     {
       int                  sigev_notify;
       int                  sigev_signo;
       union sigval         sigev_value;
};
#define SIGEV_NONE      1
#define SIGEV_SIGNAL    2
#define SI_NOINFO       32767
#define SI_USER         0
#define SI_LWP          (-1)
#define SI_QUEUE        (-2)
#define SI_TIMER        (-3)
#define SI_ASYNCIO      (-4)
#define SI_MESGQ        (-5)
```

Figure 6-21 Manifest Constants and Data Types from <stddef.h>

```
#define offsetof(s, m)      (size_t)(&(((s *)0)->m))
```

Figure 6-22 Manifest Constants and Data Types from <sys/dirent.h>

```
struct dirent {
       ino_t           d_ino;
       off_t           d_off;
       ushort_t        d_reclen;
       char            d_name[1];
};
```

Figure 6-23 Manifest Constants and Data Types from <sys/fstyp.h>

```
#define FSTYPSZ         16
#define GETFSIND        1
#define GETFSTYP        2
#define GETNFSTYP       3
```

Figure 6-24 Manifest Constants and Data Types from <sys/mnttab.h>

```
#define MNT_LINE_MAX    1024
#define MNT_TOOLONG     1
#define MNT_TOOMANY     2
#define MNT_TOOFEW      3
#define putmntent(fd, mp)\
       fprintf((fd), "%s\t%s\t%s\t%s\t%s\n",\
              (mp)->mnt_special ? (mp)->mnt_special : "-",\
              (mp)->mnt_mountp ? (mp)->mnt_mountp : "-",\
              (mp)->mnt_fstype ? (mp)->mnt_fstype : "-",\
              (mp)->mnt_mntopts ? (mp)->mnt_mntopts : "-",\
              (mp)->mnt_time ? (mp)->mnt_time : "-")
struct mnttab {
       char    *mnt_special;
       char    *mnt_mountp;
       char    *mnt_fstype;
       char    *mnt_mntopts;
       char    *mnt_time;
};
```

Figure 6-25 Manifest Constants and Data Types from <sys/systeminfo.h>

```
/* Commands to sysinfo() */
#define SI_SYSNAME         1         /* return name of operating system */
#define SI_HOSTNAME        2         /* return name of node */
#define SI_RELEASE         3         /* return release of operating system */
#define SI_VERSION         4         /* return version field of utsname */
#define SI_MACHINE         5         /* return kind of machine */
#define SI_ARCHITECTURE    6         /* return instruction set arch */
#define SI_HW_SERIAL       7         /* return hardware serial number */
#define SI_HW_PROVIDER     8         /* return hardware manufacturer */
#define SI_SRPC_DOMAIN     9         /* return secure RPC domain */
```

Figure 6-26 Manifest Constants and Data Types from <sys/uadmin.h>

```
#define A_REBOOT        1
#define A_SHUTDOWN      2
#define A_REMOUNT       4
#define AD_HALT         0
#define AD_BOOT         1
#define AD_IBOOT        2
```

Figure 6-27 Manifest Constants and Data Types from <sys/vfstab.h>

```
#define VFS_LINE_MAX    1024
#define VFS_TOOLONG     1
#define VFS_TOOMANY     2
#define VFS_TOOFEW      3
struct vfstab {
       char         *vfs_special;
       char         *vfs_fsckdev;
       char         *vfs_mountp;
       char         *vfs_fstype;
       char         *vfs_fsckpass;
       char         *vfs_automnt;
       char         *vfs_mntopts;
};
```

Figure 6-28 Manifest Constants and Data Types from <sys/lock.h>

```
#define UNLOCK              0
#define PROCLOCK            1
#define TXTLOCK             2
#define DATLOCK             4
```

Figure 6-29 Manifest Constants and Data Types from <sys/mman.h>

```
#define PROT_NONE       0x0
#define MAP_NORESERVE   0x40
#define PROC_TEXT       (PROT_EXEC | PROT_READ)
#define PROC_DATA       (PROT_READ | PROT_WRITE | PROT_EXEC)
#define SHARED          0x10
#define PRIVATE         0x20
#define MAP_FAILED      ((void *) -1)
#define MADV_NORMAL     0
#define MADV_RANDOM     1
#define MADV_SEQUENTIAL 2
#define MADV_WILLNEED   3
#define MADV_DONTNEED   4
#define MC_SYNC         1
#define MS_OLDSYNC      0x0             /* old value of MS_SYNC */
                                        /* modified for UNIX98 compliance */
#define MS_SYNC         0x4             /* wait for msync */
#define MC_LOCK         2
#define MC_UNLOCK       3
#define MC_ADVISE       4
#define MC_LOCKAS       5
```

Figure 6-30 Manifest Constants and Data Types from <sys/priocntl.h>

```
#define PC_VERSION         1
#define priocntl(idtype, id, cmd, arg)__priocntl(PC_VERSION, idtype, id, cmd, arg)
#define priocntlset(psp, cmd, arg)__priocntlset(PC_VERSION, psp, cmd, arg)
#define PC_GETCID          0
#define PC_GETCLINFO       1
#define PC_SETPARMS        2
#define PC_GETPARMS        3
#define PC_ADMIN           4
#define PC_CLNULL          -1
#define PC_CLNMSZ          16
#define PC_CLINFOSZ        (32 / sizeof(long))
#define PC_CLPARMSZ        (32 / sizeof(long))
typedef struct pcinfo {
       id_t    pc_cid;
       char    pc_clname[PC_CLNMSZ];
       long    pc_clinfo[PC_CLINFOSZ];
} pcinfo_t;
typedef struct pcparms {
       id_t    pc_cid;
       long    pc_clparms[PC_CLPARMSZ];
} pcparms_t;
```

Figure 6-31 Manifest Constants and Data Types from <sys/processor.h>

```
#define P_OFFLINE       1
#define P_ONLINE        2
#define P_STATUS        3
#define PI_TYPELEN      16
#define PI_FPUTYPE      32
typedef struct {
       int     pi_state;
       char    pi_processor_type[PI_TYPELEN];
       char    pi_fputypes[PI_FPUTYPE];
       int     pi_clock;
} processor_info_t;
#define PBIND_NONE      -1
#define PBIND_QUERY     -2
```

Figure 6-32 Manifest Constants and Data Types from <sys/procset.h>

```
typedef enum idtype {P_PID,P_PPID,P_PGID,P_SID,P_CID,P_UID,P_GID,P_ALL,P_LWPID }
idtype_t;
#define setprocset(psp, op, ltype, lid, rtype, rid) \
             ((psp)->p_op             = (op), \
             (psp)->p_lidtype        = (ltype), \
             (psp)->p_lid            = (lid), \
             (psp)->p_ridtype        = (rtype), \
             (psp)->p_rid            = (rid))
```

Figure 6-33 Manifest Constants and Data Types from <sys/rtpriocntl.h>

```
typedef struct rtparms {
       short   rt_pri;
       ulong   rt_tqsecs;
       long    rt_tqnsecs;
} rtparms_t;
typedef struct rtinfo {
       short   rt_maxpri;
} rtinfo_t;
#define RT_NOCHANGE     -1
#define RT_TQINF        -2
#define RT_TQDEF        -3
```

Figure 6-34 Manifest Constants and Data Types from <sys/swap.h>

```
#define ST_INDEL        0x01
#define SC_ADD          1
#define SC_LIST         2
#define SC_REMOVE       3
#define SC_GETNSWP      4
typedef struct swapres {
       char    *sr_name;
       off_t   sr_start;
       off_t   sr_length;
} swapres_t;
typedef struct swapent {
       char    *ste_path;
       off_t   ste_start;
       off_t   ste_length;
       long    ste_pages;
       long    ste_free;
       long    ste_flags;
} swapent_t;
typedef struct swaptable {
       int           swt_n;
       struct        swapent swt_ent[1];
} swaptbl_t;
```

Figure 6-35 Manifest Constants and Data Types from <sys/time.h>

```
typedef longlong_t         hrtime_t;
#define FD_SETSIZE         1024
#define NBBY               8
typedef long               fd_mask;
#define NFDBITS            (sizeof(fd_mask) * NBBY)        /* bits per mask */
#define howmany(x, y)      (((x)+((y)-1))/(y))
typedef struct fd_set      {fd_mask fds_bits[howmany(FD_SETSIZE, NFDBITS)];}fd_set;
#define FD_SET(n, p)       ((p)->fds_bits[(n)/NFDBITS] |= (1 << ((n) % NFDBITS)))
#define FD_CLR(n, p)       ((p)->fds_bits[(n)/NFDBITS] &= ~(1 << ((n) % NFDBITS)))
#define FD_ISSET(n,p)      ((p)->fds_bits[(n)/NFDBITS] & (1 << ((n) % NFDBITS)))
#define FD_ZERO(p)         memset((char *)(p), 0, sizeof(*(p)))
```

Figure 6-36 Manifest Constants and Data Types from <sys/tspriocntl.h>

```
typedef struct tsparms {
       short         ts_uprilim;
       short         ts_upri;
} tsparms_t;

typedef struct tsinfo {
       short         ts_maxupri;
} tsinfo_t;

#define TS_NOCHANGE     -32768
```

Figure 6-37 Manifest Constants and Data Types from <sys/types.h>

```
typedef int                     processorid_t;
typedef long long               longlong_t;
typedef unsigned long long      u_longlong_t;
typedef unsigned long           major_t;
typedef unsigned long           minor_t;
#define NODEV                   (dev_t)(-1)
```

Figure 6-38 Manifest Constants and Data Types from <syslog.h>

```
#define LOG_KERN                    (0<<3)
#define LOG_USER                    (1<<3)
#define LOG_MAIL                    (2<<3)
#define LOG_DAEMON                  (3<<3)
#define LOG_AUTH                    (4<<3)
#define LOG_SYSLOG                  (5<<3)
#define LOG_LPR                     (6<<3)
#define LOG_NEWS                    (7<<3)
#define LOG_UUCP                    (8<<3)
#define LOG_LFMT                    (14<<3)
#define LOG_CRON                    (15<<3)
#define LOG_LOCAL0                  (16<<3)
#define LOG_LOCAL1                  (17<<3)
#define LOG_LOCAL2                  (18<<3)
#define LOG_LOCAL3                  (19<<3)
#define LOG_LOCAL4                  (20<<3)
#define LOG_LOCAL5                  (21<<3)
#define LOG_LOCAL6                  (22<<3)
#define LOG_LOCAL7                  (23<<3)
#define LOG_EMERG                   0
#define LOG_ALERT                   1
#define LOG_CRIT                    2
#define LOG_ERR                     3
#define LOG_WARNING                 4
#define LOG_NOTICE                  5
#define LOG_INFO                    6
#define LOG_DEBUG                   7
#define LOG_MASK(pri)               (1 << (pri))
#define LOG_UPTO(pri)               ((1 << ((pri)+1)) - 1)
#define LOG_PID                     0x01
#define LOG_CONS                    0x02
#define LOG_ODELAY                  0x04
#define LOG_NDELAY                  0x08
#define LOG_NOWAIT                  0x10
```

Figure 6-39 Manifest Constants and Data Types from <unistd.h>

```
#define _CS_PATH    65
```

Figure 6-40 Manifest Constants and Data Types from <utmpx.h>

```
struct exit_status {short e_termination;short e_exit;};
struct utmpx {
       char                        ut_user[32];
       char                        ut_id[4];
       char                        ut_line[32];
       pid_t                       ut_pid;
       short                       ut_type;
       struct exit_status          ut_exit;
       struct timeval              ut_tv;
       long                        ut_session;
       long                        pad[5];
       short                       ut_syslen;
       char                        ut_host[257];
};
struct utmp {
       char                        ut_user[8];
       char                        ut_id[4];
       char                        ut_line[12];
       short                       ut_pid;
       short                       ut_type;
       struct       exit_status    ut_exit;
       time_t                      ut_time;
};

#define EMPTY           0
#define RUN_LVL         1
#define BOOT_TIME       2
#define OLD_TIME        3
#define NEW_TIME        4
#define INIT_PROCESS    5
#define LOGIN_PROCESS   6
#define USER_PROCESS    7
#define DEAD_PROCESS    8
```

libdl - Dynamic Object File Loading Library

Overview

The run-time dynamic linking facilities of the system are specified in this section. The particulars on dynamic linking and loading, path name resolution, data initialization functions, symbol relocation and binding, and automatic loading of secondary objects are given in Chapter 5 of this document and in the normative documents it references, the *System V Application Binary Interface* and the *System V Application Binary Interface, SPARC Processor Supplemen*t.

The interface set described here resides entirely in the REQUIRED dynamic library: */usr/lib/libdl.so.1*. Interface members of this library, listed in the table below, are REQUIRED unless explicitly noted otherwise.

SCD Extensions to the System V ABI

The SCD specifies a new library: */usr/lib/libdl.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available in the SCD Interface Semantics document. Structures and manifest constants pertaining to these functions are as specified further below.

Library Contents

Table 6-13 libdl contents

dladdr *	2.4	* - Defined in the SCD Interface Semantics. 2.4 - Interfaces added in SCD2.4
dlclose *		
dlerror *		
dlopen *		
dlsym *		

Structures and Manifest Constants

The manifest constants in Figure 6-41 are required for dlopen.

Figure 6-41 Manifest Constants and Data Types from <dlfcn.h>

```
/* Valid values for mode argument to dlopen. */
#define RTLD_LAZY   1       /* lazy function call binding          */
#define RTLD_NOW    2       /* immediate function call binding */
#define RTLD_NEXT   (void *)-1
#define RTLD_GLOBAL 0x100

typedef struct      dl_info {
       const char   *dli_fname;
       void         *dli_fbase;
       const char   *dli_sname;
       void         *dli_saddr;
} Dl_info;
```

libelf - Executable Linking Format Library

Overview

The interfaces specified in this section provide applications with the ability to manipulate executable and linking format (ELF) object files, archive files, and archive members. The interface set described here resides entirely in the REQUIRED dynamic library: */usr/lib/libelf.so.1*. Interface members of this library, listed in the table below, are REQUIRED unless explicitly noted otherwise.

SCD Extension to the System V ABI

The SCD requires a new library: */usr/lib/libelf.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. Except for ***nlist***, the semantics for these additional function definitions are available in the SCD Interface Semantics document. Structures and manifest constants pertaining to these functions are as specified further below.

Library Contents

Table 6-14 libelf contents

elf32_fsize	2.4	elf_errno	2.4	elf_nextscn	2.4
elf32_getehdr	2.4	elf_fill	2.4	elf_rand	2.4
elf32_getphdr	2.4	elf_flagdata	2.4	elf_rawdata	2.4
elf32_getshdr	2.4	elf_flagehdr	2.4	elf_rawfile	2.4
elf32_newehdr	2.4	elf_flagelf	2.4	elf_strptr	2.4
elf32_newphdr	2.4	elf_flagphdr	2.4	elf_update	2.4
elf32_xlatetof	2.4	elf_flagscn	2.4	elf_version	2.4
elf32_xlatetom	2.4	elf_flagshdr	2.4	nlist	2.4
elf64_fsize	2.4.1	elf_getarhdr	2.4		
elf64_getehdr	2.4.1	elf_getarsym	2.4		
elf64_getphdr	2.4.1	elf_getbase	2.4		
elf64_getshdr	2.4.1	elf_getdata	2.4		
elf64_newehdr	2.4.1	elf_getident	2.4		
elf64_newphdr	2.4.1	elf_getscn	2.4		
elf64_xlatetof	2.4.1	elf_hash	2.4		
elf64_xlatetom	2.4.1	elf_kind	2.4		
elf_begin	2.4	elf_ndxscn	2.4		
elf_cntl	2.4	elf_newdata	2.4		
elf_end	2.4	elf_newscn	2.4		
elf_errmsg	2.4	elf_next	2.4		

2.4 – Interfaces added in SCD2.4

2.4.1 –interfaces added in SCD 2.4.1, for 64bit support

Note: Except for nlist, all interfaces defined in the SCD Interface Semantics.

Structures and Manifest Constants

Figure 6-42 Manifest Constants and Data Types from <elf.h>

```
typedef unsigned long               Elf32_Addr;
typedef unsigned short              Elf32_Half;
typedef unsigned long               Elf32_Off;
typedef long                        Elf32_Sword;
typedef unsigned long               Elf32_Word;
typedef long                        off_t;
typedef long                        time_t;
typedef unsigned int                size_t;
typedef void                        Elf_Void;
typedef struct Elf                  Elf;
typedef struct Elf_Scn              Elf_Scn;

#define ELF32_FSZ_ADDR             4
#define ELF32_FSZ_HALF             2
#define ELF32_FSZ_OFF              4
#define ELF32_FSZ_SWORD            4
#define ELF32_FSZ_WORD             4
#define EI_NIDENT                 16
#define EI_MAG0                    0
#define EI_MAG1                    1
#define EI_MAG2                    2
#define EI_MAG3                    3
#define EI_CLASS                   4
#define EI_DATA                    5
#define EI_VERSION                 6
#define ELFMAG0                 0x7f
#define ELFMAG1                 'E'
#define ELFMAG2                 'L'
#define ELFMAG3                 'F'
#define ELFCLASSNONE               0
#define ELFCLASS32                 1
#define ELFCLASS64                 2
#define ELFDATANONE                0
#define ELFDATA2LSB                1
#define ELFDATA2MSB                2
#define EV_NONE                    0
#define EV_CURRENT                 1
#define SHT_NULL                   0
#define SHT_PROGBITS               1
#define SHT_SYMTAB                 2
#define SHT_STRTAB                 3
#define SHT_RELA                   4
#define SHT_HASH                   5
#define SHT_DYNAMIC                6
#define SHT_NOTE                   7
#define SHT_NOBITS                 8
#define SHT_REL                    9
#define SHT_DYNSYM                11
#define ELF_F_DIRTY             0x1
#define ELF_F_LAYOUT            0x4
```

```
typedef struct {
       unsigned char e_ident[EI_NIDENT];
       Elf32_Half    e_type;
       Elf32_Half    e_machine;
       Elf32_Word    e_version;
       Elf32_Addr    e_entry;
       Elf32_Off     e_phoff;
       Elf32_Off     e_shoff;
       Elf32_Word    e_flags;
       Elf32_Half    e_ehsize;
       Elf32_Half    e_phentsize;
       Elf32_Half    e_phnum;
       Elf32_Half    e_shentsize;
       Elf32_Half    e_shnum;
       Elf32_Half    e_shstrndx;
} Elf32_Ehdr;

typedef struct {
       Elf32_Word    p_type;
       Elf32_Off     p_offset;
       Elf32_Addr    p_vaddr;
       Elf32_Addr    p_paddr;
       Elf32_Word    p_filesz;
       Elf32_Word    p_memsz;
       Elf32_Word    p_flags;
       Elf32_Word    p_align;
} Elf32_Phdr;

typedef struct {
       Elf32_Word    sh_name;
       Elf32_Word    sh_type;
       Elf32_Word    sh_flags;
       Elf32_Addr    sh_addr;
       Elf32_Off     sh_offset;
       Elf32_Word    sh_size;
       Elf32_Word    sh_link;
       Elf32_Word    sh_info;
       Elf32_Word    sh_addralign;
       Elf32_Word    sh_entsize;
} Elf32_Shdr;

typedef enum {
       ELF_C_NULL = 0, ELF_C_READ, ELF_C_WRITE, ELF_C_CLR, ELF_C_SET, ELF_C_FDDONE,
       ELF_C_FDREAD, ELF_C_RDWR, ELF_C_NUM
} Elf_Cmd;

typedef enum {
       ELF_T_BYTE = 0, ELF_T_ADDR, ELF_T_DYN,   ELF_T_EHDR,
       ELF_T_HALF, ELF_T_OFF, ELF_T_PHDR, ELF_T_RELA, ELF_T_REL,
       ELF_T_SHDR, ELF_T_SWORD, ELF_T_SYM, ELF_T_WORD,   ELF_T_NUM
 Elf_Type;

typedef struct {
       Elf_Void     *d_buf;
       Elf_Type     d_type;
       size_t       d_size;
       off_t        d_off;
       size_t       d_align;
       unsigned     d_version;
} Elf_Data;
```

```
typedef struct {
       char             *ar_name;
       time_t           ar_date;
       long             ar_uid;
       long             ar_gid;
       unsigned long    ar_mode;
       off_t            ar_size;
       char             *ar_rawname;
} Elf_Arhdr;

typedef struct {
       char             *as_name;
       size_t           as_off;
       unsigned long    as_hash;
} Elf_Arsym;
typedef enum {
      ELF_K_NONE = 0, ELF_K_AR, ELF_K_COFF, ELF_K_ELF, ELF_K_NUM
} Elf_Kind;
typedef struct {
       Elf32_Word       st_name;
       Elf32_Addr       st_value;
       Elf32_Word       st_size;
       unsigned char    st_info;
       unsigned char    st_other;
       Elf32_Half       st_shndx;
} Elf32_Sym;

typedef struct {
       Elf32_Addr    r_offset;
       Elf32_Word    r_info;
} Elf32_Rel;

typedef struct {
       Elf32_Addr    r_offset;
       Elf32_Word    r_info;
       Elf32_Sword   r_addend;
} Elf32_Rela;

typedef struct {
       Elf32_Sword   d_tag;
       union {
        Elf32_Word   d_val;
        Elf32_Addr   d_ptr;
        Elf32_Off    d_off;
       } d_un;
} Elf32_Dyn;
```

Figure 6-43 Manifest Constants and Data Types from <nlist.h>

```
struct nlist {
            char                *n_name;
            long                n_value;
            short               n_scnum;
            unsigned short      n_type;
            char                n_sclass;
            char                n_numaux;
    };
```

libintl - Internationalization Library - EXPERIMENTAL

Overview

The interfaces specified in this section provide support to applications in retrieving translated text strings from internationalized message objects. The interface set described here resides entirely in the EXPERIMENTAL dynamic library: */usr/lib/libintl.so.1*. Interface members of this library, listed in the table below, are EXPERIMENTAL unless explicitly noted otherwise.

SCD Extensions to the System V ABI

The SCD requires a new library: */usr/lib/libintl.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available in the SCD Interface Semantics document.

Library Contents

Table 6-15 libintl contents

bindtextdomain	2.4 (E)	gettext	2.4 (E)	2.4 – Interfaces added to SCD2.4 E – EXPERIMENTAL interface
dcgettext	2.4 (E)	textdomain	2.4 (E)	
dgettext	2.4 (E)			

libm - Math Library

Overview

The interfaces specified in this section provide several mathematical functions. The interface set described here resides entirely in the REQUIRED dynamic library: */usr/lib/libm.so.1*. Interface members of this library, listed in the table below, are REQUIRED unless explicitly noted otherwise.

SCD Extensions to the System V ABI

The SCD requires a new library: */usr/lib/libm.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available in the SCD Interface Semantics document. Structures and manifest constants pertaining to these functions are as specified further below.

Library Contents

Table 6-16 libm contents

acos	2.4	erf	2.4	jn	2.4	sqrt	2.4
acosh	2.4	erfc	2.4	lgamma	2.4	tan	2.4
asin	2.4	exp	2.4	log	2.4	tanh	2.4
asinh	2.4	expm1 *	2.4	log10	2.4	y0	2.4
atan	2.4	fabs	2.4	log1p *	2.4	y1	2.4
atan2	2.4	floor	2.4	pow	2.4	yn	2.4
atanh	2.4	fmod	2.4	remainder	2.4		
cbrt	2.4	gamma	2.4	rint *	2.4		
ceil	2.4	hypot	2.4	scalbn *	2.4 E		
copysign *	2.4 E	ilogb *	2.4	significand *	2.4 E		
cos	2.4	j0	2.4	sin	2.4		
cosh	2.4	j1	2.4	sinh	2.4		

* - Defined in the SCD Interface Semantics.
2.4 - Interfaces added in SCD2.4

Structures and Manifest Constants

Figure 6-44 Manifest Constants and Data Types from <math.h>

```
struct exception {
       int          type;
       char         *name;
       double       arg1;
       double       arg2;
       double       retval;
};
#define INT_MIN               (-2147483647-1)
#define INT_MAX               2147483647
#define DBL_MANT_DIG          53
#define DBL_MAX_EXP           1024
```

libnisdb - Network Infor. Services Database library - EXPERIMENTAL

Overview

The interfaces specified in this section provide network information services database access functions.

The interface set described here resides entirely in the EXPERIMENTAL dynamic library: */usr/lib/libnisdb.so.1*. Interface members of this library, listed in the table below, are EXPERIMENTAL unless explicitly noted otherwise.

SCD Extensions to the System V ABI

The SCD requires a new library: */usr/lib/libnisdb.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available in the SCD Interface Semantics document. Structures and manifest constants pertaining to these functions are as specified further below.

Library Contents

Table 6-17 libnisdb contents

db_add_entry	2.4E	db_list_entries	2.4E	2.4E – EXPERIMENTAL interfaces added in SCD 2.4
db_checkpoint	2.4E	db_next_entry	2.4E	
db_create_table	2.4E	db_remove_entry	2.4E	
db_destroy_table	2.4E	db_reset_next_entry	2.4E	
db_first_entry	2.4E	db_standby	2.4E	
db_free_result	2.4E	db_table_exists	2.4E	
db_initialize	2.4E	db_unload_table	2.4E	

Structures and Manifest Constants

Figure 6-45 Manifest Constants and Data Types from <rpcsvc/nis_db.h>

```
enum db_status {
          DB_SUCCESS = 0,
          DB_NOTFOUND = 1,
          DB_NOTUNIQUE = 2,
          DB_BADTABLE = 3,
          DB_BADQUERY = 4,
          DB_BADOBJECT = 5,
          DB_MEMORY_LIMIT = 6,
          DB_STORAGE_LIMIT = 7,
          DB_INTERNAL_ERROR = 8
};
typedef enum db_status db_status;
enum db_action {
              DB_LOOKUP = 0,
              DB_REMOVE = 1,
              DB_ADD = 2,
              DB_FIRST = 3,
              DB_NEXT = 4,
              DB_ALL = 5,
              DB_RESET_NEXT = 6
};
typedef enum db_action db_action;
typedef entry_obj *entry_object_p;
typedef struct {
    u_int           db_next_desc_len;
    char           *db_next_desc_val;
} db_next_desc;

struct db_result {
       db_status    status;
       db_next_desc nextinfo;
       struct {
        u_int           objects_len;
        entry_object_p *objects_val;
} objects;
       long         ticks;
};
typedef struct db_result db_result;
```

libnsl - The Network Services Library

Overview

The interfaces specified in this section provide REQUIRED libnsl network services and Internet address manipulation interfaces listed in the *System V Application Binary Interface*, and described in the *System V Interface Definition, Third Edition*, along with additional ABI extensions.

The interface set described here resides entirely in the REQUIRED dynamic library: */usr/lib/libnsl.so.1*. Interface members of this library, listed in the table below, are REQUIRED unless explicitly noted otherwise.

The libnsl ABI Interfaces

The interfaces listed below have been included in SCD the because they are REQUIRED to be present on all systems conforming to the *System V Application Binary Interface*, in the dynamic library: */usr/lib/libnsl.so.1*.

The ABI interfaces found in the tables below are REQUIRED to be present on an ABI-conforming system. Systems without networking capabilities are not required to implement these interfaces, but must provide an entry point in libnsl for each. Entry points which are provided as stubs and not implemented must fail normally and set the external symbol errno to ENOSYS.

SCD Extensions to the System V ABI

The SCD specifies the library: */usr/lib/libnsl.so.1*, which has functions not specified by, or different from, the gABI. These functions are either not defined in the SVID, or are defined differently in the SCD than in the SVID. The semantics for these additional/modified function definitions are available in the SCD Interface Semantics document. Exported data, structures and manifest constants pertaining to these functions are as specified further below

Exported Data

Table 6-18 Exported data for libnsl

`_nderror[0x4]`	`svc_fdset`[1]	1- see libnsl library changes at the beginning of this chapter.
`_null_auth`[2]	`t_errno[0x4]`	2- DEPRECATED
`rpc_createerr[0x16]`		

Library Contents

Table 6-19 libnsl contents

auth_destroy 2.4	getnetname	nis_lerror 2.4,E
authdes_create *2.4,E	getnetpath	nis_list 2.4,E
authdes_getucred *2.4	getpublickey	nis_local_directory 2.4,E
authdes_seccreate	getrpcbyname *2.4	nis_local_group 2.4,E
authnone_create	getrpcbynumber *2.4	nis_local_host 2.4,E
authsys_create	getrpcent *2.4	nis_local_principal 2.4,E
authsys_create_default	getsecretkey	nis_lookup 2.4,E
callrpc *2.4,E	host2netname	nis_mkdir 2.4,E
clnt_broadcast *2.4,E	inet_addr 2	nis_modify 2.4,E
clnt_call *2.4	inet_netof 2	nis_modify_entry 2.4,E
clnt_control *2.4	inet_ntoa 2	nis_name_of 2.4,E
clnt_create *	key_decryptsession	nis_next_entry 2.4,E
clnt_create_vers *2.4,E	key_encryptsession	nis_perror 2.4,E
clnt_destroy *2.4	key_gendes	nis_ping 2.4,E
clnt_dg_create *	key_setsecret	nis_print_group_entry 2.4,E
clnt_freeres 2.4	nc_perror	nis_print_object 2.4,E
clnt_geterr 2.4	nc_sperror *2.4,E	nis_remove 2.4,E
clnt_pcreateerror *	netdir_free	nis_remove_entry 2.4,E
clnt_perrno	netdir_getbyaddr	nis_removemember 2.4,E
clnt_perror	netdir_getbyname	nis_rmdir 2.4,E
clnt_raw_create *	netdir_options	nis_servstate 2.4,E
clnt_spcreateerror *	netdir_perror *2.4,E	nis_sperrno 2.4,E
clnt_sperrno	netdir_sperror *2.4,E	nis_sperror 2.4,E
clnt_sperror	netname2host	nis_stats 2.4,E
clnt_tli_create *	netname2user	nis_verifygroup 2.4,E
clnt_tp_create *	nis_add 2.4,E	pmap_getmaps *2.4
clnt_vc_create *	nis_add_entry 2.4,E	pmap_getport *2.4
clntraw_create *2.4,E	nis_addmember 2.4,E	pmap_rmtcall *2.4
clnttcp_create *2.4,E	nis_checkpoint 2.4,E	pmap_set *2.4
clntudp_bufcreate *2.4,E	nis_clone_object 2.4,E	pmap_unset *2.4
clntudp_create *2.4,E	nis_creategroup 2.4,E	registerrpc *2.4,E
dial *2.4,E	nis_destroy_object 2.4,E	rpc_broadcast *2.4
doconfig *2.4,E	nis_destroygroup 2.4,E	rpc_broadcast_exp *1
endhostent 2.4	nis_dir_cmp 2.4,E	rpc_call 1
endnetconfig	nis_domain_of 2.4,E	rpc_reg *
endnetpath	nis_first_entry 2.4,E	rpcb_getaddr
endrpcent *2.4	nis_freenames 2.4,E	rpcb_getmaps
freenetconfigent	nis_freeresult 2.4,E	rpcb_gettime
get_myaddress *2.4,E	nis_freeservlist 2.4,E	rpcb_rmtcall
gethostbyaddr 2	nis_freetags 2.4,E	rpcb_set
gethostbyname 2	nis_getnames 2.4,E	rpcb_unset
gethostent 2.4	nis_getservlist 2.4,E	(See numbered notes in following table)
getnetconfig	nis_ismember 2.4,E	
getnetconfigent	nis_leaf_of 2.4,E	

Table 6-19 (cont'd) libnsl contents

sethostent 2.4	t_free	xdr_reference
setnetconfig	t_getinfo	xdr_rejected_reply
setnetpath	t_getstate 1	xdr_replymsg
setrpcent * 2.4	t_listen	xdr_setpos *2.4
svc_auth_reg * 2.4,E	t_look	xdr_short
svc_create	t_open	xdr_sizeof *E
svc_destroy 2.4	t_optmgmt	xdr_string
svc_dg_create	t_rcv	xdr_u_char
svc_dg_enablecache* 2.4,E	t_rcvconnect	xdr_u_int * 2.4
svc_exit * 2.4,E	t_rcvdis	xdr_u_long
svc_fd_create	t_rcvrel	xdr_u_short
svc_freeargs *2.4	t_rcvudata	xdr_union
svc_getargs *2.4	t_rcvuderr	xdr_vector
svc_getcaller * 2.4, E	t_snd	xdr_void
svc_getreq_common * 2.4,E	t_snddis	xdr_wrapstring
svc_getreq_poll * 2.4,E	t_sndrel	xdrmem_create
svc_getreqset	t_sndudata	xdrrec_create
svc_getrpccaller *2.4	t_strerror * 2.4,E	xdrrec_endofrecord* 2.4,E
svc_pollset *2.4,E	t_sync	xdrrec_eof
svc_raw_create	t_unbind	xdrrec_readbytes * 2.4,E
svc_reg	taddr2uaddr	xdrrec_skiprecord *
svc_register * 2.4	uaddr2taddr	xdrstdio_create
svc_run	undial * 2.4,E	xprt_register
svc_sendreply	user2netname	xprt_unregister
svc_tli_create	xdr_accepted_reply	yp_all 2.4,E,
svc_tp_create	xdr_array	yp_bind 2.4,E
svc_reg	xdr_authsys_parms	yp_first 2.4,E
svc_unregister * 2.4	xdr_authunix_params 2.4,E	yp_get_default_domain2.4,E
svc_vc_create	xdr_bool	yp_master 2.4,E
svcerr_auth	xdr_bytes	yp_match 2.4,E
svcerr_decode	xdr_callhdr	yp_next 2.4,E
svcerr_noproc	xdr_callmsg	yp_order 2.4,E
svcerr_noprog	xdr_char	yp_unbind 2.4,E
svcerr_progvers 1	xdr_control *2.4,E	yperr_string 2.4,E
svcerr_systemerr	xdr_destroy 2.4,E	ypprot_err 2.4,E
svcerr_weakauth	xdr_double	
svcfd_create * 2.4,E	xdr_enum	
svcraw_create * 2.4,E	xdr_float	
svctcp_create * 2.4	xdr_free	
svcudp_bufcreate * 2.4,E	xdr_getpos *2.4	
svcudp_create	xdr_inline *2.4	
t_accept	xdr_int	
t_alloc	xdr_long	
t_bind	xdr_opaque	
t_close	xdr_opaque_auth	
t_connect	xdr_pointer	
t_error	xdr_quadruple *2.4,E	

* - Defined in the SCD Interface Semantics document.

1 - See Network Services Library Changes section at the beginning of this chapter.

2 - Socket support routines.

E- EXPERIMENTAL Interfaces

2.3 - Interfaces added in SCD2.3

2.4 - Interfaces added or changed in SCD2.4

Structures and Manifest Constants

Figure 6-46 Manifest Constants and Data Types from <rpc/xdr.h>

```
struct netobj {
       u_int        n_len;
       char         *n_bytes;
};
typedef struct netobj   netobj;
```

Figure 6-47 Manifest Constants and Data Types from <dial.h>

```
#define INTRPT (-1)
#define D_HUNG (-2)
#define NO_ANS (-3)
#define ILL_BD (-4)
#define A_PROB (-5)
#define L_PROB (-6)
#define NO_Ldv (-7)
#define DV_NT_A (-8)
#define DV_NT_K (-9)
#define NO_BD_A (-10)
#define NO_BD_K (-11)
#define DV_NT_E (-12)
#define BAD_SYS (-13)
typedef struct {
       struct termio *attr;
       int           baud;
       int           speed;
       char          *line;
       char          *telno;
       int           modem;
       char          *device;
       int           dev_len;
} CALL;
```

Figure 6-48 Manifest Constants and Data Types from <sac.h>

```
#define NOASSIGN        0x1
#define NORUN           0x2
```

Figure 6-49 Manifest Constants and Data Types from <rpc/rpcent.h>

```
struct rpcent {
        char          *r_name;
        char          **r_aliases;
        int           r_number;
};
```

Figure 6-50 Manifest Constants and Data Types from <rpc/rpc.h>

```
typedef bool_t      (*resultproc_t)(caddr_t,...);
struct pmap {
        u_long        pm_prog;
        u_long        pm_vers;
        u_long        pm_prot;
        u_long        pm_port;
};
typedef struct pmap  pmap;
typedef pmap         PMAP;
struct pmaplist{
        PMAP             pml_map;
        struct pmaplist  *pml_next;
};
#define IPPROTO_TCP        6
#define IPPROTO_UDP       17
```

libposix4 - POSIX4 Library - EXPERIMENTAL

Overview

The interfaces specified in this section are based on interfaces provided by the POSIX 1003.4 standard. Many of these interfaces support POSIX asynchronous I/O. The interface set described here resides entirely in the EXPERIMENTAL dynamic library: */usr/lib/libposix4.so.1*. Interface members of this library, listed in the table below, are EXPERIMENTAL.

Rationale:

Interfaces specified here have not yet been implemented by multiple system vendors and are therefore EXPERIMENTAL.

SCD Extensions to the System ABI

The SCD requires a new library: */usr/lib/libposix4.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID.

Library Contents

Table 6-20 libposix4 contents

aio_cancel		mq_open	shm_open
aio_cancel64	L 2.4	mq_receive	shm_unlink
aio_error		mq_send.	sigqueue
aio_error64	L 2.4	mq_setattr	sigtimedwait
aio_fsync		mq_unlink	sigwaitinfo
aio_fsync64	L 2.4	nanosleep	timer_create
aio_read		sched_get_priority_max	timer_delete
aio_read64	L 2.4	sched_get_priority_min	timer_getoverrun
aio_return		sched_getparam	timer_gettime
aio_return64	L 2.4	sched_getscheduler	timer_settime
aio_suspend		sched_rr_get_interval	
aio_suspend64	L 2.4	sched_setparam	
aio_write		sched_setscheduler	L - 32-bit ABI Large file support routine.
aio_write64	L 2.4	sched_yield	
clock_getres		sem_close	2.4 - Interfaces added in SCD2.4.
clock_gettime		sem_destroy	
clock_settime		sem_getvalue	
fdatasync		sem_init	
lio_listio		sem_open	
lio_listio64	L 2.4	sem_post	
mq_close		sem_trywait	
mq_getattr		sem_unlink	
mq_notify		sem_wait	

libpthread - POSIX Multithreading Library - EXPERIMENTAL

Overview

The POSIX thread library, libpthread contains several functions listed in the table “libpthread Contents” below. The libposix4 library is a EXPERIMENTAL interface set with reference name */usr/lib/libpthread.so.1*. The interfaces specified in this section provide applications with POSIX multithreaded services (multiple “threads of control”).

The interface set described here resides entirely in the EXPERIMENTAL dynamic library: */usr/lib/libpthread.so.1*. Interface members of this library, listed in the table below, are EXPERIMENTAL.

Rationale:

Interfaces specified here have not yet been implemented by multiple system vendors and are therefore EXPERIMENTAL.

SCD Extensions to the System V ABI

The SCD requires a new library: */usr/lib/libpthread.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available in the *Single UNIX Specification, Version 2*. Structures and manifest constants pertaining to these functions are as specified further below.

Library Contents

Table 6-21 libpthread contents

pthread_atfork	(1) 2.4	pthread_mutex_destroy	(1) 2.4
pthread_attr_destroy	(1) 2.4	pthread_mutex_getprioceiling	(1) 2.4
pthread_attr_getdetachstate	(1) 2.4	pthread_mutex_init	(1) 2.4
pthread_attr_getguardsize	(1) 2.4	pthread_mutex_lock	(1) 2.4
pthread_attr_getinheritsched	(1) 2.4	pthread_mutex_setprioceiling	(1) 2.4
pthread_attr_getschedparam	(1) 2.4	pthread_mutex_trylock	(1) 2.4
pthread_attr_getschedpolicy	(1) 2.4	pthread_mutex_unlock	(1) 2.4
pthread_attr_getscope	(1) 2.4	pthread_mutexattr_destroy	(1) 2.4
pthread_attr_getstackaddr	(1) 2.4	pthread_mutexattr_getprioceiling	(1) 2.4
pthread_attr_getstacksize	(1) 2.4	pthread_mutexattr_getprotocol	(1) 2.4
pthread_attr_init	(1) 2.4	pthread_mutexattr_getpshared	(1) 2.4
pthread_attr_setdetachstate	(1) 2.4	pthread_mutexattr_gettype	(1) 2.4
pthread_attr_setguardsize	(1) 2.4	pthread_mutexattr_init	(1) 2.4
pthread_attr_setinheritsched	(1) 2.4	pthread_mutexattr_setprioceiling	(1) 2.4
pthread_attr_setschedparam	(1) 2.4	pthread_mutexattr_setprotocol	(1) 2.4
pthread_attr_setschedpolicy	(1) 2.4	pthread_mutexattr_setpshared	(1) 2.4
pthread_attr_setscope	(1) 2.4	pthread_mutexattr_settype	(1) 2.4
pthread_attr_setstackaddr	(1) 2.4	pthread_once	(1) 2.4
pthread_attr_setstacksize	(1) 2.4	pthread_rwlock_destroy	(1) 2.4
pthread_cancel	(1) 2.4	pthread_rwlock_init	(1) 2.4
pthread_cleanup_pop	(1) 2.4	pthread_rwlock_rdlock	(1) 2.4
pthread_cleanup_push	(1) 2.4	pthread_rwlock_tryrdlock	(1) 2.4
pthread_cond_broadcast	(1) 2.4	pthread_rwlock_tryrwrock	(1) 2.4
pthread_cond_destroy	(1) 2.4	pthread_rwlock_unlock	(1) 2.4
pthread_cond_init	(1) 2.4	pthread_rwlock_wrlock	(1) 2.4
pthread_cond_signal	(1) 2.4	pthread_rwlockattr_destroy	(1) 2.4
pthread_cond_timedwait	(1) 2.4	pthread_rwlockattr_getpshared	(1) 2.4
pthread_cond_wait	(1) 2.4	pthread_rwlockattr_init	(1) 2.4
pthread_condattr_destroy	(1) 2.4	pthread_rwlockattr_setpshared	(1) 2.4
pthread_condattr_getpshared	(1) 2.4	pthread_self	(1) 2.4
pthread_condattr_init	(1) 2.4	pthread_setcancelstate	(1) 2.4
pthread_condattr_setpshared	(1) 2.4	pthread_setcanceltype	(1) 2.4
pthread_create	(1) 2.4	pthread_setconcurrency	(1) 2.4
pthread_detach	(1) 2.4	pthread_setschedparam	(1) 2.4
pthread_equal	(1) 2.4	pthread_setspecific	(1) 2.4
pthread_exit	(1) 2.4	pthread_sigmask	(1) 2.4
pthread_getconcurrency	(1) 2.4	pthread_testcancel	(1) 2.4
pthread_getschedparam	(1) 2.4		
pthread_getspecific	(1) 2.4		
pthread_join	(1) 2.4		
pthread_key_create	(1) 2.4		
pthread_key_delete	(1) 2.4		
pthread_kill	(1) 2.4		

1 – Found in *The Single UNIX Specification, Version 2*.

2.4 – Interfaces added in SCD2.4.

Structures and Manifest Constants

Figure 6-51 Manifest Constants and Data types from <sched.h>

```
#define SCHED_OTHER     0
#define SCHED_FIFO      1
#define SCHED_RR        2
```

Figure 6-52 Manifest Constants and Data types from <pthread.h>

```
typedef unsigned int     pthread_t;
typedef unsigned int     pthread_key_t;

typedef struct _pthread_attr {
        void          *pthread_attrp;
} pthread_attr_t;

typedef struct _pthread_mutexattr {
        void          *pthread_mutexattrp;
} pthread_mutexattr_t;

typedef struct _pthread_mutex {
        struct {
             unsigned char     pthread_mutex_flag[4];
             unsigned long     pthread_mutex_type;
        } pthread_mutex_flags;
        union {
         struct {
             unsigned char     pthread_mutex_pad[8];
        } pthread_mutex_lock64;
         unsigned long long    pthread_mutex_owner64;
        } pthread_mutex_lock;
        unsigned long long     pthread_mutex_data;
} pthread_mutex_t;

typedef struct _pthread_cond {
        struct {
         unsigned char         pthread_cond_flag[4];
         unsigned long         pthread_cond_type;
        } pthread_cond_flags;
        unsigned long long     pthread_cond_data;
} pthread_cond_t;

typedef struct _pthread_condattr {
        void          *pthread_condattrp;
} pthread_condattr_t;

typedef struct _once {
        unsigned long long     pthread_once_pad[4];
} pthread_once_t;

typedef struct _pthread_rwlock {
         int                __pthread_rwlock_readers;
         unsigned short     __pthread_rwlock_type;
         unsigned short     __pthread_rwlock_magic;
         unsigned long long __pthread_rwlock_pad1[3];
         unsigned long long __pthread_rwlock_pad2[2];
         unsigned long long __pthread_rwlock_pad3[2];
} pthread_rwlock_t;
```

```
#define PTHREAD_CANCEL_ENABLE        0x00
#define PTHREAD_CANCEL_DISABLE       0x01
#define PTHREAD_CANCEL_DEFERRED      0x00
#define PTHREAD_CANCEL_ASYNCHRONOUS  0x02
#define PTHREAD_CANCELED             -19
#define PTHREAD_COND_INITIALIZER     {{{0}, 0}, 0}
#define PTHREAD_CREATE_DETACHED      0x40
#define PTHREAD_CREATE_JOINABLE      0
#define PTHREAD_INHERIT_SCHED        1
#define PTHREAD_EXPLICIT_SCHED       0
#define PTHREAD_MUTEX_DEFAULT        PTHREAD_MUTEX_NORMAL
#define PTHREAD_MUTEX_ERRORCHECK     2
#define PTHREAD_MUTEX_NORMAL         0
#define PTHREAD_MUTEX_INITIALIZER    {{{0}, 0}, {{{0}}}, 0}
#define PTHREAD_MUTEX_RECURSIVE      4
#define PTHREAD_ONCE_DONE            1
#define PTHREAD_ONCE_NOTDONE         0
#define PTHREAD_ONCE_INIT            {0, 0, 0, PTHREAD_ONCE_NOTDONE}
#define PTHREAD_PROCESS_SHARED       1
#define PTHREAD_PROCESS_PRIVATE      0
#define PTHREAD_SCOPE_SYSTEM         0x01
#define PTHREAD_SCOPE_PROCESS        0
#define PTHREAD_RWLOCK_INITIALIZER   {{{0}, 0}, {{{0}}}, 0}
```

libresolv - Domain Name Services Library - EXPERIMENTAL

Overview

The interfaces specified in this section provide applications with domain name access services. The interface set described here resides entirely in the EXPERIMENTAL dynamic library: */usr/lib/libresolv.so.1*. Interface members of this library, listed in the table below, are EXPERIMENTAL unless explicitly noted otherwise.

SCD Extensions to the System V ABI

The SCD requires a new library: */usr/lib/libresolv.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available in the SCD Interface Semantics document. Structures and manifest constants pertaining to these functions are as specified further below.

Library Contents

Table 6-22 libresolv contents

dn_comp	2.4 E	res_mkquery	2.4 E	2.4 – Interfaces added in SCD2.4.
dn_expand	2.4 E	res_send	2.4 E	E – EXPERIMENTAL interfaces
res_init	2.4 E			

Structures and Manifest Constants

Figure 6-53 Manifest Constants and Data Types from <arpa/nameser.h>

```
struct rrec {
       short         r_zone;
       short         r_class;
       short         r_type;
       u_long        r_ttl;
       int           r_size;
       char          *r_data;
};
#define QUERY                   0x0
#define IQUERY                  0x1
#define STATUS                  0x2
#define UPDATEA                 0x9
#define UPDATED                 0xa
#define UPDATEM                 0xc
#define UPDATEMA                0xd
#define ZONEINIT                0xe
#define ZONEREF                 0xf
#define MAXDNAME                256
```

Figure 6-54 Manifest Constants and Data Types from <resolv.h>

```
#define RES_INIT              0x0001
#define RES_DEBUG             0x0002
#define RES_AAONLY            0x0004
#define RES_USEVC             0x0008
#define RES_IGNTC             0x0020
#define RES_RECURSE           0x0040
#define RES_DEFNAMES          0x0080
#define RES_STAYOPEN          0x0100
#define RES_DNSRCH            0x0200
#define MAXNS                      3

struct state {
       int                        retrans;
       int                        retry;
       long                       options;
       int                        nscount;
       struct sockaddr_in         nsaddr_list[MAXNS];
#define nsaddr                    nsaddr_list[0]
       u_short                    id;
       char                       defdname[MAXDNAME];
       char                       *dnsrch[MAXDNSRCH+1];
       int                        ascount;
       struct       in_addr       sort_list[MAXADDR];
};
extern struct state               _res;
```

librpcsvc - Remote Procedure Call Services Library - EXPERIMENTAL

Overview

The interfaces specified in this section provide applications with remote procedure call services. The interface set described here resides entirely in the EXPERIMENTAL dynamic library: */usr/lib/librpcsvc.so.1*. Interface members of this library, listed in the table below, are EXPERIMENTAL unless explicitly noted otherwise.

SCD Extensions to the System V ABI

The SCD requires a new library: */usr/lib/librpcsvc.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional functions are not available in the SCD 2.4 Interface Semantics document.

Library Contents

Table 6-23 librpcsvc contents

rnusers	2.4 E	xdr_sprayarr	2.4 E	2.4 – Interfaces added in SCD2.4.
rusers	2.4 E	xdr_spraycumul	2.4 E	E – EXPERIMENTAL interfaces
rwall	2.4 E			

libsocket - Socket Library[1]

Overview

The interfaces specified in this section provide applications with socket inter-networking interfaces, primarily used with the TCP/IP protocol suite.

The interface set described here resides entirely in the REQUIRED dynamic library: */usr/lib/libsocket.so.1*. Interface members of this library, listed in the table below, are REQUIRED unless explicitly noted otherwise.

ABI Extensions to the System V ABI

The SCD specifies a new library: */usr/lib/libsocket.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available in the SCD Interface Semantics document. Structures and manifest constants pertaining to these functions are as specified further below.

Library Contents

Table 6-24 Socket Functions in libsocket

accept		getprotobynumber		recv	
bind		getprotoent		recvfrom	
connect		getservbyname		recvmsg	
endnetent	E 2.4	getservbyport		rexec	E 2.4
endprotoent	E 2.4	getservent	2.4	rresvport	E 2.4
endservent	E 2.4	getsockname		ruserok	E 2.4
ether_aton	E 2.4	getsockopt		send	
ether_hostton	E 2.4	htonl	E 2.4	sendmsg	
ether_line	2.4	htons	2.4	sendto	
ether_ntoa	E 2.4	inet_lnaof		setnetent	E
ether_ntohost	2.4	inet_makeaddr		setprotoent	E 2.4
getnetbyaddr	E 2.4	inet_network		setservent	E 2.4
getnetbyname	2.4	listen		setsockopt	
getnetent	2.4	ntohl	E 2.4	shutdown	
getpeername		ntohs	2.4	socket	
getprotobyname		rcmd	E 2.4	socketpair	2.4

2.4 – Interfaces added or changed in SCD2.4.

E– EXPERIMENTAL interfaces

Structures and Manifest Constants

The Figures below contain the values of manifest constants and type declarations of the data types needed for the socket functions.

1. Earlier this interface set was DEPRECATED (November 1st, 1993 for possible removal in Nov 1996) in favor of the transport independent interfaces offered as part of the System V standard. However the sockets interface has subsequently been seen to have widespread use in applications and is now considered to be of equal importance and validity as an application interface set. This interface was therefore restored to the REQUIRED state in SCD2.4 in December 1997.

Figure 6-55 Manifest Constants and Data Types from <errno.h>

```
#define NOBUFS              132
#define ENOPROTOOPT         99
#define EADDRINUSE          125             /* Address already in use */
#define EADDRNOTAVAIL       126             /* Can't assign requested address */
#define EAFNOSUPPORT        124             /* Address family not supported by
#define EALREADY            149             /* operation already in progress */
#define ECONNREFUSED        146             /* Connection refused */
#define EINPROGRESS         150             /* operation now in progress */
#define EISCONN             133             /* Socket is already connected */
#define EMSGSIZE            97              /* Message too long */
#define ENETUNREACH         128             /* Network is unreachable */
#define ENOTCONN            134             /* Socket is not connected */
#define ENOTSOCK            95              /* Socket operation on non-socket */
#define EOPNOTSUPP          122             /* Operation not supported on socket */
#define EPROTONOSUPPORT     120             /* Protocol not supported */
#define EPROTOTYPE          98              /* Protocol wrong type for socket */
#define ETIMEDOUT           145             /* Connection timed out */
#define EWOULDBLOCK         EAGAIN
```

Figure 6-56 Manifest Constants and Data Types from <netdb.h>

```
struct netent {
       char             *n_name;
       char             **n_aliases;
       int              n_addrtype;
       unsigned long    n_net;};
struct hostent {
        char            *h_name;            /* official name of host */
        char            **h_aliases;        /* alias list */
        int             h_addrtype;         /* host address type */
        int             h_length;           /* length of address */
        char            **h_addr_list;      /* list of addresses from name server */
#define h_addr          h_addr_list[0]      /* address, for backward compatibility */
};
struct servent {
       char          *s_name;
       char          **s_aliases;
       int           s_port;
       char          *s_proto;
};
struct protoent {
       char          *p_name;
       char          **p_aliases;
       int           p_proto;
};
#define HOST_NOT_FOUND     1         /* Authoritative Answer Host not found */
#define TRY_AGAIN          2         /* Non-Auth. Host not found, or SERVERFAIL */
#define NO_RECOVERY        3         /* Non recover errors:FORMERR,REFUSED,NOTIMP */
#define NO_DATA            4         /* Valid name, no data rec. of requested type */
#define NO_ADDRESS         NO_DATA   /* no address, look for MX record */
```

Figure 6-57 Manifest Constants and Data Types from <netinet/if_ether.h>

```
struct ether_addr {
       u_char       ether_addr_octet[6];
};
```

Figure 6-58 Manifest Constants and Data Types from <netinet/in.h>

```
/* IP address */
struct in_addr {
       union {
        struct { u_char s_b1, s_b2, s_b3, s_b4;} S_un_b;
        struct { u_short s_w1, s_w2;} S_un_w;
        u_long S_addr;
       } S_un;
};

/* socket address using IP */
struct sockaddr_in {
       short               sin_family;
       u_short             sin_port;
       struct in_addr      sin_addr;
       char                sin_zero[8];
};

/* Options for use with [gs]etsockopt at the IP level. */
#define IP_OPTIONS         1       /* set/get IP per-packet options   */
#define IP_HDRINCL         2       /* int; header is included with data (raw) */
#define IP_TOS             3       /* int; IP type of service and precedence */
#define IP_TTL             4       /* int; IP time to live */
#define IP_RECVOPTS        5       /* bool; receive all IP options w/datagram */
#define IP_RECVRETOPTS     6       /* bool; receive IP options for response */
#define IP_RECVDSTADDR     7       /* bool; receive IP dst addr w/datagram */
#define IP_RETOPTS         8       /* ip_opts; set/get IP per-packet options */
#define IP_MULTICAST_IF         0x10    /* set/get IP multicast interface */
#define IP_MULTICAST_TTL        0x11    /* set/get IP multicast timetolive */
#define IP_MULTICAST_LOOP       0x12    /* set/get IP multicast loopback   */
#define IP_ADD_MEMBERSHIP       0x13    /* add an IP group membership     */
#define IP_DROP_MEMBERSHIP      0x14    /* drop an IP group membership     */
#define IP_DEFAULT_MULTICAST_TTL 1     /* normally limit m'casts to 1 hop */
#define IP_DEFAULT_MULTICAST_LOOP 1     /* normally hear sends if a member */

/* Argument structure for IP_ADD_MEMBERSHIP and IP_DROP_MEMBERSHIP. */
struct ip_mreq {
       struct in_addr imr_multiaddr;
       struct in_addr imr_interface;
};
```

Figure 6-59 Manifest Constants and Data Types from <rpcsvc/nis.h>

```
#define NIS_MAXSTRINGLEN         255
#define NIS_MAXNAMELEN           1024
#define NIS_MAXATTRNAME          32
#define NIS_MAXATTRVAL           2048
#define NIS_MAXCOLUMNS           64
#define NIS_MAXATTR              16
#define NIS_MAXPATH              1024
#define NIS_MAXREPLICAS          128
#define NIS_MAXLINKS             16
#define NIS_PK_NONE              0
#define NIS_PK_DH                1
#define NIS_PK_RSA               2
#define NIS_PK_KERB              3
#define EN_BINARY                1
#define EN_CRYPT                 2
#define EN_XDR                   4
#define EN_MODIFIED              8
#define EN_ASN1                  64
#define TA_BINARY                1
#define TA_CRYPT                 2
#define TA_XDR                   4
#define TA_SEARCHABLE            8
#define TA_CASE                  16
#define TA_MODIFIED              32
#define TA_ASN1                  64

struct nis_attr {
       char          *zattr_ndx;
       struct {
                     u_int zattr_val_len;
                     char *zattr_val_val;
       } zattr_val;
};
typedef struct nis_attr          nis_attr;
typedef char                     *nis_name;
enum zotypes {
       BOGUS_OBJ = 0,         NO_OBJ = 1,
       DIRECTORY_OBJ = 2,     GROUP_OBJ = 3,
       TABLE_OBJ = 4,         ENTRY_OBJ = 5,
       LINK_OBJ = 6,          PRIVATE_OBJ = 7
};
typedef enum zotypes zotypes;
enum nstype {
       UNKNOWN = 0,           NIS = 1,
       SUNYP = 2,             IVY = 3,
       DNS = 4,               X500 = 5,
       DNANS = 6,             XCHS = 7,
       CDS = 8
};
typedef enum nstype nstype;
struct oar_mask {
       u_long       oa_rights;
       zotypes      oa_otype;
};
typedef struct oar_mask oar_mask;
struct endpoint {
       char         *uaddr;
```

```
        char          *family;
        char          *proto;
};
typedef struct endpoint endpoint;
struct nis_server {
        nis_name      name;
        struct {
         u_int         ep_len;
         endpoint     *ep_val;
        } ep;
        u_long        key_type;
        netobj        pkey;
};
typedef struct nis_server nis_server;
struct directory_obj {
        nis_name      do_name;
        nstype        do_type;
        struct {
         u_int        do_servers_len;
         nis_server   *do_servers_val;
        } do_servers;
        u_long        do_ttl;
        struct {
         u_int        do_armask_len;
         oar_mask     *do_armask_val;
        } do_armask;
};
typedef struct directory_obj directory_obj;
struct entry_col {
        u_long        ec_flags;
        struct {
         u_int        ec_value_len;
         char         *ec_value_val;
        } ec_value;
};
typedef struct entry_col entry_col;
struct entry_obj {
        char          *en_type;
        struct {
         u_int        en_cols_len;
         entry_col    *en_cols_val;
        } en_cols;
};
    typedef struct entry_obj entry_obj;
struct group_obj {
        u_long        gr_flags;
        struct {
         u_int        gr_members_len;
         nis_name     *gr_members_val;
        } gr_members;
};
typedef struct group_obj group_obj;
struct link_obj {
        zotypes       li_rtype;
        struct {
         u_int        li_attrs_len;
         nis_attr     *li_attrs_val;
        } li_attrs;
        nis_name      li_name;
};
typedef struct link_obj link_obj;
struct table_col {
        char          *tc_name;
        u_long        tc_flags;
        u_long        tc_rights;
};
typedef struct table_col table_col;
```

```
struct table_obj {
       char          *ta_type;
       int           ta_maxcol;
       u_char        ta_sep;
       struct {
        u_int        ta_cols_len;
        table_col    *ta_cols_val;
       } ta_cols;
       char          *ta_path;
};
typedef struct table_obj table_obj;
struct objdata {
       zotypes                zo_type;
       union {
        struct directory_obj  di_data;
        struct group_obj      gr_data;
        struct table_obj      ta_data;
        struct entry_obj      en_data;
        struct link_obj       li_data;
        struct {
             u_int            po_data_len;
             char             *po_data_val;
       } po_data;
       } objdata_u;
};
typedef struct objdata objdata;
struct nis_oid {
       u_long        ctime;
       u_long        mtime;
};
typedef struct nis_oid nis_oid;
struct nis_object {
       nis_oid       zo_oid;
       nis_name      zo_name;
       nis_name      zo_owner;
       nis_name      zo_group;
       nis_name      zo_domain;
       u_long        zo_access;
       u_long        zo_ttl;
       objdata       zo_data;
};
typedef struct nis_object nis_object;
enum nis_error {
       NIS_SUCCESS = 0,       NIS_S_SUCCESS = 1,      NIS_NOTFOUND = 2,
       NIS_S_NOTFOUND = 3,    NIS_CACHEEXPIRED = 4,   NIS_NAMEUNREACHABLE = 5,
       NIS_UNKNOWNOBJ = 6,    NIS_TRYAGAIN = 7,       NIS_SYSTEMERROR = 8,
       NIS_CHAINBROKEN = 9,   NIS_PERMISSION = 10,    NIS_NOTOWNER = 11,
       NIS_NOT_ME = 12,       NIS_NOMEMORY = 13,      NIS_NAMEEXISTS = 14,
       NIS_NOTMASTER = 15,    NIS_INVALIDOBJ = 16,    NIS_BADNAME = 17,
       NIS_NOCALLBACK = 18,   NIS_CBRESULTS = 19,     NIS_NOSUCHNAME = 20,
       NIS_NOTUNIQUE = 21,    NIS_IBMODERROR = 22,    NIS_NOSUCHTABLE = 23,
       NIS_TYPEMISMATCH = 24, NIS_LINKNAMEERROR = 25, NIS_PARTIAL = 26,
       NIS_TOOMANYATTRS = 27, NIS_RPCERROR = 28,      NIS_BADATTRIBUTE = 29,
       NIS_NOTSEARCHABLE = 30,NIS_CBERROR = 31,       NIS_FOREIGNNS = 32,
       NIS_BADOBJECT = 33,    NIS_NOTSAMEOBJ = 34,    NIS_MODFAIL = 35,
       NIS_BADREQUEST = 36,   NIS_NOTEMPTY = 37,      NIS_COLDSTART_ERR = 38,
       NIS_RESYNC = 39,       NIS_FAIL = 40,          NIS_UNAVAIL = 41,
       NIS_RES2BIG = 42,      NIS_SRVAUTH = 43,       NIS_CLNTAUTH = 44,
       NIS_NOFILESPACE = 45,  NIS_NOPROC = 46,        NIS_DUMPLATER = 47
};
typedef enum nis_error nis_error;
struct nis_result {
       nis_error     status;
```

```
        struct {
         u_int        objects_len;
         nis_object   *objects_val;
        } objects;
        netobj        cookie;
        u_long        zticks;
        u_long        dticks;
        u_long        aticks;
        u_long        cticks;
};
typedef struct nis_result nis_result;
#define FOLLOW_LINKS       (1<<0)
#define FOLLOW_PATH        (1<<1)
#define HARD_LOOKUP        (1<<2)
#define ALL_RESULTS        (1<<3)
#define NO_CACHE           (1<<4)
#define MASTER_ONLY        (1<<5)
#define EXPAND_NAME        (1<<6)
```

Figure 6-60 Manifest Constants and Data Types from <sys/socket.h>

```
/* Types */
#define SOL_SOCKET     0xffff
#define SOCK_STREAM    2               /* stream socket */
#define SOCK_DGRAM     1               /* datagram socket */
#define SOCK_RAW       4               /* raw-protocol interface */
#define SOCK_RDM       5               /* reliably-delivered message */
#define SOCK_SEQPACKET 6               /* sequenced packet stream */

/* Option flags per-socket. */
#define SO_DEBUG           0x0001          /* turn on debugging info recording */
#define SO_ACCEPTCONN      0x0002          /* socket has had listen() */
#define SO_REUSEADDR       0x0004          /* allow local address reuse */
#define SO_KEEPALIVE       0x0008          /* keep connections alive */
#define SO_DONTROUTE       0x0010          /* just use interface addresses */
#define SO_BROADCAST       0x0020          /* permit sending of broadcast msgs */
#define SO_USELOOPBACK     0x0040          /* bypass hardware when possible */
#define SO_LINGER          0x0080          /* linger on close if data present */
#define SO_OOBINLINE       0x0100          /* leave received OOB data in line */

/* Additional options, not kept in so_options. */
#define SO_SNDBUF          0x1001          /* send buffer size */
#define SO_RCVBUF          0x1002          /* receive buffer size */
#define SO_SNDLOWAT        0x1003          /* send low-water mark */
#define SO_RCVLOWAT        0x1004          /* receive low-water mark */
#define SO_SNDTIMEO        0x1005          /* send timeout */
#define SO_RCVTIMEO        0x1006          /* receive timeout */
#define SO_ERROR           0x1007          /* get error status and clear */
#define SO_TYPE            0x1008          /* get socket type */
#define SO_PROTOTYPE       0x1009          /* get/set protocol type */

/* Structure used for manipulating linger option. */
struct linger {
        int     l_onoff;
        int     l_linger;
```

```
};

/* Level number for (get/set) sockopt() to apply to socket itself. */
#define SOL_SOCKET      0xffff          /* options for socket level */

/* Address families. */
#define AF_UNSPEC          0               /* unspecified */
#define AF_UNIX            1               /* local to host (pipes, portals) */
#define AF_INET            2               /* internetwork: UDP, TCP, etc. */
#define AF_IMPLINK         3               /* arpanet imp addresses */
#define AF_PUP             4               /* pup protocols: e.g. BSP */
#define AF_CHAOS           5               /* mit CHAOS protocols */
#define AF_NS              6               /* XEROX NS protocols */
#define AF_NBS             7               /* nbs protocols */
#define AF_ECMA            8               /* european computer manufacturers */
#define AF_DATAKIT         9               /* datakit protocols */
#define AF_CCITT           10              /* CCITT protocols, X.25 etc */
#define AF_SNA             11              /* IBM SNA */
#define AF_DECnet          12              /* DECnet */
#define AF_DLI             13              /* Direct data link interface */
#define AF_LAT             14              /* LAT */
#define AF_HYLINK          15              /* NSC Hyperchannel */
#define AF_APPLETALK       16              /* Apple Talk */
#define AF_NIT             17              /* Network Interface Tap */
#define AF_802             18              /* IEEE 802.2, also ISO 8802 */
#define AF_OSI             19              /* umbrella for all families used */
#define AF_X25             20              /* CCITT X.25 in particular */
#define AF_OSINET          21              /* AFI = 47, IDI = 4 */
#define AF_GOSIP           22              /* U.S. Government OSI */
#define AF_MAX             22

/* Structure used by kernel to store most addresses. */
struct sockaddr {
       u_short      sa_family;
       char         sa_data[14];
};
/* Structure used by kernel to pass protocol * information in raw sockets. */
struct sockproto {
       u_short      sp_family;
       u_short      sp_protocol;
};

/* Protocol families, same as address families for now. */
#define PF_UNSPEC          AF_UNSPEC
#define PF_UNIX            AF_UNIX
#define PF_INET            AF_INET
#define PF_IMPLINK         AF_IMPLINK
#define PF_PUP             AF_PUP
#define PF_CHAOS           AF_CHAOS
#define PF_NS              AF_NS
#define PF_NBS             AF_NBS
#define PF_ECMA            AF_ECMA
#define PF_DATAKIT         AF_DATAKIT
#define PF_CCITT           AF_CCITT
#define PF_SNA             AF_SNA
#define PF_DECnet          AF_DECnet
```

```
#define PF_DLI              AF_DLI
#define PF_LAT              AF_LAT
#define PF_HYLINK           AF_HYLINK
#define PF_APPLETALK        AF_APPLETALK
#define PF_NIT              AF_NIT
#define PF_802              AF_802
#define PF_OSI              AF_OSI
#define PF_X25              AF_X25
#define PF_OSINET           AF_OSINET
#define PF_GOSIP            AF_GOSIP
#define PF_MAX              AF_MAX

/* Maximum queue length specifiable by listen. */
#define SOMAXCONN    5

/* Message header for recvmsg and sendmsg calls. */
struct msghdr {
        caddr_t         msg_name;               /* optional address */
        int             msg_namelen;            /* size of address */
        struct iovec    *msg_iov;               /* scatter/gather array */
        int             msg_iovlen;             /* # elements in msg_iov */
        caddr_t         msg_accrights;          /* access rights sent/received */
        int             msg_accrightslen;
};

#define MSG_OOB         0x1             /* process out-of-band data */
#define MSG_PEEK        0x2             /* peek at incoming message */
#define MSG_DONTROUTE   0x4             /* send without using routing tables */
#define MSG_MAXIOVLEN   16

/* option header */
struct opthdr {
        long    level;
        long    name;
        long    len;
};

#define OPTLEN(x)   ((((x) + sizeof (long) - 1) / sizeof (long)) * sizeof (long))
#define OPTVAL(opt) ((char *)(opt + 1))

/* the optdefault structure is used for internal tables of option default values. */
struct optdefault {
        int             optname;
        char            *val;
        int             len;
};
/* the opproc structure is used to build tables of options processing functions for
dooptions(). */
struct opproc {
        int             level;
        int             (*func)();
};

/* This structure is used to encode pseudo system calls */
struct socksysreq {int      args[7];};
/* This structure is used for adding new protocols to the list supported by sockets. */
struct socknewproto {
        int     family;         /* address family (AF_INET, etc.) */
        int     type;           /* protocol type (SOCK_STREAM, etc.) */
```

```
        int     proto;          /* per family proto number */
        dev_t   dev;            /* major/minor to use (must be a clone) */
        int     flags;          /* protosw flags */
};
```

libthread - Multithreading Library-DEPRECATED

Overview

The interfaces specified in this section provide applications with the ability to create multiple "threads of control" within their address spaces.

The interface set described here resides entirely in the ~~REQUIRED~~ dynamic library: */usr/lib/libthread.so.1*. Interface members of this library, listed in the table below, are ~~REQUIRED~~ unless explicitly noted otherwise.

SCD Extensions to the System V ABI

The SCD requires a new library: */usr/lib/libthread.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available in the SCD Interface Semantics document. Structures and manifest constants pertaining to these functions are as specified further below.

Besides the multithreading interface set specified in this section, systems must also provide enhancements to the system services provided by libc. These enhancements are, for the most part, transparent to the application. However, in a few cases, these enhancements manifest themselves as new entry points in libc. This is necessary as the manner in which the interface was previously defined was non reentrant, and made it impossible to express a multithread-safe implementation. For the most part, these new reentrant routines have the name of the old routine with the string "_r" appended. All of these entry points are part of libc. Those whose "root names" are also present in libc also reside there. All, with the exception of ___*errno*, have synonyms. See the previous section "C Library" for additional information.

For an application to use libthread correctly, it must specify a reference to libthread in a **DT_NEEDED** entry prior to a **DT_NEEDED** entry which specifies libc. libthread redefines the semantics of a number of entry points normally provided by libc, primarily to support the correct management of signals in a multithreaded program.

Library Contents

Table 6-25 libthread contents

cond_broadcast		sema_post	thr_setconcurrency
cond_destroy		sema_trywait	thr_setprio
cond_init		sema_wait	thr_setspecific
cond_signal		setcontext	thr_sigsetmask
cond_timedwait		sigaction	thr_suspend
cond_wait		siglongjmp 2.4	thr_yield
creat64	L(E), 2.4	sigprocmask	
fork1		sigsetjmp 2.4	L – 32-bit ABI Large file support routine.
mutex_destroy		sigsuspend 2.4	
mutex_init		sigwait	E – EXPERIMENTAL interfaces.
mutex_lock		sleep	
mutex_trylock		thr_continue	2.4 – Interfaces added in SCD2.4
mutex_unlock		thr_create	
open64	L(E), 2.4	thr_exit	
rw_rdlock		thr_getconcurrency	
rw_tryrdlock		thr_getprio	
rw_trywrlock		thr_getspecific	
rw_unlock		thr_join	
rw_wrlock		thr_keycreate	
rwlock_destroy		thr_kill	
rwlock_init		thr_main	
sema_destroy		thr_min_stack	
sema_init		thr_self	

Structures and Manifest Constants

Figure 6-61 Manifest Constants and Data Types from <errno.h>

```
/* When _REENTRANT is defined, a multithreaded application is being constructed. */
#ifdef _REENTRANT
#define errno (*___errno())
#else
extern int errno;
#endif
```

Figure 6-62 Manifest Constants and Data Types from <synch.h>

```
#define USYNC_THREAD       0               /* private to a process */
#define USYNC_PROCESS      1               /* shared by processes */
typedef struct {/* unspecified, but sizeof(mutext_t) is 24. */} mutex_t;
typedef struct {/* unspecified, but sizeof(cond_t) is 16. */} cond_t;
typedef struct {/* unspecified, but sizeof(sema_t) is 48. */} sema_t;
typedef struct {/* unspecified, but sizeof(rwlock_t) is 64. */} rwlock_t;
```

Figure 6-63 Manifest Constants and Data Types from <thread.h>

```
typedef unsigned int thread_t;
typedef unsigned int thread_key_t;
#define THR_BOUND               0x00000001
#define THR_NEW_LWP             0x00000002
#define THR_DETACHED            0x00000040
#define THR_SUSPENDED           0x00000080
#define THR_DAEMON              0x00000100
```

libucb - University of California at Berkeley Compatibility Library

Overview

The interfaces specified in this section provide applications with compatibility to interfaces initially developed at the University of California at Berkeley.

The interface set described here resides entirely in the REQUIRED dynamic library: */usr/lib/libucb.so.1*. Interface members of this library, listed in the table below, are REQUIRED unless explicitly noted otherwise.

Note: new applications should not be using this library.

SCD Extension to the System V ABI

The SCD requires a new library: */usr/lib/libucb.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available either in the *SCD Interface Semantics* document or XPG4.2 (as noted below).

Library Contents

Table 6-26 libucb contents

_longjmp	E	getwd	E	scandir64	2.4,L,E	sprintf	E
_setjmp	E	index	E	sethostname	E	srand	E
alphasort	E	initstate	E	setjmp	E	srandom	E
alphasort64	2.4,L,E	killpg	E	setlinebuf	E	times	E
bcmp		longjmp	E	setpriority	E	ualarm	E
bcopy	E	mctl	E	setregid	E	usleep	E
bzero	E	nice	E	setreuid	E	vsprintf	E
fopen	E	psignal	E	setstate		wait3	E
freopen	E	rand	E	settimeofday			
ftime		random		sigblock	E	L - 32-bit ABI Large file support routine.	
getdtablesize	E	re_comp		siginterrupt			
gethostid		re_exec		signal	E	E - EXPERIMENTAL interface.	
gethostname	E	readdir64	2.4,L,E	sigpause	E		
getpagesize		reboot	E	sigsetmask	E	2.4 - Interfaces added in SCD2.4	
getpriority	E	rindex	E	sigstack			
getrusage		scandir	E	sigvec	E		
gettimeofday	E	setbuffer	E	sleep	E		

libw - Wide Character Support Library

Overview

The interfaces specified in this section provide application support for wide (2-byte) characters.

The interface set described here resides entirely in the REQUIRED dynamic library: */usr/lib/libw.so.1*. Interface members of this library, listed in the table below, are REQUIRED unless explicitly noted otherwise.

SCD Extensions to the System V ABI

The SCD requires a new library: */usr/lib/libw.so.1*, which has functions not specified by the gABI. These functions are not defined in the SVID. The semantics for these additional function definitions are available in the SCD Interface Semantics document. Structures and manifest constants pertaining to these functions are as specified further below.

Library Contents

Table 6-27 libw contents

fgetwc	(1) 2.4	iswgraph	(1) 2.4	wscol	2.4 (E)	wstod	2.4 (E)
fgetws	(1) 2.4	iswlower	(1) 2.4	wscoll	2.4 (E)	wstok	2.4 (E)
fputwc	(1) 2.4	iswprint	(1) 2.4	wscpy	2.4 (E)	wstol	2.4 (E)
fputws	(1) 2.4	iswpunct	(1) 2.4	wscspn	2.4 (E)	wsxfrm	2.4 (E)
getwidth	2.4 (E)	iswspace	(1) 2.4	wsdup	2.4 (E)		
getws	2.4 (E)	iswupper	(1) 2.4	wslen	2.4 (E)	1 – Defined in XPG4.2	
isenglish	2.4 (E)	iswxdigit	(1) 2.4	wsncasecmp	2.4 (E)		
isideogram	2.4 (E)	putws	2.4 (E)	wsncat	2.4 (E)	2.4 – New interfaces added or changed in SCD2.4.	
isnumber	2.4 (E)	towlower	(1) 2.4	wsncmp	2.4 (E)		
isphonogram	2.4 (E)	towupper	(1) 2.4	wsncpy	2.4 (E)		
isspecial	2.4 (E)	ungetwc	(1) 2.4	wspbrk	2.4 (E)	E – EXPERIMENTAL Interface	
iswalnum	(1) 2.4	wscasecmp	2.4 (E)	wsprintf	2.4 (E)		
iswalpha	(1) 2.4	wscat	2.4 (E)	wsrchr	2.4 (E)		
iswcntrl	(1) 2.4	wschr	2.4 (E)	wsscanf	2.4 (E)		
iswdigit	(1) 2.4	wscmp	2.4 (E)	wsspn	2.4 (E)		

Structures and Manifest Constants

Figure 6-64 Manifest Constants and Data Types from <sys/euc.h>

```
typedef struct {
       short int _eucw1, _eucw2, _eucw3;
       short int _scrw1, _scrw2, _scrw3;
       short int _pcw;
       char _multibyte;
} eucwidth_t;
```

Figure 6-65 Manifest Constants and Data Types from <wchar.h>

```
typedef long wchar_t;
```

Figure 6-66 Manifest Constants and Data Types from <wctype.h>

```
typedef long wint_t;
```

Libraries (64-bit gABI) - ~~EXPERIMENTAL~~

Overview

In addition to the common (32-bit ABI and 64-bit ABI) changes noted previously in this chapter, this section specifies additional generic changes for the 64-bit ABI. The 64-bit ABI interfaces are EXPERIMENTAL.

Miscellaneous Libraries Changes (64-bit gABI):

#	Facility	Location	Description

1	Network Services Library	gABI	add to figure 6-11, page 6-12 the following functions:
			`xdr_hyper`
			`xdr_u_hyper`
			`xdr_int32`
			`xdr_u_int32`
			`xdr_long_double`

2	Global Data Symbols	gABI	change in page 6-7 the type of _numeric[2] from “unsigned char” to “wchar_t”
3	Vendor Extensions	gABI	Replace the last paragraph on page 6-8 (the one beginning “A symbol of the form” and ending “to the system library.”) with the following: Symbols with the prefix **_$vendor.***company* provide operating system entries for the vendor named *company*. The system library does not have unadorned alternatives for these names. As an example, the “XYZ Computer Company” might use the prefix **_$vendor.xyz**.

Libraries (64-bit psABI) - ~~EXPERIMENTAL~~

Overview

A In addition to the common (32-bit ABI and 64-bit ABI) changes noted previously in this chapter, this section specifies additional SPARC processor-specific changes for the 64-bit ABI. ~~The 64-bit ABI interfaces are EXPERIMENTAL.~~

Table 31: Library Logical and Reference Names

Library	Reference Name
(runtime linker)	**/usr/lib/sparcv9/ld.so.1**
libaio	**/usr/lib/sparcv9/libaio.so.1**
libc	**/usr/lib/sparcv9/libc.so.1**
libdl	**/usr/lib/sparcv9/libdl.so.1**
libelf	**/usr/lib/sparcv9/libelf.so.1**
libm	**/usr/lib/sparcv9/libm.so.1**
libnsl	**/usr/lib/sparcv9/libnsl.so.1**
libposix4	**/usr/lib/sparcv9/libposix4.so.1**
libpthread	**/usr/lib/sparcv9/libpthread.so.1**
libresolv	**/usr/lib/sparcv9/libresolv.so.1**
libsocket	**/usr/lib/sparcv9/libsocket.so.1**
libthread	**/usr/lib/sparcv9/libthread.so.1**
libw	**/usr/lib/sparcv9/libw.so.1**

Libc - C library

The Semantics for these additional function definitions are available in the SCD Interface Semantics document.

Table 6-32 libc SPARC Support Routines (64-bit ABI)

__align_cpy_1		_Qp_div	_Qp_sqrt
__align_cpy_2		_Qp_dtoq	_Qp_stoq
__align_cpy_4		_Qp_feq	_Qp_sub
__align_cpy_8		_Qp_fge	_Qp_uitoq
__align_cpy_16		_Qp_fgt	_Qp_uxtoq
__dtou	1	_Qp_fne	_Qp_xtoq
__dtoul		_Qp_flt	
__dtoll	2	_Qp_fbe	
__dtoull	2	_Qp_itoq	
__ftoul		_Qp_mul	
__ftoll	2	_Qp_neg	
__ftou	1	_Qp_qtod	
__ftoull	2	_Qp_qtoi	
__sparc_utrap_install		_Qp_qtos	
_Qp_add		_Qp_qtoui	
_Qp_cmp		_Qp_qtoux	
_Qp_cmpe		_Qp_qtox	

1 - See C Library Changes section at the beginning of this chapter.

2 - Long long intrinsics support routines - routines supporting operations on a 64-bit integer ("long long") for both signed and unsigned quantities.
Calling sequence for 64-bit integer arguments and return value is described in Low-Level System Information Changes in Chapter 3.

Library Contents

Each library interface listed in this chapter for the 32-bit ABI is also supported in the 64-bit ABI with the following exceptions:

1) The large files support (transitional) interfaces provided in the 32-bit ABI (i.e. those file-accessing interfaces whose standard names have been qualified with a "64" suffix) are not present in the 64-bit ABI. The interfaces with unqualified names in the 64-bit ABI all operate on large files directly, since large files constitute the native files interface in the 64-bit ABI.

2) All _Q_* functions. These 32-bit libc entry points have 64-bit specfic counterparts under a different name in the 64-bit libc.

3) __dtoll, __ftoll, __mul64, __umul64, __div64, __udiv64, __rem64, __urem64: The above 32-bit libc entry points are mapped to either a hardware instruction or a very short sequence of hardware instructions in 64-bit mode.

System Data Interfaces

Vendor Extensions

An ABI-conforming system vendor may add additional symbolic constants (represented in this chapter as ANSI C #define macros) to facilitate the use of vendor-specific services. The ABI does not define these symbolic constants or their values, and programs using them are not ABI-conforming. Nonetheless, the ABI defines an extension mechanism, providing a way to avoid conflict among the services from multiple vendors. This extension mechanism is as follows:

- Non-negative symbolic constant values are reserved to SPARC International.

- Negative symbolic constant values are reserved to vendors. Bits 30 through 15 of each symbolic constant value must contain the binary representation of the vendor's Vendor Identification Number obtained from SPARC International.

It is expected that vendors will use this extension mechanism to add, for example, new vendor-specific _SC_symbolic constants to ***<unistd.h>***.

Structures and Manifest Constants

The following figures represent all library-related structures and manifest constants for the 64-bit ABI:

Figure 6-6: <errno.h>

```
#define ENAMETOOLONG      78
#define EOVERFLOW         79
#define ENOTUNIQ          80
#define EBADFD            81
#define EREMCHG           82
#define ENOSYS            89
#define ELOOP             90
#define ERESTART          91
#define ESTRPIPE          92
#define ENOTEMPTY         93
#define EUSERS            94
#define ESTALE            151
extern int errno;
```

Figure 6-7: <fcntl.h>

```
typedef struct flock{
             short        l_type;
             short        l_whence;
             off_t        l_start;
             off_t        l_len;
             int          l_sysid;
             pid_t        l_pid;
             long         l_pad[4];
} flock_t;
```

Figure 6-9: <sys/aio.h>

```
typedef struct aio_result_t {
        ssize_t          aio_return;
        int              aio_errno;
        } aio_result_t;
```

Figure 6-12: <sys/ipc.h>

```
struct ipc_perm{
             uid_t        uid;
             gid_t        gid;
             uid_t        cuid;
             gid_t        cgid;
             mode_t       mode;
             uint_t       seq;
             key_t        key;
};
```

Figure 6-16: <math.h>

```
typedef union _h_val {
        unsigned int     i[2];
        unsigned long    l;
        double           d;
} _h_val
external const _h_val    __huge_val;
#define HUGE_VAL         __huge_val.d;
```

Figure 6-19: <sys/msg.h>

```
struct msqid_ds {
        struct ipc_perm  msg_perm;
        struct msg       *msg_first;
        struct msg       *msg_last;
        unsigned long    msg_ctypes;
        unsigned long    msg_qnum;
        unsigned long    msgqbytes;
        pid_t            msglspid;
        pid_t            msglrpid;
        time_t           msg_stime;
        time_t           msg_rtime;
        time_t           msg_ctime;
        long             msg_pad4[4];
};
```

Figure 6-20: <sys/netconfig.h>

```
struct netconfig {
        char             *nc_netid;
        unsigned int     nc_semantics;
        unsigned int     nc_flag;
        char             *nc_protofmly;
        char             *nc_proto;
        char             *nc_device;
        unsigned int     nc_nlookups;
        char             **nc_lookups;
        unsigned int     nc_unused[8];
};
```

Figure 6-21: <netdir.h>

```
struct nd_addrlist        {int n_cnt; struct netbuf *n_addrs;};
struct nd_hostservlist    {int h_cnt; struct nd_hostserv *h_hostservs;};
struct nd_hostserv        {char *h_host; char *h_serv;};
#define ND_BADARG         -2
#define ND_NOMEM          -1
#define ND_OK             0
#define ND_NOHOST         1
#define ND_NOSERV         2
#define ND_NOSYM          3
#define ND_OPEN           4
#define ND_ACCESS         5
#define ND_UKNWN          6
#define ND_NOCTRL         7
#define ND_FAILCTRL       8
#define ND_SYSTEM         9
#define ND_HOSTSERV       0
#define ND_HOSTSERVLIST   1
#define ND_ADDR           2
#define ND_ADDRLIST       3
#define HOST_SELF         "\\1"
#define HOST_ANY          "\\2"
#define HOST_BROADCAST    "\\3"
#define ND_SET_BROADCAST          1
#define ND_SET_RESERVEDPORT       2
#define ND_CHECK_RESERVEDPORT     3
#define ND_MERGEADDR              4
```

Figure 6-23: <sys/param.h>

```
#define CANBSIZ           256
#define NGROUPS_UMIN      0
#define MAXPATHLEN        1024
#define MAXSYMLINKS       20
#define MAXNAMELEN        256
#define NADDR             13
#define PIPE_MAX          5120
#define NBBY              8
#define NBPSCTR           512
```

Figure 6-27 <sys/resource.h>

```
typedef unsigned long rlim_t;
#define RLIM_INFINITY     (-3l)
#define RLIM_SAVED_MAX    (-2l)
#define RLIM_SAVED_CUR    (-1l)
```

Figure 6-28: <rpc/rpc.h>

```
union des_block {
     struct {
             uint_t high;
             uint_t low;
     } key;
     char    c[8];
};
struct opaque_auth {
         enum_t oa_flavor;
         caddr_t oa_base;
         uint_t oa_length;
};
typedef struct __auth {
         struct opaque_auth        ah_cred;
         struct opaque_auth        ah_verf;
         union des_block           ah_key;
         struct auth_ops {
             void (*ah_nextverf)();
             int  (*ah_marshal)();
             int  (*ah_validate)();
             int  (*ah_refresh)();
             void (*ah_destroy)();
         } *ah_ops;
         caddr_t ah_private;
} AUTH;
struct authsys_parms {
             uint_t       aup_time;
             caddr_t      aup_machname;
             uid_t        aup_uid;
             gid_t        aup_gid;
             uint_t       aup_len;
             gid_t        *aup_gids;
};
extern struct opaque_auth _null_auth;
#define AUTH_NONE         0
struct rpc_err {
         enum clnt_statre_status;
         union {
                 struct {
                             int RE_errno;
                             int RE_t_errno;
                 } RE_err;
                 enum auth_stat RE_why;
                 struct {     rpcvers_t low;
                             rpcvers_t high;
                 } RE_vers;
                 struct {     int s1;
                             int s2;
                 } RE_lb;
} ru;

typedef struct __client {
             AUTH         *cl_auth;
             struct clnt_ops {
                      enum clnt_stat   (*cl_call)();
                      void             (*cl_abort)();
                      void             (*cl_geterr)();
                      bool_t           (*cl_freeres)();
                      void             (*cl_destroy)();
                      bool_t           (*cl_control)();
                      int              (*cl_settimers)();
             } *cl_ops;
             caddr_t      cl_private;
             char         *cl_netid;
             char         *cl_tp;
} CLIENT;
typedef uint_t            rpcprog_t;
typedef uint_t            rpcvers_t;
typedef uint_t            rpcproc_t;
struct xp_ops {
             bool_t       (*xp_recv)();
             enum xprt_stat(*xp_stat)();
             bool_t       (*xp_getargs)();
             boot_t       (*xp_reply)();
             bool_t       (*xp_freeargs)();
             void         (*xp_destroy)();
             bool_t       (*xp_control)();
};
```

Figure 6-28: <rpc/rpc.h> (continued)

```
typedef struct __svcxprt {
            int                     xp_fd;
            ushort_t                xp_port;
            struct xp_ops           *xp_ops;
            int                     xp_addrlen;
            char                    *xp_tp;
            char                    *xp_netid;
            struct netbuf           xp_ltaddr;
            struct netbuf           xp_rtaddr;
            char                    xp_raddr[16];
            struct opaque_auth      xp_verf;
            caddr_t                 xp_p1;
            caddr_t                 xp_p2;
            caddr_t                 xp_p3;
            int                     xp_type;
} SVCXPRT;
struct svc_req {
            rpcprog_t               rq_prog;
            rpcvers_t               rq_vers;
            rpcproc_t               rq_proc;
            struct opaque_auth      rq_cred;
            caddr_t                 rq_clntcred;
            struct __svcxprt        *rq_xprt;
};
#define FD_SETSIZE                  65536
struct accepted_reply {
            struct opaque_auth      ar_verf;
            enum accept_stat        ar_stat;
            union {
                  struct {
                        rpcvers_t   low;
                        rpcvers_t   high;
                  } AR_versions;
                  struct {
                        caddr_t     where;
                        xdrproc_t   proc;
                  } AR_results;
            } ru;
};
struct rejected_reply {
            enum reject_stat        rj_stat;
            union {
                  struct {
                        rpcvers_t   low;
                        rpcvers_t   high;
                  } RJ_versions;
                  enum auth_stat    RJ_why;
            } ru;
};
struct call_body {
            rpcvers_t               cb_rpcvers;
            rpcprog_t               cb_prog;
            rpcvers_t               cb_vers;
            rpcproc_t               cb_proc;
            struct opaque_auth      cb_cred;
            struct opaque_auth      cb_verf;
};
struct rpc_msg {
            uint_t                                  rm_xid;
            enum msg_type                           rm_direction;
            union {
                     struct call_body               RM_cmb;
                     struct reply_body              RM_rmd;
            } ru;
};
struct rpcb {
            rpcprog_t   r_prog;
            rpcvers_t   r_vers;
            char        *r_netid;
            char        *r_addr;
            char        *r_owner;
};
struct authdes_fullname {
            char        *name;
            des_block   key;
            uint_t      window;
};
struct authdes_cred {
            enum        authdes_namekind        adc_namekind;
            struct      authdes_fullname        adc_fullname;
            uint_t                              adc_nickname;
};
```

Figure 6-28: <rpc/rpc.h> (continued)

```
typedef struct XDR {
             enum xdr_op               x_op;
             struct xdr_ops {
                          bool_t       (*x_getlong)(struct XDR *, long *);
                          bool_t       (*x_putlong)(struct XDR *, long *);
                          bool_t       (*x_getbytes)(struct XDR *, caddr_t, int);
                          bool_t       (*x_putbytes)(struct XDR *, caddr_t, int);
                          uint_t       (*x_getpostn)(struct XDR *);
                          bool_t       (*x_setpostn)(struct XDR *, uint_t);
                          int *        (*x_inline)(struct XDR *, int);
                          void         (*x_destroy)(struct XDR *);
                          bool_t       (*x_control)(struct XDR *, int, void *);
                          bool_t       (*x_getint32)(struct XDR *, int32_t *);
                          bool_t       (*x_putint32)(struct XDR *, int32_t *);
             } *x_ops;
             caddr_t      x_public;
             caddr_t      x_private;
             caddr_t      x_base;
             int          x_handy;
} XDR;

typedef bool_t            (*xdrproc_t)();
```

Figure 6-30: <sys/sem.h>

```
struct semid_ds {
         struct ipc_perm          sem_perm;
         struct sem               *sem_base;
         ushort_t                 sem_nsems;
         time_t                   sem_otime;
         time_t                   sem_ctime;
         int                      sem_binary;
         long                     sem_pad3[3];
};
```

Figure 6-31: <setjmp.h>

```
#define      _JBLEN       12
#define      _SIGJBLEN    19
typedef long              jmp_buf[_JBLEN];
typedef long              sigjmp_buf[_SIGJBLEN];
```

Figure 6-32: <sys/shm.h>

```
struct shmid_ds{
             struct ipc_perm          shm_perm;
             size_t                   shm_segsz;
             void                     *shm_amp;
             ushort_t                 shm_lkcnt;
             pid_t                    shm_lpid;
             pid_t                    shm_cpid;
             unsigned long            shm_nattch;
             ulong_t                  shm_cnattch;
             time_t                   shm_atime;
             time_t                   shm_dtime;
             time_t                   shm_ctime;
             char                     shm_pad4[4];
};
```

Figure 6-33: <signal.h>

```
#define SS_DISABLE        0x00000002
struct sigaltstack {
        void              *ss_sp;
        size_t            ss_size;
        int               ss_flags;
} stack_t;

struct sigstack {
        void              *ss_sp;
        int               ss_onstack;
};

typedef struct {
        unsigned int      sigbits[4]
} sigset_t;

struct sigaction {
        int               sa_flags;
        void              (*_handler)();
        sigset_t          sa_mask;
};
```

Figure 6-34: <sys/siginfo.h>

```
#define SI_MAXSZ          256
#define SI_PAD            ((SI_MAXSZ / sizeof (int)) - 4)
typedef struct_timespec {time_t _tv_sec; long _tv_nsec;} timespec_t;
union __sigval { /* should be defined */};

typedef struct {
            int           si_signo;
            int           si_code;
            int           si_errno;
            int           si_pad;
            union {
            int           __pad[SI_PAD];
            struct {
                          pid_t         __pid;
                          union {
                          struct {uid_t __uid; union __sigval __value;} __kill;
                          struct {clock_t__utime; int __status; clock_t__stime;} __cld;
                          } __pdata;
            } __proc;
                          struct {void *__addr; int __trapno; caddr_t__pc;    } __fault;
                          struct {int  __fd; long   __band;} __file;
                          struct {
                                        caddr_t       __faddr;
                                        timestruc_t __tstamp;
                                        short         __syscall;
                                        char          _nsysarg;
                                        char          __fault;
                                        long          __sysarg[8];
                                        int           __mstate[10];
                          } __prof;
            } __data;
} siginfo_t;
```

Figure 6-35: <sys/stat.h>

```
#define _ST_FSTYPSZ       16
struct       stat {
             dev_t        st_dev;
             ino_t        st_ino;
             mode_t       st_mode;
             nlink_t      st_nlink;
             uid_t        st_uid;
             gid_t        st_gid;
             dev_t        st_rdev;
             off_t        st_size;
             timestruc_t  st_atim;
             timestruc_t  st_mtim;
             timestruc_t  st_ctim;
             int          st_blksize;
             long         st_blocks;
             char         st_fstype[_ST_FSTYPSZ];
};
#define st_mtime          st_mtim.tv_sec
#define st_ctime          st_ctim.tv_sec
#define st_atime          st_atim.tv_sec
```

Figure 6-36: <sys/statvfs.h>

```
typedef struct statvfs {
             unsigned long            f_bsize;
             unsigned long            f_frsize;
             ulong_t                  f_blocks;
             ulong_t                  f_bfree;
             ulong_t                  f_bavail;
             ulong_t                  f_files;
             ulong_t                  f_ffree;
             ulong_t                  f_favail;
             unsigned long            f_fsid;
             char                     f_basetype[_FSTYPSZ];
             unsigned long            f_flag;
             unsigned long            f_namemax;
             char                     f_fstr[32];
} statvfs_t;
```

Figure 6-38: <stddef.h>

```
#define NULL                     0
typedef long                     ptrdiff_t;
typedef unsigned long            size_t;
typedef int                      wchar_t;
```

Figure 6-39: <stdio.h>

```
typedef long              fpos_t;
#define _NFILE            20
#define NULL              0
#define BUFSIZ            1024
#define _IOFBF            0000
#define _IOLBF            0100
#define _IONBF            0004
#define EOF               (-1)
#define FOPEN_MAX         _NFILE
#define FILENAME_MAX      1024
#define SEEK_SET          0
#define SEEK_CUR          1
#define SEEK_END          2
#define TMP_MAX           17576
#define stdin             (&__iob[0])
#define stdout            (&__iob[1])
#define stderr            (&__iob[2])
#define L_ctermid         9
#define L_cuserid         9
#define P_tmpdir          "/var/tmp/"
#define L_tmpnam          25

typedef struct {
            long          __impl[16];
} FILE;
```

Figure 6-41: <stropts.h>

```
struct strbuf {
        int               maxlen;
        int               len;
        caddr_t           buf;
};

struct strpeek {
        struct strbuf     ctlbuf;
        struct strbuf     databuf;
        int flags;
};

struct strfdinsert {
        struct strbuf     ctlbuf;
        struct strbuf     databuf;
        int               flags;
        int               fildes;
        int               offset;
};

struct strrecvfd {
        int               fd;
        uid_t             uid;
        gid_t             gid;
        char              fill[8];
};
```

Figure 6-42: <termios.h>

```
typedef   unsigned int    tcflag_t;
typedef   unsigned char   cc_t;
typedef   unsigned int    speed_t;
```

Figure 6-47: <sys/time.h>

```
struct timeval {
        time_t          tv_sec;
        long            tv_usec;
};

struct timezone {
        int             tz_minuteswest;
        int             tz_dsttime;
};

typedef struct timespec {
        time_t          tv_sec;
        long            tv_nsec;
} timespec_t;

typedef struct timespec timestruc_t;
```

Figure 6-54: <tiuser.h>

```
struct t_bind {
        struct netbuf   addr;
        uint_t          qlen;
};

struct t_info {
        int             addr;
        int             options;
        int             tsdu;
        int             etsdu;
        int             connect;
        int             discon;
        int             servtype;
};

struct t_optmgmt {
        struct netbuf   opt;
        unsigned int    flags;
};

struct t_uderr {
        struct netbuf   addr;
        struct netbuf   opt;
        int             error;
};
```

Figure 6-59: <sys/types.h>

```
typedef unsigned char               uchar_t;
typedef unsigned short              ushort_t;
typedef unsigned int                uint_t;
typedef unsigned long               ulong_t;
typedef char*                       caddr_t;
typedef long                        daddr_t;
typedef short                       sysid_t;
typedef long                        off_t;
typedef ulong_t                     ino_t;
typedef int                         id_t;
typedef uint_t                      major_t;
typedef uint_t                      minor_t;
typedef uint_t                      mode_t;
typedef int                         key_t;
typedef int                         uid_t;
typedef uid_t                       gid_t;
typedef uint_t                      nlink_t;
typedef ulong_t                     dev_t;
typedef int                         pid_t;
typedef ulong_t                     size_t;
typedef long                        time_t;
typedef long                        clock_t;
```

Figure 6-60: <ucontext.h>

```
#include <sys/regset.h>
typedef struct ucontext {
            uint_t                  uc_flags;
            ucontext_t              *uc_link;
            sigset_t                uc_sigmask;
            stack_t                 uc_stack;
            mcontext_t              uc_mcontext;
            long                    uc_filler[4];
} ucontext_t;
#define UC_ASR          040
```

Figure 6-61: <uio.h>

```
typedef struct iovec {
        caddr_t         iov_base;
        size_t          iov_len;
} iovec_t;
```

Figure 6-63: <unistd.h>

```
#define _POSIX_VERSION              *
#define _XOPEN_VERSION              *
#define _SC_ARG_MAX                 1
#define _SC_CHILD_MAX               2
#define _SC_CLK_TCK                 3
#define _SC_NGROUPS_MAX             4
#define _SC_OPEN_MAX                5
#define _SC_JOB_CONTROL             6
#define _SC_SAVED_IDS               7
#define _SC_VERSION                 8
#define _SC_PASS_MAX                9
#define _SC_LOGNAME_MAX             10
#define _SC_PAGESIZE                11
#define _SC_XOPEN_VERSION           12
#define _PC_LINK_MAX                1
#define _PC_MAX_CANON               2
#define _PC_MAX_INPUT               3
#define _PC_NAME_MAX                4
#define _PC_PATH_MAX                5
#define _PC_PIPE_BUF                6
#define _PC_NO_TRUNC                7
#define _PC_VDISABLE                8
#define _PC_CHOWN_RESTRICTED        9
#define STDIN_FILENO                0
#define STDOUT_FILENO               1
#define STDERR_FILENO               2
```

Figure 6-140: <inttypes.h>

```
typedef signed char                 int8_t;
typedef short                       int16_t;
typedef int                         int32_t;
typedef long                        int64_t;
typedef unsigned char               uint8_t;
typedef unsigned short              uint16_t;
typedef unsigned int                uint32_t;
typedef unsigned long               uint64_t;
typedef long                        intptr_t;
typedef unsigned long               uintptr_t;
```

Figure 6-141: <sys/regset.h>

```
typedef long              greg_t;
#define _NGREG            21
typedef greg_t            gregset_t[_NGREG];
#define REG_CCR           0
#define REG_PC            1
#define REG_nPC           2
#define REG_Y             3
#define REG_G1            4
#define REG_G2            5
#define REG_G3            6
#define REG_G4            7
#define REG_G5            8
#define REG_G6            9
#define REG_G7            10
#define REG_O0            11
#define REG_O1            12
#define REG_O2            13
#define REG_O3            14
#define REG_O4            15
#define REG_O5            16
#define REG_O6            17
#define REG_O7            18
#define REG_ASI           19
#define REG_FPRS          20
#define REG_SP            REG_O6
#define REG_R0            REG_O0
#define REG_R1            REG_O1

struct rwindow {
        greg_t            rw_local[8];
        greg_t            rw_in[8];
};

typedef struct {
        int               wbcnt;
        greg_t            *spbuf[SPARC_MAXREGWINDOWS];
        struct window     wbuf[SPARC_MAXREGWINDOW];
} gwindows_t;

struct fpq {
        unsigned int      *fpq_addr;
        unsigned int      *fpq_instr;
};

struct fpu {
        union {
                uint_t          fpu_regs[32];
                uint64_t        fpu_dregs[32];
                long double     fpu_qregs[16];
        } fpu_fr;

        union {
                uint32_t        fpu_regs[32];
                double          fpu_dregs[32];
                long double     fpu_qregs[16];
        } fpu_fr;


        struct fq               *fpu_q;
        uint64_t                fpu_fsr;
        uint8_t                 fpu_qcnt;
        uint8_t                 fpu_q_entrysize;
        uint8_t                 fpu_en;
};

typedef struct fpu fpregset_t;

typedef greg_t asrset_t[16]; /* %asr16 -> %asr31 */

typedef struct {
        uint_t            xrs_id;
        caddr_t           xrs_ptr;
} xrs_t;

typedef struct {
        gregset_t         gregs;
        gwindows_t        *gwins;
        fpregset_t        fpregs;
```

Figure 6-142: <tpicommon.h>

```
struct opthdr {
        int             level;
        int             name;
        int             len;
};
```

Figure 6-143: <sys/utrap.h>

```
#define UT_INSTRUCTION_EXCEPTION       1
#define UT_INSTRUCTION_DISABLED        1
#define UT_INSTRUCTION_ERROR           2
#define UT_INSTRUCTION_PROTECTION      3
#define UT_ILLTRAP_INSTRUCTION         4
#define UT_ILLEGAL_INSTRUCTION         5
#define UT_PRIVILEGED_OPCODE           6
#define UT_FP_DISABLED                 7
#define UT_FP_EXCEPTION_IEEE_754       8
#define UT_FP_EXCEPTION_OTHER          9
#define UT_TAG_OVERVIEW                10
#define UT_DIVISION_BY_ZERO            11
#define UT_DATA_EXCEPTION              12
#define UT_DATA_ERROR                  13
#define UT_DATA_PROTECTION             14
#define UT_MEM_ADDRESS_NOT_ALIGNED     15
#define UT_PRIVILEGED_ACTION           16
#define UT_ASYNC_DATA_ERROR            17
#define UT_TRAP_INSTRUCTION_16         18
#define UT_TRAP_INSTRUCTION_17         19
#define UT_TRAP_INSTRUCTION_18         20
#define UT_TRAP_INSTRUCTION_19         21
#define UT_TRAP_INSTRUCTION_20         22
#define UT_TRAP_INSTRUCTION_21         23
#define UT_TRAP_INSTRUCTION_22         24
#define UT_TRAP_INSTRUCTION_23         25
#define UT_TRAP_INSTRUCTION_24         26
#define UT_TRAP_INSTRUCTION_25         27
#define UT_TRAP_INSTRUCTION_26         28
#define UT_TRAP_INSTRUCTION_27         29
#define UT_TRAP_INSTRUCTION_28         30
#define UT_TRAP_INSTRUCTION_29         31
#define UT_TRAP_INSTRUCTION_30         32
#define UT_TRAP_INSTRUCTION_31         33

#define UTH_NOCHANGE ((utrap_handler_t)(-1))

typedef int utrap_entry_t;
typedef void *utrap_handler_t;

__sparc_utrap_install(utrap_entry_t type,
            utrap_handler_t new_precise, utrap_handler_t new_deferred,
            utrap_handler_t *old_precise, utrap_handler_t *old_deferred);
```

Figure 6-137: <netinet/in.h>

```
typedef uint16_t                    in_port_t;
typedef uint_t                      in_addr_t;
typedef uint_t                      ipaddr_t;
typedef unsigned short              sa_family_t;
#define INADDR_ANY                  (ipaddr_t)0x00000000U
#define INADDR_LOOPBACK             (ipaddr_t)0x7f000001U
#define INADDR_BROADCAST            (ipaddr_t)0xffffffffU
struct in_addr {
    union    {
                struct { uint8_t s_b1, s_b2, s_b3, s_b4;       } _S_un_b;
                struct { uint16_t s_w1, s_w2;                  } _S_un_w;
                in_addr_t _S_addr;
            } _S_un;
        };
#define IN_CLASSA(i)                (((ipaddr_t)(i) & 0x80000000U) == 0)
#define IN_CLASSA_NET               (ipaddr_t)0xff000000U
#define IN_CLASSA_NSHIFT            24
#define IN_CLASSA_HOST              (ipaddr_t)0x00ffffffU
#define IN_CLASSA_MAX               128
#define IN_CLASSB(i)                (((ipaddr_t)(i) & 0xc0000000U) == 0x80000000U)
#define IN_CLASSB_NET               (ipaddr_t)0xffff0000U
#define IN_CLASSB_NSHIFT            16
#define IN_CLASSB_HOST              (ipaddr_t)0x0000ffffU
#define IN_CLASSB_MAX               65536
#define IN_CLASSC(i)                (((ipaddr_t)(i) & 0xe0000000U) == 0xc0000000U)
#define IN_CLASSC_NET               (ipaddr_t)0xffffff00U
#define IN_CLASSC_NSHIFT            8
#define IN_CLASSC_HOST              (ipaddr_t)0x000000ffU
#define IN_CLASSD(i)                (((ipaddr_t)(i) & 0xf0000000U) == 0xe0000000U)
#define IN_CLASSD_NET               (ipaddr_t)0xf0000000U
#define IN_CLASSD_NSHIFT            28
#define IN_CLASSD_HOST              (ipaddr_t)0x0fffffffU
#define IN_MULTICAST(i)             IN_CLASSD(i)
#define IN_EXPERIMENTAL(i)          (((ipaddr_t)(i) & 0xe0000000U) == 0xe0000000U)
#define IN_BADCLASS(i)              (((ipaddr_t)(i) & 0xf0000000U) == 0xf0000000U)
#define INADDR_ANY                  (ipaddr_t)0x00000000U
#define INADDR_LOOPBACK             (ipaddr_t)0x7f000001U
#define INADDR_BROADCAST            (ipaddr_t)0xffffffffU
#define INADDR_UNSPEC_GROUP         (ipaddr_t)0xe0000000U
#define INADDR_ALLHOSTS_GROUP       (ipaddr_t)0xe0000001U
#define INADDR_ALLRTRS_GROUP        (ipaddr_t)0xe0000002U
#define INADDR_MAX_LOCAL_GROUP      (ipaddr_t)0xe00000ffU
```

SCD 2.4.1

Formats and Protocols

Introduction

This chapter is split into a common section followed by a 64-bit gABI section. The common section applies to both the 32-bit ABI and 64-bit ABI, except where explicitly noted otherwise. Archive file formats, networking protocols, and the terminfo data base format may be found in Chapter 7 of the *System V Application Binary Interface*.

Formats and Protocols Changes

The following are changes to the *System V ABI*, the *System V ABI SPARC Processor Supplement*, and the *System V Interface Definition* as reported to SPARC International.

#	Facility	Location	Description
1	rpcbind Operation	gABI	Change - page 7-38-The reference to IP in the first paragraph is ambiguous -- port 111 is used for IP-carried transports (rather than IP itself).
2	terminfo	gABI	on page 7-7 and 7-8, the text: . . . terminal capabilities are stored here in the order in which **that** are listed under the . . . should read: . . terminal capabilities are stored here in the order in which **they** are listed under the . .

Interconnecting SCD Conforming Systems

Overview

This section contains the REQUIRED internetworking interfaces available to applications running on an SCD conforming system. Note that the networking ABI is defined by the TLI interfaces described in section BA_LIB of the *System V Interface Definition (Third Edition), Volume I*. This chapter adds to that definition by specifying that there shall be present in all SCD complying systems an Internet Protocol Suite (IPS) transport provider that is accessible through TLI. Also added are the commands, which exist in /usr/bin, and their associated daemons, which exist in */usr/sbin*.

Transport Providers

All SPARC-compliant systems will provide a transport provider interface for each of the IP protocols, TCP, UDP, ICMP, and ARP. The device names for these transport provider interfaces must be */dev/tcp*, */dev/udp*, */dev/icmp*, and */dev/arp* respectively. Additionally, shared objects will be present to convert IP format universal addresses into the necessary internal format needed by the TLI interfaces. These interfaces are previously defined in the Network Services Library section of chapter 6 (Libraries).

Additional Interfaces

The interfaces listed below in Table 7-1 show the additional commands, protocols, and service daemons that are included to ensure inter-operability between SCD conforming systems. The table includes three columns, the command name which is invoked, the Request for Comments (RFC) number for the protocol specification as maintained by the Internet Engineering Task Force, and a short description of the feature provided.

Table 7-2 shows the “well-known” port numbers as derived from RFC 1700 that SCD conforming systems are REQUIRED to provide for supported services.

Table 7-1: Required Commands

Command	RFC	Description
rlogin	BSDNET	Remote terminal services (BSD)
rsh	BSDNET	Remote user shell (BSD)
rcp	BSDNET	Remote file copy (BSD)
rwho	BSDNET	Remote user information service (BSD)
rdate	BSDNET	Remote uptime statistics (BSD)
talk	BSDNET	Remote chat utility (BSD)
finger	rfc1288	Information server for logged on users
telnet	<many>	Interactive terminal services
ftp	rfc959	File transfer protocol
arp	rfc826	Address Resolution Protocol

Table 7-2: Well-Known Port Numbers

Keyword	Description	TCP Port Number	UDP Port Number
tcpmux	rfc1078	1	
echo	Echo	7	7
discard	Discard	9	9
systat	Active Users	11	11
daytime	Daytime	13	13
netstat	Who is up or NETSTAT	15	15
chargen	Character Generator	19	19
ftp-data	File Transfer Protocol (Data)	20	
ftp	File Transfer Protocol	21	
telnet	Terminal Connection	23	
smtp	Simple Mail Transport Protocol	25	
time	Time	37	37
name	Host Name Server	42	42
nicname	Who Is	43	43
domain	Domain Name Server	53	53
tftp	Trivial File Transfer	69	69
	Any private RJE service	77	77
finger	Finger	79	79
supdup	SUPDUP Protocol	95	
hostname	NIC Host Name Server	101	
iso-tsap	ISO-TSAP	102	
uucp-path	UUCP Path Service	117	
ntp	Network Time Protocol	123	123
X	X Window Service	6000+Display Number	

Format and Protocols (64-bit gABI) - ~~EXPERIMENTAL~~

Format and Protocols changes:

#	Facility	Location	Description
1	**XDR**	gABI	page 7-14, add new data type "Quad Precision Floating-point", after the description of the "Double-precision Floating-point" as follows:

Quad-precision Floating-point

XDR defines the encoding for the quad-precision floating-point data type "long double" (128 bits or 16 bytes). The encoding used is a logical extension to the IEEE standard for single and double precision encoding. XDR encodes the following three fields, which describe the quad-precision floating-point number:

S: The sign of the number. Values 0 and 1 represent positive and negative, respectively. One bit.

E: The exponent of the number, base 2. 15 bits are devoted to this field. The exponent is biased by 16383.

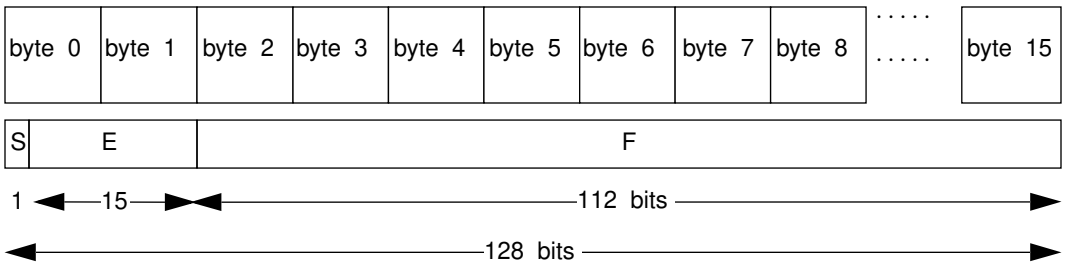
F: The fractional part of the number's mantissa, base 2. 112 bits are devoted to this field.

Therefore, the floating-point number is described by:

```
(-1)**S * 2**(E-Bias) * 1.F
```

It is declared as follows:

Quad-Precision Floating-point



The most and least significant bits of a quad-precision floating-point number are 0 and 127. The beginning bit (and the most significant bit) offsets of S, E, and F are 0, 1, and 16, respectively. Note that these numbers refer to the mathematical positions of the bits, and NOT to their actual physical locations (which vary from medium to medium).

Even though quad-precision floating-point is not yet a part of the IEEE standard, the IEEE 754 specifications should be consulted concerning the encoding for signed zero, signed infinity (overflow), and denormalized numbers (underflow). According to IEEE specifications, the "NaN" (not a number) is system dependent.

CHAPTER 8: System Commands

SCD 2.4.1

/System Commands

Introduction

This chapter is common to both the 32-bit ABI and 64-bit ABI, unless explicitly noted otherwise. 32-bit ABI commands are REQUIRED, unless explicitly noted otherwise. 64-bit ABI commands are EXPERIMENTAL.

This chapter contains the commands for application programs as listed in the *System V Application Binary Interface (Third Edition)*, and described in the *System V Interface Definition, (Third Edition)*.

Table 8-1. Commands for Application Programs

ar 2.3	false	priocntl	uncompress 2.3 (L)
awk 2.4 (L)	find †† 2.4 (L)	pwd *	uucp
basename 2.3	fmtmsg	rm 2.4 (L)	uulog
cat	gencat 2.3	rmdir 2.4 (L)	uustat
cd†	gettxt	sed 2.4 (L)	uux
chgrp 2.4 (L)	grep	sh ††, 2.4 (L)	vi
chmod 2.4 (L)	id	sleep	wait†
chown 2.4 (L)	kill	sort	wc 2.3 (L)
cmp 2.4 (L)	line	stty	who ††
cp 2.4 (L)	ln 2.4 (L)	su	
cpio	logname	sum 2.3 (L)	
compress †† 2.3 (L)	lp	tail 2.4 (L)	
date	ls 2.4 (L)	tee 2.4 (L)	
dirname 2.3	make 2.3	test *, 2.4 (L)	
dd 2.4 (L)	mkdir 2.4 (L)	touch 2.4 (L)	
df	mkmsg 2.4.1	tr 2.4 (L)	
echo *	mv 2.4 (L)	true	
ed	passwd	tty	
ex ††	pg	umask †	
expr	pr ††	uname	

* These commands marked are also built into the standard UNIX system shell, sh.

† These commands are only available as commands built-in to the UNIX system shell, sh.

†† - See system commands changes that follow.

L- REQUIRED 32-bit ABI Large File aware utility.

2.3- New interfaces added to SCD2.3.

2.4- New interfaces added to SCD2.4. 2.4.1- New interfaces added to SCD 2.4.1

Figure 8-1 : tar.h

```
#define TMAGIC          "ustar"
#define TMAGLEN         6
#define TVERSION        "00"
#define TVERSLEN        2
#define REGTYPE         '0'
#define AREGTYPE        '\0'
#define LNKTYPE         '1'
#define SYMTYPE         '2'
#define CHRTYPE         '3'
#define BLKTYPE         '4'
#define DIRTYPE         '5'
#define FIFOTYPE        '6'
#define CONTTYPE        '7'
#define TSUID           04000
#define TSGID           02000
#define TSVTX           01000
#define TUREAD          00400
#define TUWRITE         00200
#define TUEXEC          00100
#define TGREAD          00040
#define TGWRITE         00020
#define TGEXEC          00010
#define TOREAD          00004
#define TOWRITE         00002
#define TOEXEC          00001
```

System Commands Changes

The following are changes to the basic system commands (detailed in the *System V Application Binary Interface*), as reported to SPARC International.

#	Facility	Location	Description
1	ex(BU_CMD)	SVID, Vol. 2	Change - The SVID states that the "ed compatible" option of ex causes the g suffix on substitute commands to be remembered, and toggled by repeating the suffix. Omitted from this description is the fact that this behavior is applicable only to the "&" form of substitute commands.

System Commands Changes (continued)

#	Facility	Location	Description
1	***ex*(BU_CMD)**	SVID, Vol. 2	Change - The "c" command should be defined as "Enters input mode; the input text replaces the specified lines. The last input line becomes the current line; if no lines are input ~~the line before the deleted line(s) becomes the current line."~~ the line after the deleted lines becomes the current line.
~~1~~	~~**ex(BU_CMD)**~~	~~SVID, Vol. 2~~	~~Change - The "m" command description must be changed to note that the current line becomes the last of the moved lines, rather than the first.~~
2	***find*(BU_CMD)**	SVID, Vol. 2	Change the descriptions of -atime, -mtime, and -ctime from "in n days" to "n days ago."
3	***pr*(BU_CMD)**	SVID, Vol. 2	Change - The SVID says that using -m with the -column option will cause the -m option to override the -column option. This does not match current practice; using these two options together will be treated as an error.
3	***pr*(BU_CMD)**	SVID, Vol. 2	Change - Comments about truncating lines in the text of the description and in the options are incorrect with respect to single column output: existing practice and P1003.2 is that truncation is not applied to single column output. The "note" in the description of the -w option is to be applicable to multi-column output only. In the description change the second paragraph to read: "By default, in multi-column mode, columns are...."
4	***sh*(BU_CMD)**	SVID, Vol. 2	Changed - In the section marked "Input/Output" the description of "<<[-]word" states: "... \ must be used to quote the characters \, $, ‘, and the first character of word" should be changed to read "... \ must be used to quote the characters \, $, and ‘". This matches both existing practice and P1003.2.
5	***who*(AU_CMD)**	SVID, Vol. 2	Change the description of the -T and -a option to "The -T and -a options to who are unspecified and cannot be relied on to be portable." *Rationale:* On investigation, these options were found to differ on various SPARC implementations. The -a option is an aggregate option; rather than using this option, for SCD 2.x portability an application should use the specific individual options to who that the application requires. Rather than using the -T option, an application should use either the -s or -u option for SCD 2.x portability.
6	***sh*(BU_CMD)**	gABI	On page 8-1 at the bottom of the page, the text:] . . . UNIX system shell (shBU_CMD). should read:] UNIX system shell sh(BU_CMD).

7	**compress(BU_CMD)**	SVID, Vol 2	Change - The SVID states that "Whenever possible, each file is replaced by one with the extension .Z, while keeping the same ownership modes, as well as access and modification times." The SCD only requires the ownership, modes, and access and modification times to be preserved when the invoker has appropriate privileges.

SCD 2.4.1

Execution Environment

Introduction

This chapter is common to both the 32-bit ABI and 64-bit ABI, unless explicitly noted otherwise.

All information regarding File System Structure and Contents may be found in Chapter 9 of the *System V Application Binary Interface (Third Edition*).

Execution Environment Changes

The following are changes to the *System V Application Binary Interface (Third Edition)*, the *System V Application Binary Interface - SPARC Processor Supplement (Third Edition)*, and the *System V Interface Definition (Third Edition)* as reported to SPARC International.

#	Facility	Location	Description
1	Root sub-tree - */dev*	gABI	Change Figure 9-1 page 9-4, Required device files are: */dev/tty*, */dev/null*, */dev/console*, */dev/zero*. The device:/dev/lpx should be removed from this figure; */dev/lpX* is not an SCD required device. Similarly the sub-directories: */dev/rmt* and */dev/mt* should be removed from this figure; these are not SCD required */dev/* sub-directories. The definition of */dev/zero* can be found in the SCD 2.4 Interface Semantics.
2	/usr	gABI	Change, page 9-5 of the gABI, /usr/X/lib/app-defaults "The directory where X11 Window System default application resource files are installed." to: "Optional directory where X11 Window System default application resource files are installed."
3	/usr	gABI	Add, page 9-5 of the gABI, "/usr/X/lib/locale/C The directory where X11 Window System localization packages are installed for the C locale."
4	/usr	gABI	Add, page 9-5 of the gABI, "/usr/X/lib/locale/C/app-defaults The directory where X11 Window System default application resource files for the C locale are installed."

CHAPTER 10: Windowing and Terminal Interfaces

SCD 2.4.1

Windowing and Terminal Interface

Introduction

This chapter is common to both the 32-bit ABI and 64-bit ABI, except that the 64-bit ABI is EXPERIMENTAL.

This chapter contains the following major sections:

1- The X library (libX11)
2- The Motif 1.2 widget set library (libMrm, libXm)
3- The X Toolkit (libXt)
4- The Open Look Widget set (libXol)
5- The X extensions library (libEext)

The following table identifies the actual version numbers and reference names for windowing and terminal shared objects on a SPARC system:

.

Library	Reference Name
libMrm	/usr/lib/libMrm.so.1.2 (deprecated) /usr/lib/libMrm.so.3 (deprecated) /usr/dt/lib/libMrm.so.1.2 (deprecated) /usr/dt/lib/libMrm.so.3
libX11	/usr/lib/libX11.so.5 /usr/lib/libX11.so.4 (deprecated)
libXext	/usr/lib/libXext.so.0
libXol	/usr/lib/libXol.so.3
libXm	/usr/lib/libXm.so.1.2 (deprecated) /usr/lib/libXm.so.3 (deprecated) /usr/dt/lib/libXm.so.1.2(deprecated) /usr/dt/lib/libXm.so.3
libXt	/usr/lib/libXt.so.5 /usr/lib/libXt.so.4 (deprecated)

The X Library

Overview

This section identifies binary interfaces for libX, which are defined in *The X Window System (Third Edition)* by Robert W. Scheifler and James Gettys (Digital Press, ISBN 1-55558-088-2).

In addition, all SCD 2.4 systems will support the mechanisms and conventions as specified in the *Inter-Client Communications Convention Manual* (ICCCM) in *The X Window System (Third Edition)* by Robert W. Scheifler and James Gettys (Digital Press, ISBN 1-55558-088-2).

The libX Interfaces

The interfaces listed below in Table 10-1 have been included in SCD 2.4 because they are REQUIRED to be present on all compliant systems, in the dynamic libraries: /usr/lib/libX11.so.4 and /usr/lib/libX11.so.5. Table 10-2 contains the exported data which are also REQUIRED to be present in /usr/lib/libX11.so.4 and /usr/lib/libX11.so.5. The format of these entries is: data[size].

Since the X Version 11, Release 5 specification is a proper superset of the X Version 11, Release 4 specification, applicationdevelopers can link to either /usr/lib/libX11.so.4 or /usr/lib/libX11.so.5 to access X Version 11, Release 4 and Release 5 interfaces. See the SPARC Compliance Definition 2.0, 2.1, 2.2 , 2.3, or 2.4 for a list of X11R4 components.

Figures 10-1 through 10-7 detail the manifest constants and visible data structures associated with the X library.

Table 10-1: Contents of libX (1 of 4)

XActivateScreenSaver
XAddExtension
XAddHost
XAddHosts
XAddPixel
XAddToExtensionList
XAddToSaveSet
XAllocClassHint
XAllocColor
XAllocColorCells
XAllocColorPlanes
XAllocIconSize
XAllocNamedColor
XAllocSizeHints
XAllocStandardColormap
XAllocWMHints
XAllowEvents
XAllPlanes
XAutoRepeatOff
XAutoRepeatOn
XBaseFontNameListOfFontSet
XBell
XBitmapBitOrder
XBitmapPad
XBitmapUnit
XBlackPixel
XBlackPixelOfScreen
XCellsOfScreen
XChangeActivePointerGrab
XChangeGC
XChangeKeyboardControl
XChangeKeyboardMapping
XChangePointerControl
XChangeProperty
XChangeSaveSet
XChangeWindowAttributes
XCheckIfEvent
XCheckMaskEvent
XCheckTypedEvent
XCheckTypedWindowEvent
XCheckWindowEvent
XCirculateSubwindows
XCirculateSubwindowsDown
XCirculateSubwindowsUp
XClearArea
XClearWindow
XClipBox
XCloseDisplay
XCloseIM
XcmsAddColorSpace
XcmsAddFunctionSet
XcmsAllocColor
XcmsAllocNamedColor
XcmsCCCOfColormap
XcmsCIELabClipab
XcmsCIELabClipL
XcmsCIELabClipLab
XcmsCIELabQueryMaxC
XcmsCIELabQueryMaxL
XcmsCIELabQueryMaxLC
XcmsCIELabQueryMinL
XcmsCIELabToCIEXYZ
XcmsCIELabWhiteShiftColors
XcmsCIELuvClipL
XcmsCIELuvClipLuv
XcmsCIELuvClipuv
XcmsCIELuvQueryMaxC
XcmsCIELuvQueryMaxL
XcmsCIELuvQueryMaxLC
XcmsCIELuvQueryMinL
XcmsCIELuvToCIEuvY
XcmsCIELuvWhiteShiftColors
XcmsCIEuvYToCIELuv
XcmsCIEuvYToCIEXYZ
XcmsCIEuvYToTekHVC
XcmsCIExyYToCIEXYZ
XcmsCIEXYZToCIELab
XcmsCIEXYZToCIEuvY
XcmsCIEXYZToCIExyY
XcmsCIEXYZToRGBi
XcmsClientWhitePointOfCCC
XcmsConvertColors
XcmsCreateCCC
XcmsDefaultCCC
XcmsDisplayOfCCC
XcmsFormatOfPrefix
XcmsFreeCCC
XcmsLookupColor
XcmsPrefixOfFormat
XcmsQueryBlack
XcmsQueryBlue
XcmsQueryColor
XcmsQueryColors
XcmsQueryGreen
XcmsQueryRed
XcmsQueryWhite
XcmsRGBiToCIEXYZ
XcmsRGBiToRGB
XcmsRGBToRGBi
XcmsScreenNumberOfCCC
XcmsScreenWhitePointOfCCC
XcmsSetCompressionProc
XcmsSetWhiteAdjustProc
XcmsSetWhitePoint
XcmsStoreColor
XcmsStoreColors
XcmsTekHVCClipC
XcmsTekHVCClipV
XcmsTekHVCClipVC
XcmsTekHVCQueryMaxC
XcmsTekHVCQueryMaxV
XcmsTekHVCQueryMaxVC
XcmsTekHVCQueryMaxVSamples
XcmsTekHVCQueryMinV
XcmsTekHVCToCIEuvY
XcmsTekHVCWhiteShiftColors
XcmsVisualOfCCC
XConfigureWindow
XConnectionNumber
XContextDependentDrawing
XConvertSelection
XCopyArea
XCopyColormapAndFree
XCopyGC
XCopyPlane
XCreateBitmapFromData
XCreateColormap
XCreateFontCursor
XCreateFontSet
XCreateGC
XCreateGlyphCursor
XCreateIC
XCreateImage
XCreatePixmap
XCreatePixmapCursor
XCreatePixmapFromBitmapData
XCreateRegion
XCreateSimpleWindow
XCreateWindow
XDefaultColormap
XDefaultColormapOfScreen
XDefaultDepth
XDefaultDepthOfScreen
XDefaultGC
XDefaultGCOfScreen
XDefaultRootWindow
XDefaultScreen
XDefaultScreenOfDisplay
XDefaultString
XDefaultVisual

Table 10-1. Contents of libX (2 of 4)

XDefaultVisualOfScreen
XDefineCursor
XDeleteContext
XDeleteModifiermapEntry
XDeleteProperty
XDestroyIC
XDestroyImage
XDestroyRegion
XDestroySubwindows
XDestroyWindow
XDisableAccessControl
XDisplayCells
XDisplayHeight
XDisplayHeightMM
XDisplayKeycodes
XDisplayMotionBufferSize
XDisplayName
XDisplayOfIM
XDisplayOfScreen
XDisplayPlanes
XDisplayString
XDisplayWidth
XDisplayWidthMM
XDoesBackingStore
XDoesSaveUnders
XDrawArc
XDrawArcs
XDrawImageString
XDrawImageString16
XDrawLine
XDrawLines
XDrawPoint
XDrawPoints
XDrawRectangle
XDrawRectangles
XDrawSegments
XDrawString
XDrawString16
XDrawText
XDrawText16
XEHeadOfExtensionList
XEmptyRegion
XEnableAccessControl
XEqualRegion
XESetCloseDisplay
XESetCopyGC
XESetCreateFont
XESetCreateGC
XESetError
XESetErrorString
XESetEventToWire
XESetFlushGC
XESetFreeFont
XESetFreeGC
XESetPrintErrorValues
XESetWireToError
XESetWireToEvent
XEventMaskOfScreen
XEventsQueued
XExtentsOfFontSet
XFetchBuffer
XFetchBytes
XFetchName
XFillArc
XFillArcs
XFillPolygon
XFillRectangle
XFillRectangles
XFilterEvent
XFindContext
XFindOnExtensionList
XFlush
XFlushGC
XFontsOfFontSet
XForceScreenSaver
XFree
XFreeColormap
XFreeColors
XFreeCursor
XFreeExtensionList
XFreeFont
XFreeFontInfo
XFreeFontNames
XFreeFontPath
XFreeFontSet
XFreeGC
XFreeModifiermap
XFreePixmap
XFreeStringList
XGContextFromGC
XGeometry
XGetAtomName
XGetClassHint
XGetCommand
XGetDefault
XGetErrorDatabaseText
XGetErrorText
XGetFontPath
XGetFontProperty
XGetGCValues
XGetGeometry
XGetIconName
XGetIconSizes
XGetICValues
XGetImage
XGetIMValues
XGetInputFocus
XGetKeyboardControl
XGetKeyboardMapping
XGetModifierMapping
XGetMotionEvents
XGetNormalHints
XGetPixel
XGetPointerControl
XGetPointerMapping
XGetRGBColormaps
XGetScreenSaver
XGetSelectionOwner
XGetSizeHints
XGetStandardColormap
XGetSubImage
XGetTextProperty
XGetTransientForHint
XGetVisualInfo
XGetWindowAttributes
XGetWindowProperty
XGetWMClientMachine
XGetWMColormapWindows
XGetWMHints
XGetWMIconName
XGetWMName
XGetWMNormalHints
XGetWMProtocols
XGetWMSizeHints
XGrabButton
XGrabKey
XGrabKeyboard
XGrabPointer
XGrabServer
XHeightMMOfScreen
XHeightOfScreen
XIconifyWindow
XIfEvent
XImageByteOrder
XIMOfIC
XInitExtension
XInsertModifiermapEntry
XInstallColormap
XInternAtom
XIntersectRegion

Table 10-1. Contents of libX (3 of 4)

XKeycodeToKeysym
XKeysymToKeycode
XKeysymToString
XKillClient
XLastKnownRequestProcessed
XListDepths
XListExtensions
XListFonts
XListFontsWithInfo
XListHosts
XListInstalledColormaps
XListPixmapFormats
XListProperties
XLoadFont
XLoadQueryFont
XLocaleOfFontSet
XLocaleOfIM
XLookupColor
XLookupKeysym
XLookupString
XLowerWindow
XMapRaised
XMapSubwindows
XMapWindow
XMaskEvent
XMatchVisualInfo
XMaxCmapsOfScreen
XMaxRequestSize
XmbDrawImageString
XmbDrawString
XmbDrawText
XmbLookupString
XmbResetIC
XmbSetWMProperties
XmbTextEscapement
XmbTextExtents
XmbTextListToTextProperty
XmbTextPerCharExtents
XmbTextPropertyToTextList
XMinCmapsOfScreen
XMoveResizeWindow
XMoveWindow
XNewModifiermap
XNextEvent
XNextRequest
XNoOp
XOffsetRegion
XOpenDisplay
XOpenIM
XParseColor
XParseGeometry
XPeekEvent
XPeekIfEvent
XPending
Xpermalloc
XPlanesOfScreen
XPointInRegion
XPolygonRegion
XProtocolRevision
XProtocolVersion
XPutBackEvent
XPutImage
XPutPixel
XQLength
XQueryBestCursor
XQueryBestSize
XQueryBestStipple
XQueryBestTile
XQueryColor
XQueryColors
XQueryExtension
XQueryFont
XQueryKeymap
XQueryPointer
XQueryTextExtents
XQueryTextExtents16
XQueryTree
XRaiseWindow
XReadBitmapFile
XRebindKeysym
XRecolorCursor
XReconfigureWMWindow
XRectInRegion
XRefreshKeyboardMapping
XRemoveFromSaveSet
XRemoveHost
XRemoveHosts
XReparentWindow
XResetScreenSaver
XResizeWindow
XResourceManagerString
XRestackWindows
XrmCombineDatabase
XrmCombineFileDatabase
XrmDestroyDatabase
XrmEnumerateDatabase
XrmGetDatabase
XrmGetFileDatabase
XrmGetResource
XrmGetStringDatabase
XrmInitialize
XrmLocaleOfDatabase
XrmMergeDatabases
XrmParseCommand
XrmPermStringToQuark
XrmPutFileDatabase
XrmPutLineResource
XrmPutResource
XrmPutStringResource
XrmQGetResource
XrmQGetSearchList
XrmQGetSearchResource
XrmQPutResource
XrmQPutStringResource
XrmQuarkToString
XrmSetDatabase
XrmStringToBindingQuarkList
XrmStringToQuark
XrmStringToQuarkList
XrmUniqueQuark
XRootWindow
XRootWindowOfScreen
XRotateBuffers
XRotateWindowProperties
XSaveContext
XScreenCount
XScreenNumberOfScreen
XScreenOfDisplay
XScreenResourceString
XSelectInput
XSendEvent
XServerVendor
XSetAccessControl
XSetAfterFunction
XSetArcMode
XSetBackground
XSetClassHint
XSetClipMask
XSetClipOrigin
XSetClipRectangles
XSetCloseDownMode
XSetCommand
XSetDashes
XSetErrorHandler
XSetFillRule
XSetFillStyle
XSetFont
XSetFontPath
XSetForeground
XSetFunction

Table 10-1. Contents of libX (4 of 4)

XSetGraphicsExposures
XSetICFocus
XSetIconName
XSetIconSizes
XSetICValues
XSetInputFocus
XSetIOErrorHandler
XSetLineAttributes
XSetLocaleModifiers
XSetModifierMapping
XSetNormalHints
XSetPlaneMask
XSetPointerMapping
XSetRegion
XSetRGBColormaps
XSetScreenSaver
XSetSelectionOwner
XSetSizeHints
XSetStandardColormap
XSetStandardProperties
XSetState
XSetStipple
XSetSubwindowMode
XSetTextProperty
XSetTile
XSetTransientForHint
XSetTSOrigin
XSetWindowBackground
XSetWindowBackgroundPixmap
XSetWindowBorder
XSetWindowBorderPixmap
XSetWindowBorderWidth
XSetWindowColormap
XSetWMClientMachine
XSetWMColormapWindows
XSetWMHints
XSetWMIconName
XSetWMName
XSetWMNormalHints
XSetWMProperties
XSetWMProtocols
XSetWMSizeHints
XShrinkRegion
XStoreBuffer
XStoreBytes
XStoreColor
XStoreColors
XStoreName
XStoreNamedColor
XStringListToTextProperty
XStringToKeysym
XSubImage
XSubtractRegion
XSupportsLocale
XSync
XSynchronize
XTextExtents
XTextExtents16
XTextPropertyToStringList
XTextWidth
XTextWidth16
XTranslateCoordinates
XUndefineCursor
XUngrabButton
XUngrabKey
XUngrabKeyboard
XUngrabPointer
XUngrabServer
XUninstallColormap
XUnionRectWithRegion
XUnionRegion
XUnloadFont
XUnmapSubwindows
XUnmapWindow
XUnsetICFocus
XVaCreateNestedList
XVendorRelease
XVisualIDFromVisual
XWarpPointer
XwcDrawImageString
XwcDrawString
XwcDrawText
XwcFreeStringList
XwcLookupString
XwcResetIC
XwcTextEscapement
XwcTextExtents
XwcTextListToTextProperty
XwcTextPerCharExtents
XwcTextPropertyToTextList
XWhitePixel
XWhitePixelOfScreen
XWidthMMOfScreen
XWidthOfScreen
XWindowEvent
XWithdrawWindow
XWMGeometry
XWriteBitmapFile
XXorRegion
_XAllocScratch[1]
_XFlush[1]
_XFlushGCCache[1]
_XRead[1]
_XReadPad[1]
_XReply[1]
_XSend[1]
_XSetLastRequestRead[1]
1 - New in SCD 2.3

Table 10-2: Exported Data for libX.

XcmsCIELabColorSpace[0x18]
XcmsCIELuvColorSpace[0x18]
XcmsCIEuvYColorSpace[0x18]
XcmsCIExyYColorSpace[0x18]
XcmsCIEXYZColorSpace[0x18]
XcmsLinearRGBFunctionSet[0x18]
XcmsRGBColorSpace[0x18]
XcmsRGBiColorSpace[0x18]
XcmsTekHVCColorSpace[0x18]
XcmsUNDEFINEDColorSpace[0x18]
_Xdebug[0x4]

Unsafe Macros

Ordinarily, this document only specifies the system resources available for use by applications on all SPARC compliant systems and makes no comment regarding the programming language or API used by application programmers for building applications. But SPARC International recognizes that many SPARC applications will be written in the C programming language and are likely to use the API specified by the X Consortium. Some of the data structures defined as part of the X ABI, such as struct Display, struct Screen, and struct XImage, are intended to be opaque to the application; that is, the application isn't supposed to contain any knowledge of the size or layout of the data structures.

Some of the macros defined by the X Consortium as part of the X API violate this assumption for opaque data. Below is a table of macros from the X API which are considered by SPARC International to be unsafe; that is, they cause knowledge about the size and/or layout of opaque data structures to be embedded in applications. Embedding this information in an application may prevent the application from being binary compatible with future versions of X which use a different size or layout for these opaque data structures.

Fortunately, each of the unsafe macros has a counterpart in the X library. Table 10-3 below lists each of the unsafe macros and its safe function counterpart from the X library.

Table 10-3: ABI Unsafe Macros

Unsafe Macro	Equivalent X Function
BitmapPad	XBitmapPad
BitmapUnit	XBitmapUnit
BlackPixel	XBlackPixel
BlackPixelOfScreen	XBlackPixelOfScreen
CellsOfScreen	XCellsOfScreen
ClientWhitePointOfCCC	XClientWhitePointOfCCC
ConnectionNumber	XConnectionNumber
DefaultColormap	XDefaultColormap
DefaultColormapOfScreen	XDefaultColormapOfScreen
DefaultDepth	XDefaultDepth
DefaultDepthOfScreen	XDefaultDepthOfScreen
DefaultGC	XDefaultGC
DefaultGCOfScreen	XDefaultGCOfScreen
DefaultRootWindow	XDefaultRootWindow
DefaultScreen	XDefaultScreen
DefaultScreenOfDisplay	XDefaultScreenOfDisplay
DefaultVisual	XDefaultVisual
DefaultVisualOfScreen	XDefaultVisualOfScreen
DisplayCells	XDisplayCells
DisplayHeight	XDisplayHeight
DisplayHeightMM	XDisplayHeightMM
DisplayOfCCC	XDisplayOfCCC
DisplayOfScreen	XDisplayOfScreen
DisplayPlanes	XDisplayPlanes
DisplayString	XDisplayString

Table 10-3: ABI Unsafe Macros

Unsafe Macro	Equivalent X Function
DisplayWidth	XDisplayWidth
DisplayWidthMM	XDisplayWidthMM
DoesBackingStore	XDoesBackingStore
DoesSaveUnders	XDoesSaveUnders
EventMaskOfScreen	XEventMaskOfScreen
HeightMMOfScreen	XHeightMMOfScreen
HeightOfScreen	XHeightOfScreen
ImageByteOrder	XImageByteOrder
LastKnownRequestProcessed	XLastKnownRequestProcessed
MaxCmapsOfScreen	XMaxCmapsOfScreen
MinCmapsOfScreen	XMinCmapsOfScreen
NextRequest	XNextRequest
PlanesOfScreen	XPlanesOfScreen
ProtocolRevision	XProtocolRevision
ProtocolVersion	XProtocolVersion
QLength	XQLength
RootWindow	XRootWindow
RootWindowOfScreen	XRootWindowOfScreen
ScreenCount	XScreenCount
ScreenNumberOfCCC	XScreenNumberOfCCC
ScreenOfDisplay	XScreenOfDisplay
ScreenWhiteOfCCC	XScreenWhiteOfCCC
ServerVendor	XServerVendor
VendorRelease	XVendorRelease
VisualOfCCC	XVisualOfCCC
WhitePixel	XWhitePixel
WhitePixelOfScreen	XWhitePixelOfScreen
WidthMMOfScreen	XWidthMMOfScreen
WidthOfScreen	XWidthOfScreen

Following are the definitions of manifest constants and data types needed by applications to interface to the Xlib functions listed in Table 10-1.

Though the SPARC Compliance Definition specifies an Application Binary Interface (ABI) rather than an Application Program Interface (API) the manifest constants and data type definitions are broken up into different tables based on which header files a programmer would ordinarily expect to find the definitions for two reasons:

- it makes the document more informative for the programmer who is trying to meet the standard, and
- it is expected that this will make the document easier to edit and review.

The header files these definitions are taken from are

- <X11/Xlib.h>,
- <X11/X.h>,
- <X11/Xresource.h>,
- <X11/Xutil.h>,
- <X11/Xcms.h>, and
- <X11/keysymdef.h>.

All header definitions are based on X, version 11, release 5 from the MIT X Consortium.

X Library Changes

The following are changes to the System V Application Binary Interface, SPARC processor supplement, Third Edition.

#	Facility	Location	Description
1	<*X11/X.h*>	psABI	Addition - On page 6-81, in Figure 6-83 add the following constants:

```
#define X_PROTOCOL                  11
#define X_PROTOCOL_REVISION         0
#define ShiftMapIndex               0
#define LockMapIndex                1
#define ControlMapIndex             2
#define Mod1MapIndex                3
#define Mod2MapIndex                4
#define Mod3MapIndex                5
#define Mod4MapIndex                6
#define Mod5MapIndex                7
#define FirstExtensionError         128
#define LastExtensionError          255
#define GCLastBit                   22
#define FontChange                  255
#define DisableScreenSaver          0
#define DisableScreenInterval       0
#define HostInsert                  0
#define HostDelete                  1
```

2	<*X11/X.h*>	psABI	Addition - On page 6-81, in Figure 6-83 add the following type definition: typedef unsigned long Mask;
3	<*X11/Xcms.h*>	psABI	Addition - On page 6-99, in Figure 6-101 make the following addition:

```
typedef struct _XcmsCCC {
    Display             *dpy;
    int                 screenNumber;
    Visual              *visual;
    XcmsColor           clientWhitePt;
    XcmsCompressionProc gamutCompProc;
    XPointer            gamutCompClientData;
    XcmsWhiteAdjustProc whitePtAdjProc;
    XPointer            whitePtAdjClientData;
    XcmsPerScrnInfo     *pPerScrnInfo;
} XcmsCCCRec;
```

4	<*X11/Xcms.h*>	psABI	Change - On page 6-99, in Figure 6-101 make the following change:

```
Replace     typedef void *XcmsCCC;
With        typedef struct _XcmsCCC *XcmsCCC;
```

5	<*X11/Xcms.h*>	psABI	Addition - On page 6-96, in Figure 6-98 add the following type definitions:

```
typedef Status (*XcmsWhiteAdjustProc)();
typedef Status (*XcmsScreenInitProc)();
typedef void (*XcmsScreenFreeProc)();
```

X Library Changes (continued)

#	Facility	Location	Description

6	<*X11/Xlib.h*>	psABI	Change - On page 6-101, in Figure 6-104 make the following changes:
			Replace `typedef void XExtData;`
			With
			`typedef struct _XExtData {`
			`int number;`
			`struct _XExtData *next;`
			`int (*free_private)();`
			`XPointer private_data;`
			`} XExtData;`
			
			Replace `typedef void XExtCodes;`
			With
			`typedef struct {`
			`int extension;`
			`int major_opcode;`
			`int first_event;`
			`int first_error;`
			`} XExtCodes;`

7	<*X11/Xlib.h*>	psABI	Change - On page 6-102, in Figure 6-105 make the following changes: Replace `typedef void *GC;` With `typedef struct _XGC *GC;` Replace `typedef struct _dummy Visual;` With `typedef struct Visual;`
8	<*X11/Xlib.h*>	psABI	Addition - On page 6-102, in Figure 6-105 add the following type definition: typedef struct Depth;
9	<*X11/Xlib.h*>	psABI	Change - On page 6-103, in Figure 6-106 make the following change: Replace `typedef struct _dummy Screen;` With `typedef struct _Screen Screen;`
10	<*X11/Xlib.h*>	psABI	Change - On page 6-107, in Figure 6-110 make the following change: Replace `typedef struct _dummy Display;` With `typedef struct _XDisplay Display;`
11	<*X11/Xlib.h*>	psABI	Change - On page 6-121, in Figure 6-124 make the following change: Replace `typedef struct _dummy XFontSet;` With `typedef struct _XFontSet *XFontSet;`
12	<*X11/Xresource.h*>	psABI	Addition - On page 6-127, in Figure 6-130 add the following constant: `#define NULLSTRING ((XrmString) 0)`

13	<*X11/Xresource.h*>	psABI	Addition - On page 6-127, in Figure 6-130 add the following type definitions:
			`typedef char *XrmString;`
			`typedef struct _XrmHashBucketRec XrmHashBucket;`
			`typedef struct _XrmHashBucketRec *XrmDatabase;`

X Library Changes (continued)

#	Facility	Location	Description
14	<*X11/Xlib.h*>	psABI	Change - On page 6-122, in Figure 6-125 make the following changes: Replace *typedef struct {* *char* **chars;* *int* *nchars;* *int* *delta;* *XFontSet* **font_set;* *} XmbTextItem;* With *typedef struct {* *char* **chars;* *int* *nchars;* *int* *delta;* *XFontSet* *font_set;* *} XmbTextItem;* Replace typedef void *XIM; With typedef struct _XIM *XIM; Replace typedef void *XIC; With typedef struct _XIC *XIC; Replace typedef void *XIC; With typedef struct _XIC *XIC;
15	<*X11/Xutil.h*>	psABI	Change - On page 6-132, in Figure 6-135 make the following changes: Replace typedef void *Region; With: typedef struct _XRegion *Region;
16	<*X11/Xcms.h*>	psABI	Change in Page 6-96 Figure 6-98: typedef unsigned int XcmscolorFormat; to typedef unsigned long XcmsColorFormat;
17	<*X11/Intrinsic.h*>	psABI	Change in Page 6-78 Figure 6-77: #define XtiMAll (XtiMXEvent | XtiMTimer | XtIMAlternateInput) to: #define XtIMAll (XtIMXEvent | XtIMTimer | XtIMAlternateInput | XtIMSignal)

Figure 10-1: Manifest Constants from <X11/keysymdef.h>

```
#define XK_VoidSymbol                   0xFFFFFF
#define XK_BackSpace                    0xFF08
#define XK_Tab                          0xFF09
#define XK_Linefeed                     0xFF0A
#define XK_Clear                        0xFF0B
#define XK_Return                       0xFF0D
#define XK_Pause                        0xFF13
#define XK_Scroll_Lock                  0xFF14
#define XK_Escape                       0xFF1B
#define XK_Delete                       0xFFFF
#define XK_Multi_key                    0xFF20
#define XK_Kanji                        0xFF21
#define XK_Muhenkan                     0xFF22
#define XK_Henkan_Mode                  0xFF23
#define XK_Henkan                       0xFF23
#define XK_Romaji                       0xFF24
#define XK_Hiragana                     0xFF25
#define XK_Katakana                     0xFF26
#define XK_Hiragana_Katakana            0xFF27
#define XK_Zenkaku                      0xFF28
#define XK_Hankaku                      0xFF29
#define XK_Zenkaku_Hankaku              0xFF2A
#define XK_Touroku                      0xFF2B
#define XK_Massyo                       0xFF2C
#define XK_Kana_Lock                    0xFF2D
#define XK_Kana_Shift                   0xFF2E
#define XK_Eisu_Shift                   0xFF2F
#define XK_Eisu_toggle                  0xFF30
#define XK_Home                         0xFF50
#define XK_Left                         0xFF51
#define XK_Up                           0xFF52
#define XK_Right                        0xFF53
#define XK_Down                         0xFF54
#define XK_Prior                        0xFF55
#define XK_Next                         0xFF56
#define XK_End                          0xFF57
#define XK_Begin                        0xFF58
#define XK_Select                       0xFF60
#define XK_Print                        0xFF61
#define XK_Execute                      0xFF62
#define XK_Insert                       0xFF63
#define XK_Undo                         0xFF65
#define XK_Redo                         0xFF66
#define XK_Menu                         0xFF67
#define XK_Find                         0xFF68
#define XK_Cancel                       0xFF69
#define XK_Help                         0xFF6A
#define XK_Break                        0xFF6B
#define XK_Mode_switch                  0xFF7E
#define XK_script_switch                0xFF7E
#define XK_Num_Lock                     0xFF7F
#define XK_KP_Space                     0xFF80
#define XK_KP_Tab                       0xFF89
#define XK_KP_Enter                     0xFF8D
#define XK_KP_F1                        0xFF91
#define XK_KP_F2                        0xFF92
#define XK_KP_F3                        0xFF93
#define XK_KP_F4                        0xFF94
#define XK_KP_Equal                     0xFFBD
#define XK_KP_Multiply                  0xFFAA
#define XK_KP_Add                       0xFFAB
#define XK_KP_Separator                 0xFFAC
#define XK_KP_Subtract                  0xFFAD
#define XK_KP_Decimal                   0xFFAE
#define XK_KP_Divide                    0xFFAF
#define XK_KP_0                         0xFFB0
#define XK_KP_1                         0xFFB1
#define XK_KP_2                         0xFFB2
#define XK_KP_3                         0xFFB3
#define XK_KP_4                         0xFFB4
#define XK_KP_5                         0xFFB5
#define XK_KP_6                         0xFFB6
#define XK_KP_7                         0xFFB7
#define XK_KP_8                         0xFFB8
#define XK_KP_9                         0xFFB9
#define XK_F1                           0xFFBE
#define XK_F2                           0xFFBF
```

```
#define XK_F3                   0xFFC0
#define XK_F4                   0xFFC1
#define XK_F5                   0xFFC2
#define XK_F6                   0xFFC3
#define XK_F7                   0xFFC4
#define XK_F8                   0xFFC5
#define XK_F9                   0xFFC6
#define XK_F10                  0xFFC7
#define XK_F11                  0xFFC8
#define XK_L1                   0xFFC8
#define XK_F12                  0xFFC9
#define XK_L2                   0xFFC9
#define XK_F13                  0xFFCA
#define XK_L3                   0xFFCA
#define XK_F14                  0xFFCB
#define XK_L4                   0xFFCB
#define XK_F15                  0xFFCC
#define XK_L5                   0xFFCC
#define XK_F16                  0xFFCD
#define XK_L6                   0xFFCD
#define XK_F17                  0xFFCE
#define XK_L7                   0xFFCE
#define XK_F18                  0xFFCF
#define XK_L8                   0xFFCF
#define XK_F19                  0xFFD0
#define XK_L9                   0xFFD0
#define XK_F20                  0xFFD1
#define XK_L10                  0xFFD1
#define XK_F21                  0xFFD2
#define XK_R1                   0xFFD2
#define XK_F22                  0xFFD3
#define XK_R2                   0xFFD3
#define XK_F23                  0xFFD4
#define XK_R3                   0xFFD4
#define XK_F24                  0xFFD5
#define XK_R4                   0xFFD5
#define XK_F25                  0xFFD6
#define XK_R5                   0xFFD6
#define XK_F26                  0xFFD7
#define XK_R6                   0xFFD7
#define XK_F27                  0xFFD8
#define XK_R7                   0xFFD8
#define XK_F28                  0xFFD9
#define XK_R8                   0xFFD9
#define XK_F29                  0xFFDA
#define XK_R9                   0xFFDA
#define XK_F30                  0xFFDB
#define XK_R10                  0xFFDB
#define XK_F31                  0xFFDC
#define XK_R11                  0xFFDC
#define XK_F32                  0xFFDD
#define XK_R12                  0xFFDD
#define XK_F33                  0xFFDE
#define XK_R13                  0xFFDE
#define XK_F34                  0xFFDF
#define XK_R14                  0xFFDF
#define XK_F35                  0xFFE0
#define XK_R15                  0xFFE0

/* Modifiers */
#define XK_Shift_L              0xFFE1
#define XK_Shift_R              0xFFE2
#define XK_Control_L            0xFFE3
#define XK_Control_R            0xFFE4
#define XK_Caps_Lock            0xFFE5
#define XK_Shift_Lock           0xFFE6
#define XK_Meta_L               0xFFE7
#define XK_Meta_R               0xFFE8
#define XK_Alt_L                0xFFE9
#define XK_Alt_R                0xFFEA
#define XK_Super_L              0xFFEB
#define XK_Super_R              0xFFEC
#define XK_Hyper_L              0xFFED
#define XK_Hyper_R              0xFFEE

#endif /* XK_MISCELLANY */

/*  Latin 1  Byte 3 = 0  */
#ifdef XK_LATIN1

#define XK_space                0x020
```

```
#define XK_exclam               0x021
#define XK_quotedbl             0x022
#define XK_numbersign           0x023
#define XK_dollar               0x024
#define XK_percent              0x025
#define XK_ampersand            0x026
#define XK_apostrophe           0x027
#define XK_parenleft            0x028
#define XK_parenright           0x029
#define XK_asterisk             0x02a
#define XK_plus                 0x02b
#define XK_comma                0x02c
#define XK_minus                0x02d
#define XK_period               0x02e
#define XK_slash                0x02f
#define XK_0                    0x030
#define XK_1                    0x031
#define XK_2                    0x032
#define XK_3                    0x033
#define XK_4                    0x034
#define XK_5                    0x035
#define XK_6                    0x036
#define XK_7                    0x037
#define XK_8                    0x038
#define XK_9                    0x039
#define XK_colon                0x03a
#define XK_semicolon            0x03b
#define XK_less                 0x03c
#define XK_equal                0x03d
#define XK_greater              0x03e
#define XK_question             0x03f
#define XK_at                   0x040
#define XK_A                    0x041
#define XK_B                    0x042
#define XK_C                    0x043
#define XK_D                    0x044
#define XK_                     0x045
#define XK_F                    0x046
#define XK_G                    0x047
#define XK_H                    0x048
#define XK_I                    0x049
#define XK_J                    0x04a
#define XK_K                    0x04b
#define XK_L                    0x04c
#define XK_M                    0x04d
#define XK_N                    0x04e
#define XK_O                    0x04f
#define XK_P                    0x050
#define XK_Q                    0x051
#define XK_R                    0x052
#define XK_S                    0x053
#define XK_T                    0x054
#define XK_U                    0x055
#define XK_V                    0x056
#define XK_W                    0x057
#define XK_X                    0x058
#define XK_Y                    0x059
#define XK_Z                    0x05a
#define XK_bracketleft          0x05b
#define XK_backslash            0x05c
#define XK_bracketright         0x05d
#define XK_asciicircum          0x05e
#define XK_underscore           0x05f
#define XK_grave                0x060
#define XK_a                    0x061
#define XK_b                    0x062
#define XK_c                    0x063
#define XK_d                    0x064
#define XK_e                    0x065
#define XK_f                    0x066
#define XK_g                    0x067
#define XK_h                    0x068
#define XK_i                    0x069
#define XK_j                    0x06a
#define XK_k                    0x06b
#define XK_l                    0x06c
#define XK_m                    0x06d
#define XK_n                    0x06e
#define XK_o                    0x06f
#define XK_p                    0x070
#define XK_q                    0x071
```

```
#define XK_r                    0x072
#define XK_s                    0x073
#define XK_t                    0x074
#define XK_u                    0x075
#define XK_v                    0x076
#define XK_w                    0x077
#define XK_x                    0x078
#define XK_y                    0x079
#define XK_z                    0x07a
#define XK_braceleft            0x07b
#define XK_bar                  0x07c
#define XK_braceright           0x07d
#define XK_asciitilde           0x07e
#define XK_nobreakspace         0x0a0
#define XK_exclamdown           0x0a1
#define XK_cent                 0x0a2
#define XK_sterling             0x0a3
#define XK_currency             0x0a4
#define XK_yen                  0x0a5
#define XK_brokenbar            0x0a6
#define XK_section              0x0a7
#define XK_diaeresis            0x0a8
#define XK_copyright            0x0a9
#define XK_ordfeminine          0x0aa
#define XK_guillemotleft        0x0ab
#define XK_notsign              0x0ac
#define XK_hyphen               0x0ad
#define XK_registered           0x0ae
#define XK_macron               0x0af
#define XK_degree               0x0b0
#define XK_plusminus            0x0b1
#define XK_twosuperior          0x0b2
#define XK_threesuperior        0x0b3
#define XK_acute                0x0b4
#define XK_mu                   0x0b5
#define XK_paragraph            0x0b6
#define XK_periodcentered       0x0b7
#define XK_cedilla              0x0b8
#define XK_onesuperior          0x0b9
#define XK_masculine            0x0ba
#define XK_guillemotright       0x0bb
#define XK_onequarter           0x0bc
#define XK_onehalf              0x0bd
#define XK_threequarters        0x0be
#define XK_questiondown         0x0bf
#define XK_Agrave               0x0c0
#define XK_Aacute               0x0c1
#define XK_Acircumflex          0x0c2
#define XK_Atilde               0x0c3
#define XK_Adiaeresis           0x0c4
#define XK_Aring                0x0c5
#define XK_AE                   0x0c6
#define XK_Ccedilla             0x0c7
#define XK_Egrave               0x0c8
#define XK_Eacute               0x0c9
#define XK_Ecircumflex          0x0ca
#define XK_Ediaeresis           0x0cb
#define XK_Igrave               0x0cc
#define XK_Iacute               0x0cd
#define XK_Icircumflex          0x0ce
#define XK_Idiaeresis           0x0cf
#define XK_ETH                  0x0d0
#define XK_Ntilde               0x0d1
#define XK_Ograve               0x0d2
#define XK_Oacute               0x0d3
#define XK_Ocircumflex          0x0d4
#define XK_Otilde               0x0d5
#define XK_Odiaeresis           0x0d6
#define XK_multiply             0x0d7
#define XK_Ooblique             0x0d8
#define XK_Ugrave               0x0d9
#define XK_Uacute               0x0da
#define XK_Ucircumflex          0x0db
#define XK_Udiaeresis           0x0dc
#define XK_Yacute               0x0dd
#define XK_THORN                0x0de
#define XK_ssharp               0x0df
#define XK_agrave               0x0e0
#define XK_aacute               0x0e1
#define XK_acircumflex          0x0e2
#define XK_atilde               0x0e3
```

```
#define XK_adiaeresis                   0x0e4
#define XK_aring                        0x0e5
#define XK_ae                           0x0e6
#define XK_ccedilla                     0x0e7
#define XK_egrave                       0x0e8
#define XK_eacute                       0x0e9
#define XK_ecircumfle                   0x0ea
#define XK_ediaeresis                   0x0eb
#define XK_igrave                       0x0ec
#define XK_iacute                       0x0ed
#define XK_icircumflex                  0x0ee
#define XK_idiaeresis                   0x0ef
#define XK_eth                          0x0f0
#define XK_ntilde                       0x0f1
#define XK_ograve                       0x0f2
#define XK_oacute                       0x0f3
#define XK_ocircumflex                  0x0f4
#define XK_otilde                       0x0f5
#define XK_odiaeresis                   0x0f6
#define XK_division                     0x0f7
#define XK_oslash                       0x0f8
#define XK_ugrave                       0x0f9
#define XK_uacute                       0x0fa
#define XK_ucircumflex                  0x0fb
#define XK_udiaeresis                   0x0fc
#define XK_yacute                       0x0fd
#define XK_thorn                        0x0fe
#define XK_ydiaeresis                   0x0ff
#endif /* XK_LATIN1 */

/*   Latin 2   Byte 3 = 1 */
#ifdef XK_LATIN2
#define XK_Aogonek                      0x1a1
#define XK_breve                        0x1a2
#define XK_Lstroke                      0x1a3
#define XK_Lcaron                       0x1a5
#define XK_Sacute                       0x1a6
#define XK_Scaron                       0x1a9
#define XK_Scedilla                     0x1aa
#define XK_Tcaron                       0x1ab
#define XK_Zacute                       0x1ac
#define XK_Zcaron                       0x1ae
#define XK_Zabovedot                    0x1af
#define XK_aogonek                      0x1b1
#define XK_ogonek                       0x1b2
#define XK_lstroke                      0x1b3
#define XK_lcaron                       0x1b5
#define XK_sacute                       0x1b6
#define XK_caron                        0x1b7
#define XK_scaron                       0x1b9
#define XK_scedilla                     0x1ba
#define XK_tcaron                       0x1bb
#define XK_zacute                       0x1bc
#define XK_doubleacute                  0x1bd
#define XK_zcaron                       0x1be
#define XK_zabovedot                    0x1bf
#define XK_Racute                       0x1c0
#define XK_Abreve                       0x1c3
#define XK_Lacute                       0x1c5
#define XK_Cacute                       0x1c6
#define XK_Ccaron                       0x1c8
#define XK_Eogonek                      0x1ca
#define XK_Ecaron                       0x1cc
#define XK_Dcaron                       0x1cf
#define XK_Dstroke                      0x1d0
#define XK_Nacute                       0x1d1
#define XK_Ncaron                       0x1d2
#define XK_Odoubleacute                 0x1d5
#define XK_Rcaron                       0x1d8
#define XK_Uring                        0x1d9
#define XK_Udoubleacute                 0x1db
#define XK_Tcedilla                     0x1de
#define XK_racute                       0x1e0
#define XK_abreve                       0x1e3
#define XK_lacute                       0x1e5
#define XK_cacute                       0x1e6
#define XK_ccaron                       0x1e8
#define XK_eogonek                      0x1ea
#define XK_ecaron                       0x1ec
#define XK_dcaron                       0x1ef
#define XK_dstroke                      0x1f0
```

```
#define XK_nacute                       0x1f1
#define XK_ncaron                       0x1f2
#define XK_odoubleacute                 0x1f5
#define XK_udoubleacute                 0x1fb
#define XK_rcaron                       0x1f8
#define XK_uring                        0x1f9
#define XK_tcedilla                     0x1fe
#define XK_abovedot                     0x1ff
#endif /* XK_LATIN2 */

/*   Latin 3  Byte 3 = 2 */
#ifdef XK_LATIN3
#define XK_Hstroke                      0x2a1
#define XK_Hcircumflex                  0x2a6
#define XK_Iabovedot                    0x2a9
#define XK_Gbreve                       0x2ab
#define XK_Jcircumflex                  0x2ac
#define XK_hstroke                      0x2b1
#define XK_hcircumflex                  0x2b6
#define XK_idotless                     0x2b9
#define XK_gbreve                       0x2bb
#define XK_jcircumflex                  0x2bc
#define XK_Cabovedot                    0x2c5
#define XK_Ccircumflex                  0x2c6
#define XK_Gabovedot                    0x2d5
#define XK_Gcircumflex                  0x2d8
#define XK_Ubreve                       0x2dd
#define XK_Scircumflex                  0x2de
#define XK_cabovedot                    0x2e5
#define XK_ccircumflex                  0x2e6
#define XK_gabovedot                    0x2f5
#define XK_gcircumflex                  0x2f8
#define XK_ubreve                       0x2fd
#define XK_scircumflex                  0x2fe
#endif /* XK_LATIN3 */

/*  Latin 4   Byte 3 = 3 */
#ifdef XK_LATIN4
#define XK_kra                          0x3a2
#define XK_Rcedilla                     0x3a3
#define XK_Itilde                       0x3a5
#define XK_Lcedilla                     0x3a6
#define XK_Emacron                      0x3aa
#define XK_Gcedilla                     0x3ab
#define XK_Tslash                       0x3ac
#define XK_rcedilla                     0x3b3
#define XK_itilde                       0x3b5
#define XK_lcedilla                     0x3b6
#define XK_emacron                      0x3ba
#define XK_gcedilla                     0x3bb
#define XK_tslash                       0x3bc
#define XK_ENG                          0x3bd
#define XK_eng                          0x3bf
#define XK_Amacron                      0x3c0
#define XK_Iogonek                      0x3c7
#define XK_Eabovedot                    0x3cc
#define XK_Imacron                      0x3cf
#define XK_Ncedilla                     0x3d1
#define XK_Omacron                      0x3d2
#define XK_Kcedilla                     0x3d3
#define XK_Uogonek                      0x3d9
#define XK_Utilde                       0x3dd
#define XK_Umacron                      0x3de
#define XK_amacron                      0x3e0
#define XK_iogonek                      0x3e7
#define XK_eabovedot                    0x3ec
#define XK_imacron                      0x3ef
#define XK_ncedilla                     0x3f1
#define XK_omacron                      0x3f2
#define XK_kcedilla                     0x3f3
#define XK_uogonek                      0x3f9
#define XK_utilde                       0x3fd
#define XK_umacron                      0x3fe
#endif /* XK_LATIN4 */

/* Katakana Byte 3 = 4  */
#ifdef XK_KATAKANA
#define XK_overline                     0x47e
#define XK_kana_fullstop                0x4a1
#define XK_kana_openingbracket          0x4a2
#define XK_kana_closingbracket          0x4a3
```

```
#define XK_kana_comma                   0x4a4
#define XK_kana_conjunctive             0x4a5
#define XK_kana_WO                      0x4a6
#define XK_kana_a                       0x4a7
#define XK_kana_i                       0x4a8
#define XK_kana_u                       0x4a9
#define XK_kana_e                       0x4aa
#define XK_kana_o                       0x4ab
#define XK_kana_ya                      0x4ac
#define XK_kana_yu                      0x4ad
#define XK_kana_yo                      0x4ae
#define XK_kana_tsu                     0x4af
#define XK_prolongedsound               0x4b0
#define XK_kana_A                       0x4b1
#define XK_kana_I                       0x4b2
#define XK_kana_U                       0x4b3
#define XK_kana_E                       0x4b4
#define XK_kana_O                       0x4b5
#define XK_kana_KA                      0x4b6
#define XK_kana_KI                      0x4b7
#define XK_kana_KU                      0x4b8
#define XK_kana_KE                      0x4b9
#define XK_kana_KO                      0x4ba
#define XK_kana_SA                      0x4bb
#define XK_kana_SHI                     0x4bc
#define XK_kana_SU                      0x4bd
#define XK_kana_SE                      0x4be
#define XK_kana_SO                      0x4bf
#define XK_kana_TA                      0x4c0
#define XK_kana_CHI                     0x4c1
#define XK_kana_TSU                     0x4c2
#define XK_kana_TE                      0x4c3
#define XK_kana_TO                      0x4c4
#define XK_kana_NA                      0x4c5
#define XK_kana_NI                      0x4c6
#define XK_kana_NU                      0x4c7
#define XK_kana_NE                      0x4c8
#define XK_kana_NO                      0x4c9
#define XK_kana_HA                      0x4ca
#define XK_kana_HI                      0x4cb
#define XK_kana_FU                      0x4cc
#define XK_kana_HE                      0x4cd
#define XK_kana_HO                      0x4ce
#define XK_kana_MA                      0x4cf
#define XK_kana_MI                      0x4d0
#define XK_kana_MU                      0x4d1
#define XK_kana_ME                      0x4d2
#define XK_kana_MO                      0x4d3
#define XK_kana_YA                      0x4d4
#define XK_kana_YU                      0x4d5
#define XK_kana_YO                      0x4d6
#define XK_kana_RA                      0x4d7
#define XK_kana_RI                      0x4d8
#define XK_kana_RU                      0x4d9
#define XK_kana_RE                      0x4da
#define XK_kana_RO                      0x4db
#define XK_kana_WA                      0x4dc
#define XK_kana_N                       0x4dd
#define XK_voicedsound                  0x4de
#define XK_semivoicedsound              0x4df
#define XK_kana_switch                  0xFF7E
#endif /* XK_KATAKANA */

/*  Arabic Byte 3 = 5 */
#ifdef XK_ARABIC
#define XK_Arabic_comma                 0x5ac
#define XK_Arabic_semicolon             0x5bb
#define XK_Arabic_question_mark         0x5bf
#define XK_Arabic_hamza                 0x5c1
#define XK_Arabic_maddaonalef           0x5c2
#define XK_Arabic_hamzaonalef           0x5c3
#define XK_Arabic_hamzaonwaw            0x5c4
#define XK_Arabic_hamzaunderalef        0x5c5
#define XK_Arabic_hamzaonyeh            0x5c6
#define XK_Arabic_alef                  0x5c7
#define XK_Arabic_beh                   0x5c8
#define XK_Arabic_tehmarbuta            0x5c9
#define XK_Arabic_teh                   0x5ca
#define XK_Arabic_theh                  0x5cb
#define XK_Arabic_jeem                  0x5cc
#define XK_Arabic_hah                   0x5cd
```

```
#define XK_Arabic_khah                  0x5ce
#define XK_Arabic_dal                   0x5cf
#define XK_Arabic_thal                  0x5d0
#define XK_Arabic_ra                    0x5d1
#define XK_Arabic_zain                  0x5d2
#define XK_Arabic_seen                  0x5d3
#define XK_Arabic_sheen                 0x5d4
#define XK_Arabic_sad                   0x5d5
#define XK_Arabic_dad                   0x5d6
#define XK_Arabic_tah                   0x5d7
#define XK_Arabic_zah                   0x5d8
#define XK_Arabic_ain                   0x5d9
#define XK_Arabic_ghain                 0x5da
#define XK_Arabic_tatweel               0x5e0
#define XK_Arabic_feh                   0x5e1
#define XK_Arabic_qaf                   0x5e2
#define XK_Arabic_kaf                   0x5e3
#define XK_Arabic_lam                   0x5e4
#define XK_Arabic_meem                  0x5e5
#define XK_Arabic_noon                  0x5e6
#define XK_Arabic_ha                    0x5e7
#define XK_Arabic_waw                   0x5e8
#define XK_Arabic_alefmaksura           0x5e9
#define XK_Arabic_yeh                   0x5ea
#define XK_Arabic_fathatan              0x5eb
#define XK_Arabic_dammatan              0x5ec
#define XK_Arabic_kasratan              0x5ed
#define XK_Arabic_fatha                 0x5ee
#define XK_Arabic_damma                 0x5ef
#define XK_Arabic_kasra                 0x5f0
#define XK_Arabic_shadda                0x5f1
#define XK_Arabic_sukun                 0x5f2
#define XK_Arabic_switch                0xFF7E
#endif /* XK_ARABIC */

/* Cyrillic Byte 3 = 6  */
#ifdef XK_CYRILLIC
#define XK_Serbian_dje                  0x6a1
#define XK_Macedonia_gje                0x6a2
#define XK_Cyrillic_io                  0x6a3
#define XK_Ukrainian_ie                 0x6a4
#define XK_Macedonia_dse                0x6a5
#define XK_Ukrainian_i                  0x6a6
#define XK_Ukrainian_yi                 0x6a7
#define XK_Cyrillic_je                  0x6a8
#define XK_Cyrillic_lje                 0x6a9
#define XK_Cyrillic_nje                 0x6aa
#define XK_Serbian_tshe                 0x6ab
#define XK_Macedonia_kje                0x6ac
#define XK_Byelorussian_shortu          0x6ae
#define XK_Cyrillic_dzhe                0x6af
#define XK_numerosign                   0x6b0
#define XK_Serbian_DJE                  0x6b1
#define XK_Macedonia_GJE                0x6b2
#define XK_Cyrillic_IO                  0x6b3
#define XK_Ukrainian_IE                 0x6b4
#define XK_Macedonia_DSE                0x6b5
#define XK_Ukrainian_I                  0x6b6
#define XK_Ukrainian_YI                 0x6b7
#define XK_Cyrillic_JE                  0x6b8
#define XK_Cyrillic_LJE                 0x6b9
#define XK_Cyrillic_NJE                 0x6ba
#define XK_Serbian_TSHE                 0x6bb
#define XK_Macedonia_KJE                0x6bc
#define XK_Byelorussian_SHORTU          0x6be
#define XK_Cyrillic_DZHE                0x6bf
#define XK_Cyrillic_yu                  0x6c0
#define XK_Cyrillic_a                   0x6c1
#define XK_Cyrillic_be                  0x6c2
#define XK_Cyrillic_tse                 0x6c3
#define XK_Cyrillic_de                  0x6c4
#define XK_Cyrillic_ie                  0x6c5
#define XK_Cyrillic_ef                  0x6c6
#define XK_Cyrillic_ghe                 0x6c7
#define XK_Cyrillic_ha                  0x6c8
#define XK_Cyrillic_i                   0x6c9
#define XK_Cyrillic_shorti              0x6ca
#define XK_Cyrillic_ka                  0x6cb
#define XK_Cyrillic_el                  0x6cc
#define XK_Cyrillic_em                  0x6cd
#define XK_Cyrillic_en                  0x6ce
```

```
#define XK_Cyrillic_o                   0x6cf
#define XK_Cyrillic_pe                  0x6d0
#define XK_Cyrillic_ya                  0x6d1
#define XK_Cyrillic_er                  0x6d2
#define XK_Cyrillic_es                  0x6d3
#define XK_Cyrillic_te                  0x6d4
#define XK_Cyrillic_u                   0x6d5
#define XK_Cyrillic_zhe                 0x6d6
#define XK_Cyrillic_ve                  0x6d7
#define XK_Cyrillic_softsign            0x6d8
#define XK_Cyrillic_yeru                0x6d9
#define XK_Cyrillic_ze                  0x6da
#define XK_Cyrillic_sha                 0x6db
#define XK_Cyrillic_e                   0x6dc
#define XK_Cyrillic_shcha               0x6dd
#define XK_Cyrillic_che                 0x6de
#define XK_Cyrillic_hardsign            0x6df
#define XK_Cyrillic_YU                  0x6e0
#define XK_Cyrillic_A                   0x6e1
#define XK_Cyrillic_BE                  0x6e2
#define XK_Cyrillic_TSE                 0x6e3
#define XK_Cyrillic_DE                  0x6e4
#define XK_Cyrillic_IE                  0x6e5
#define XK_Cyrillic_EF                  0x6e6
#define XK_Cyrillic_GHE                 0x6e7
#define XK_Cyrillic_HA                  0x6e8
#define XK_Cyrillic_I                   0x6e9
#define XK_Cyrillic_SHORTI              0x6ea
#define XK_Cyrillic_KA                  0x6eb
#define XK_Cyrillic_EL                  0x6ec
#define XK_Cyrillic_EM                  0x6ed
#define XK_Cyrillic_EN                  0x6ee
#define XK_Cyrillic_O                   0x6ef
#define XK_Cyrillic_PE                  0x6f0
#define XK_Cyrillic_YA                  0x6f1
#define XK_Cyrillic_ER                  0x6f2
#define XK_Cyrillic_ES                  0x6f3
#define XK_Cyrillic_TE                  0x6f4
#define XK_Cyrillic_U                   0x6f5
#define XK_Cyrillic_ZHE                 0x6f6
#define XK_Cyrillic_VE                  0x6f7
#define XK_Cyrillic_SOFTSIGN            0x6f8
#define XK_Cyrillic_YERU                0x6f9
#define XK_Cyrillic_ZE                  0x6fa
#define XK_Cyrillic_SHA                 0x6fb
#define XK_Cyrillic_E                   0x6fc
#define XK_Cyrillic_SHCHA               0x6fd
#define XK_Cyrillic_CHE                 0x6fe
#define XK_Cyrillic_HARDSIGN            0x6ff
#endif /* XK_CYRILLIC */

/* Greek* Byte 3 = 7 */
#ifdef XK_GREEK
#define XK_Greek_ALPHAaccent            0x7a1
#define XK_Greek_EPSILONaccent          0x7a2
#define XK_Greek_ETAaccent              0x7a3
#define XK_Greek_IOTAaccent             0x7a4
#define XK_Greek_IOTAdiaeresis          0x7a5
#define XK_Greek_OMICRONaccent          0x7a7
#define XK_Greek_UPSILONaccent          0x7a8
#define XK_Greek_UPSILONdieresis        0x7a9
#define XK_Greek_OMEGAaccent            0x7ab
#define XK_Greek_accentdieresis         0x7ae
#define XK_Greek_horizbar               0x7af
#define XK_Greek_alphaaccent            0x7b1
#define XK_Greek_epsilonaccent          0x7b2
#define XK_Greek_etaaccent              0x7b3
#define XK_Greek_iotaaccent             0x7b4
#define XK_Greek_iotadieresis           0x7b5
#define XK_Greek_iotaaccentdieresis     0x7b6
#define XK_Greek_omicronaccent          0x7b7
#define XK_Greek_upsilonaccent          0x7b8
#define XK_Greek_upsilondieresis        0x7b9
#define XK_Greek_upsilonaccentdieresis  0x7ba
#define XK_Greek_omegaaccent            0x7bb
#define XK_Greek_ALPHA                  0x7c1
#define XK_Greek_BETA                   0x7c2
#define XK_Greek_GAMMA                  0x7c3
#define XK_Greek_DELTA                  0x7c4
#define XK_Greek_EPSILON                0x7c5
#define XK_Greek_ZETA                   0x7c6
```

```
#define XK_Greek_ETA                    0x7c7
#define XK_Greek_THETA                  0x7c8
#define XK_Greek_IOTA                   0x7c9
#define XK_Greek_KAPPA                  0x7ca
#define XK_Greek_LAMDA                  0x7cb
#define XK_Greek_LAMBDA                 0x7cb
#define XK_Greek_MU                     0x7cc
#define XK_Greek_NU                     0x7cd
#define XK_Greek_XI                     0x7ce
#define XK_Greek_OMICRON                0x7cf
#define XK_Greek_PI                     0x7d0
#define XK_Greek_RHO                    0x7d1
#define XK_Greek_SIGMA                  0x7d2
#define XK_Greek_TAU                    0x7d4
#define XK_Greek_UPSILON                0x7d5
#define XK_Greek_PHI                    0x7d6
#define XK_Greek_CHI                    0x7d7
#define XK_Greek_PSI                    0x7d8
#define XK_Greek_OMEGA                  0x7d9
#define XK_Greek_alpha                  0x7e1
#define XK_Greek_beta                   0x7e2
#define XK_Greek_gamma                  0x7e3
#define XK_Greek_delta                  0x7e4
#define XK_Greek_epsilon                0x7e5
#define XK_Greek_zeta                   0x7e6
#define XK_Greek_eta                    0x7e7
#define XK_Greek_theta                  0x7e8
#define XK_Greek_iota                   0x7e9
#define XK_Greek_kappa                  0x7ea
#define XK_Greek_lamda                  0x7eb
#define XK_Greek_lambda                 0x7eb
#define XK_Greek_mu                     0x7ec
#define XK_Greek_nu                     0x7ed
#define XK_Greek_xi                     0x7ee
#define XK_Greek_omicron                0x7ef
#define XK_Greek_pi                     0x7f0
#define XK_Greek_rho                    0x7f1
#define XK_Greek_sigma                  0x7f2
#define XK_Greek_finalsmallsigma        0x7f3
#define XK_Greek_tau                    0x7f4
#define XK_Greek_upsilon                0x7f5
#define XK_Greek_phi                    0x7f6
#define XK_Greek_chi                    0x7f7
#define XK_Greek_psi                    0x7f8
#define XK_Greek_omega                  0x7f9
#define XK_Greek_switch                 0xFF7E
#endif /* XK_GREEK */

/*TechnicalByte 3 = 8  */
#ifdef XK_TECHNICAL
#define XK_leftradical                  0x8a1
#define XK_topleftradical               0x8a2
#define XK_horizconnector               0x8a3
#define XK_topintegral                  0x8a4
#define XK_botintegral                  0x8a5
#define XK_vertconnector                0x8a6
#define XK_topleftsqbracket             0x8a7
#define XK_botleftsqbracket             0x8a8
#define XK_toprightsqbracket            0x8a9
#define XK_botrightsqbracket            0x8aa
#define XK_topleftparens                0x8ab
#define XK_botleftparens                0x8ac
#define XK_toprightparens               0x8ad
#define XK_botrightparens               0x8ae
#define XK_leftmiddlecurlybrace         0x8af
#define XK_rightmiddlecurlybrace        0x8b0
#define XK_topleftsummation             0x8b1
#define XK_botleftsummation             0x8b2
#define XK_topvertsummationconnector    0x8b3
#define XK_botvertsummationconnector    0x8b4
#define XK_toprightsummation            0x8b5
#define XK_botrightsummation            0x8b6
#define XK_rightmiddlesummation         0x8b7
#define XK_lessthanequal                0x8bc
#define XK_notequal                     0x8bd
#define XK_greaterthanequal             0x8be
#define XK_integral                     0x8bf
#define XK_therefore                    0x8c0
#define XK_variation                    0x8c1
#define XK_infinity                     0x8c2
#define XK_nabla                        0x8c5
```

```
#define XK_approximate                  0x8c8
#define XK_similarequal                 0x8c9
#define XK_ifonlyif                     0x8cd
#define XK_implies                      0x8ce
#define XK_identical                    0x8cf
#define XK_radical                      0x8d6
#define XK_includedin                   0x8da
#define XK_includes                     0x8db
#define XK_intersection                 0x8dc
#define XK_union                        0x8dd
#define XK_logicaland                   0x8de
#define XK_logicalor                    0x8df
#define XK_partialderivative            0x8ef
#define XK_function                     0x8f6
#define XK_leftarrow                    0x8fb
#define XK_uparrow                      0x8fc
#define XK_rightarrow                   0x8fd
#define XK_downarrow                    0x8fe
#endif /* XK_TECHNICAL */

/* Special Byte 3 = 9 */
#ifdef XK_SPECIAL
#define XK_blank                        0x9df
#define XK_soliddiamond                 0x9e0
#define XK_checkerboard                 0x9e1
#define XK_ht                           0x9e2
#define XK_ff                           0x9e3
#define XK_cr                           0x9e4
#define XK_lf                           0x9e5
#define XK_nl                           0x9e8
#define XK_vt                           0x9e9
#define XK_lowrightcorner               0x9ea
#define XK_uprightcorner                0x9eb
#define XK_upleftcorner                 0x9ec
#define XK_lowleftcorner                0x9ed
#define XK_crossinglines                0x9ee
#define XK_horizlinescan1               0x9ef
#define XK_horizlinescan3               0x9f0
#define XK_horizlinescan5               0x9f1
#define XK_horizlinescan7               0x9f2
#define XK_horizlinescan9               0x9f3
#define XK_leftt                        0x9f4
#define XK_rightt                       0x9f5
#define XK_bott                         0x9f6
#define XK_topt                         0x9f7
#define XK_vertbar                      0x9f8
#endif /* XK_SPECIAL */

/* Publishing  Byte 3 = a */
#ifdef XK_PUBLISHING
#define XK_emspace                      0xaa1
#define XK_enspace                      0xaa2
#define XK_em3space                     0xaa3
#define XK_em4space                     0xaa4
#define XK_digitspace                   0xaa5
#define XK_punctspace                   0xaa6
#define XK_thinspace                    0xaa7
#define XK_hairspace                    0xaa8
#define XK_emdash                       0xaa9
#define XK_endash                       0xaaa
#define XK_signifblank                  0xaac
#define XK_ellipsis                     0xaae
#define XK_doubbaselinedot              0xaaf
#define XK_onethird                     0xab0
#define XK_twothirds                    0xab1
#define XK_onefifth                     0xab2
#define XK_twofifths                    0xab3
#define XK_threefifths                  0xab4
#define XK_fourfifths                   0xab5
#define XK_onesixth                     0xab6
#define XK_fivesixths                   0xab7
#define XK_careof                       0xab8
#define XK_figdash                      0xabb
#define XK_leftanglebracket             0xabc
#define XK_decimalpoint                 0xabd
#define XK_rightanglebracket            0xabe
#define XK_marker                       0xabf
#define XK_oneeighth                    0xac3
#define XK_threeeighths                 0xac4
#define XK_fiveeighths                  0xac5
#define XK_seveneighths                 0xac6
```

```
#define XK_trademark                    0xac9
#define XK_signaturemark                0xaca
#define XK_trademarkincircle            0xacb
#define XK_leftopentriangle             0xacc
#define XK_rightopentriangle            0xacd
#define XK_emopencircle                 0xace
#define XK_emopenrectangle              0xacf
#define XK_leftsinglequotemark          0xad0
#define XK_rightsinglequotemark         0xad1
#define XK_leftdoublequotemark          0xad2
#define XK_rightdoublequotemark         0xad3
#define XK_prescription                 0xad4
#define XK_minutes                      0xad6
#define XK_seconds                      0xad7
#define XK_latincross                   0xad9
#define XK_hexagram                     0xada
#define XK_filledrectbullet             0xadb
#define XK_filledlefttribullet          0xadc
#define XK_filledrighttribullet         0xadd
#define XK_emfilledcircle               0xade
#define XK_emfilledrect                 0xadf
#define XK_enopencircbullet             0xae0
#define XK_enopensquarebullet           0xae1
#define XK_openrectbullet               0xae2
#define XK_opentribulletup              0xae3
#define XK_opentribulletdown            0xae4
#define XK_openstar                     0xae5
#define XK_enfilledcircbullet           0xae6
#define XK_enfilledsqbullet             0xae7
#define XK_filledtribulletup            0xae8
#define XK_filledtribulletdown          0xae9
#define XK_leftpointer                  0xaea
#define XK_rightpointer                 0xaeb
#define XK_club                         0xaec
#define XK_diamond                      0xaed
#define XK_heart                        0xaee
#define XK_maltesecross                 0xaf0
#define XK_dagger                       0xaf1
#define XK_doubledagger                 0xaf2
#define XK_checkmark                    0xaf3
#define XK_ballotcross                  0xaf4
#define XK_musicalsharp                 0xaf5
#define XK_musicalflat                  0xaf6
#define XK_malesymbol                   0xaf7
#define XK_femalesymbol                 0xaf8
#define XK_telephone                    0xaf9
#define XK_telephonerecorder            0xafa
#define XK_phonographcopyright          0xafb
#define XK_caret                        0xafc
#define XK_singlelowquotemark           0xafd
#define XK_doublelowquotemark           0xafe
#define XK_cursor                       0xaff
#endif /* XK_PUBLISHING */

/*  APL   Byte 3 = b  */
#ifdef XK_APL
#define XK_leftcaret                    0xba3
#define XK_rightcaret                   0xba6
#define XK_downcaret                    0xba8
#define XK_upcaret                      0xba9
#define XK_overbar                      0xbc0
#define XK_downtack                     0xbc2
#define XK_upshoe                       0xbc3
#define XK_downstile                    0xbc4
#define XK_underbar                     0xbc6
#define XK_jot                          0xbca
#define XK_quad                         0xbcc
#define XK_uptack                       0xbce
#define XK_circle                       0xbcf
#define XK_upstile                      0xbd3
#define XK_downshoe                     0xbd6
#define XK_rightshoe                    0xbd8
#define XK_leftshoe                     0xbda
#define XK_lefttack                     0xbdc
#define XK_righttack                    0xbfc
#endif /* XK_APL */

/* Hebrew  Byte 3 = c  */
#ifdef XK_HEBREW
#define XK_hebrew_doublelowline         0xcdf
#define XK_hebrew_aleph                 0xce0
```

```
#define XK_hebrew_bet                0xce1
#define XK_hebrew_gimel              0xce2
#define XK_hebrew_dalet              0xce3
#define XK_hebrew_he                 0xce4
#define XK_hebrew_waw                0xce5
#define XK_hebrew_zain               0xce6
#define XK_hebrew_chet               0xce7
#define XK_hebrew_tet                0xce8
#define XK_hebrew_yod                0xce9
#define XK_hebrew_finalkaph          0xcea
#define XK_hebrew_kaph               0xceb
#define XK_hebrew_lamed              0xcec
#define XK_hebrew_finalmem           0xced
#define XK_hebrew_mem                0xcee
#define XK_hebrew_finalnun           0xcef
#define XK_hebrew_nun                0xcf0
#define XK_hebrew_samech             0xcf1
#define XK_hebrew_ayin               0xcf2
#define XK_hebrew_finalpe            0xcf3
#define XK_hebrew_pe                 0xcf4
#define XK_hebrew_finalzade          0xcf5
#define XK_hebrew_zade               0xcf6
#define XK_hebrew_qoph               0xcf7
#define XK_hebrew_resh               0xcf8
#define XK_hebrew_shin               0xcf9
#define XK_hebrew_taw                0xcfa
#define XK_Hebrew_switch             0xFF7E
```

The X Extension Library

Overview

This chapter identifies binary interfaces for libXext, which are defined in the document entitled "X11 Nonrectangular Window Shape Extension" by Keith Packard (copyright X Consortium).

The Extension Library Interfaces

The interfaces listed below in Table 10-4 have been included in SCD2.4 because they are REQUIRED to be present on all compliant systems, in the dynamic library */usr/lib/libXext.so.0*. Note that for this release of the SCD the interfaces exported by this library are restricted only to those concerned with the X11 Nonrectangular Window Shape Extension.

Table 10-4: Contents of libXext

XShapeCombineMask
XShapeCombineRectangles
XShapeCombineRegion
XShapeCombineShape
XShapeGetRectangles
XShapeInputSelected
XShapeOffsetShape
XShapeQueryExtension
XShapeQueryExtents
XShapeQueryVersion
XShapeSelectInput

Figure 10-2 details the manifest constants associated with the Extension library.

Figure 10-2: Manifest Constants from <X11/extensions/shape.h>

```
#define ShapeSet                0
#define ShapeUnion              1
#define ShapeIntersect          2
#define ShapeSubtract           3
#define ShapeInvert             4
#define ShapeBounding           0
#define ShapeClip               1
#define ShapeNotifyMask         (1L << 0)
#define ShapeNotify             0
```

The X Toolkit

Overview

This chapter identifies binary interfaces for `libXt`, which are defined in the document *X Toolkit Intrisincs - C Language Interface* by Joel McCormack, Paul Asente, and Ralph R. Swick which is distributed by the X Consortium with X Version 11, Release 5.

In addition, all SCD 2.4 systems will support the X 11 Release 5 Protocol, as defined in *The X Window System (Third Edition)* by Robert W. Scheifler and James Gettys (Digital Press, ISBN 1-55558-088-2).

Finally, all SCD 2.4 systems will support the mechanisms and conventions as specified in the *Inter-Client Communications Convention Manual* (ICCCM) in *The X Window System (Third Edition)* by Robert W. Scheifler and James Gettys (Digital Press, ISBN 1-55558-088-2).

The libXt Interfaces

The interfaces listed below in Table 10-5 and Table 10-6 have been included in SCD 2.4 because they are REQUIRED to be present on all compliant systems, in the dynamic libraries: */usr/lib/libXt.so.4* and */usr/lib/libXt.so.5*.

Table 10-7 contains a list of unsafe macros. These macros should be avoided by application programmers which are trying to build portable SPARC applications.

Table 10-8 contains the exported data which are also REQUIRED to be present in libXt.so.4 and libXt.so.5. The format of these entries is: data[size]. Data without a size are opaque.

Since the X Version 11, Release 5 specification is a proper superset of the X Version 11, Release 4 specification, application developers can link to either */usr/lib/libXt.so.4* or */usr/lib/libXt.so.5* to access X Version 11, Release 4 and Release 5 interfaces. See the SPARC Compliance Definition 2.0, 2.1, 2.2, 2.3 or 2.4 for a list of X11R4 components.

Figures 10-10 through 10-18 detail the manifest constants and visible data structures associated with the X Toolkit library.

Figures 10-19 through 10-26 detail the manifest constants and visible data structures needed by widget programmers. Only widget programmers should use the information in these figures.

Table 10-5. Contents of `libXt`, Part 1 of 2

XtAddCallback
XtAddCallbacks
XtAddEventHandler
XtAddExposureToRegion
XtAddGrab
XtAddRawEventHandler
XtAllocateGC
XtAppAddActionHook
XtAppAddActions
XtAppAddInput
XtAppAddTimeOut
XtAppAddWorkProc
XtAppCreateShell
XtAppError
XtAppErrorMsg
XtAppGetErrorDatabase
XtAppGetErrorDatabaseText
XtAppGetSelectionTimeout
XtAppInitialize
XtAppMainLoop
XtAppNextEvent
XtAppPeekEvent
XtAppPending
XtAppProcessEvent
XtAppReleaseCacheRefs
XtAppSetErrorHandler
XtAppSetErrorMsgHandler
XtAppSetFallbackResources
XtAppSetSelectionTimeout
XtAppSetTypeConverter
XtAppSetWarningHandler
XtAppSetWarningMsgHandler
XtAppWarning
XtAppWarningMsg
XtAugmentTranslations
XtBuildEventMask
XtCallAcceptFocus
XtCallActionProc
XtCallbackExclusive
XtCallbackNone
XtCallbackNonexclusive
XtCallbackPopdown
XtCallbackReleaseCacheRef
XtCallbackReleaseCacheRefList
XtCallCallbackList
XtCallCallbacks
XtCallConverter
XtCalloc
XtClass
XtCloseDisplay
XtConfigureWidget
XtConvertAndStore
XtConvertCase
XtCreateApplicationContext
XtCreateManagedWidget
XtCreatePopupShell
XtCreateWidget
XtCreateWindow
XtCvtColorToPixel
XtCvtIntToBool
XtCvtIntToBoolean
XtCvtIntToColor
XtCvtIntToFloat
XtCvtIntToFont
XtCvtIntToPixel
XtCvtIntToPixmap
XtCvtIntToShort
XtCvtIntToUnsignedChar
XtCvtStringToAcceleratorTable
XtCvtStringToAtom
XtCvtStringToBool
XtCvtStringToBoolean
XtCvtStringToCursor
XtCvtStringToDimension
XtCvtStringToDisplay
XtCvtStringToFile
XtCvtStringToFloat
XtCvtStringToFont
XtCvtStringToFontSet
XtCvtStringToFontStruct
XtCvtStringToInitialState
XtCvtStringToInt
XtCvtStringToPixel
XtCvtStringToShort
XtCvtStringToTranslationTable
XtCvtStringToUnsignedChar
XtCvtStringToVisual
XtDatabase
XtDestroyApplicationContext
XtDestroyWidget
XtDisownSelection
XtDispatchEvent
XtDisplay
XtDisplayInitialize
XtDisplayOfObject
XtDisplayStringConversionWarning
XtDisplayToApplicationContext
XtFindFile
XtFree
XtGetActionKeysym
XtGetActionList
XtGetApplicationNameAndClass
XtGetApplicationResources
XtGetConstraintResourceList
XtGetGC
XtGetKeysymTable
XtGetMultiClickTime
XtGetResourceList
XtGetSelectionRequest
XtGetSelectionValue
XtGetSelectionValueIncremental
XtGetSelectionValues
XtGetSelectionValuesIncremental
XtGetSubresources
XtGetSubvalues
XtGetValues
XtGrabButton
XtGrabKey
XtGrabKeyboard
XtGrabPointer
XtHasCallbacks
XtInitializeWidgetClass
XtInsertEventHandler
XtInsertRawEventHandler
XtInstallAccelerators
XtInstallAllAccelerators
XtIsApplicationShell
XtIsComposite
XtIsConstraint
XtIsManaged
XtIsObject
XtIsOverrideShell
XtIsRealized
XtIsRectObj
XtIsSensitive
XtIsShell
XtIsSubclass
XtIsTopLevelShell
XtIsTransientShell
XtIsVendorShell
XtIsWidget
XtIsWMShell
XtKeysymToKeycodeList
XtLastTimestampProcessed
XtMakeGeometryRequest
XtMakeResizeRequest
XtMalloc
XtManageChild
XtManageChildren
XtMapWidget
XtMenuPopupAction
XtMergeArgLists
XtMoveWidget
XtName
XtNameToWidget
XtNewString
XtOpenDisplay
XtOverrideTranslations
XtOwnSelection
XtOwnSelectionIncremental
XtParent
XtParseAcceleratorTable
XtParseTranslationTable
XtPopdown
XtPopup
XtPopupSpringLoaded
XtQueryGeometry
XtRealizeWidget
XtRealloc
XtRegisterCaseConverter
XtRegisterGrabAction
XtReleaseGC
XtRemoveActionHook
XtRemoveAllCallbacks
XtRemoveCallback
XtRemoveCallbacks
XtRemoveEventHandler
XtRemoveGrab
XtRemoveInput
XtRemoveRawEventHandler
XtRemoveTimeOut
XtRemoveWorkProc
XtResizeWidget
XtResizeWindow
XtResolvePathname
XtScreen
XtScreenDatabase
XtScreenOfObject
XtSetKeyboardFocus
XtSetKeyTranslator
XtSetLanguageProc
XtSetMappedWhenManaged
XtSetMultiClickTime
XtSetSensitive
XtSetSubvalues
XtSetTypeConverter
XtSetValues
XtSetWMColormapWindows
XtSuperclass
XtToolkitInitialize
XtTranslateCoords

Table 10-5. Contents of `libXt`, Part 2 of 2

XtTranslateKey	XtUnrealizeWidget	XtVaGetValues
XtTranslateKeycode	XtVaAppCreateShell	XtVaSetSubvalues
XtUngrabButton	XtVaAppInitialize	XtVaSetValues
XtUngrabKey	XtVaCreateArgsList	XtWidgetToApplicationContext
XtUngrabKeyboard	XtVaCreateManagedWidget	XtWindow
XtUngrabPointer	XtVaCreatePopupShell	XtWindowOfObject
XtUninstallTranslations	XtVaCreateWidget	XtWindowToWidget
XtUnmanageChild	XtVaGetApplicationResources	
XtUnmanageChildren	XtVaGetSubresources	_XTInherit
XtUnmapWidget	XtVaGetSubvalues	

Deprecated X Toolkit Functions

Table10-6 is a list of Xt functions which are now DEPRECATED but continue to be supported for the sake of old applications. The X Consortium defines these functions as obsolete. When MIT stops shipping these functions as part of the X11 sample implementation these functions may be removed from the SCD. Application developers are discouraged from using these functions in new applications. The effective date of DEPRECATION is November 1st, 1993. These function interfaces may be removed from the SCD as early as November 1st, 1996

Table10-6: Deprecated libXt Functions

Obsolete Function	Superseded By
XtAddActions	XtAppAddActions
XtAddConverter	XtSetTypeConverter
XtAddInput	XtAppAddInput
XtAddTimeOut	XtAppAddTimeOut
XtAddWorkProc	XtAppAddWorkProc2
XtAppAddConverter	XtAppSetTypeConverter
XtConvert	XtConvertAnStore
XtCreateApplicationShell	XtAppCreateShell
XtDestroyGC	XtReleaseGC
XtDirectConvert	XtCallConverter
XtError	XtAppError
XtErrorMsg	XtAppErrorMsg
XtGetErrorDatabase	XtAppGetErrorDatabase
XtGetErrorDatabaseText	XtAppGetErrorDatabaseText
XtGetSelectionTimeout	XtAppGetSelectionTimeout
XtInitialize	XtAppInitialize
XtMainLoop	XtAppMainLoop
XtNextEvent	XtAppNextEvent
XtPeekEvent	XtAppPeekEvent
XtPending	XtAppPending
XtProcessEvent	XtAppProcessEvent
XtSetErrorHandler	XtAppSetErrorHandler
XtSetErrorMsgHandler	XtAppSetErrorMsgHandler
XtSetSelectionTimeout	XtAppSetSelectionTimeout
XtSetWarningHandler	XtAppSetWarningHandler
XtSetWarningMsgHandler	XtAppSetWarningMsgHandler
XtStringConversionWarning	XtDisplayStringConversionWarning
XtWarning	XtAppWarning
XtWarningMsg	XtAppWarningMsg

Unsafe Macros

Ordinarily, this document only specifies the system resources available for use by applications on all SPARC compliant systems and makes no comment regarding the programming language or API used by application programmers for building applications. But SPARC International recognizes that many SPARC applications will be written in the C programming language and are likely to use the API specified by the X Consortium. Some of the macros defined by the X Consortium for the X Toolkit access symbols which are not defined to be part of the ABI.

All of these macros are defined by the `<X11/Intrinsic.h>` header file. Fortunately, each of these macros have ABI compliant functions which can be used in their place. Table 10-7 has a list of these macros. The ABI compliant functions have the same name as the the unsafe macros. This means that C programmers that wish to use the functions, rather than the macros, must "`#undef`" the macros in their source code after the point where the source code includes `<X11/Intrinsic.h>`.

Table 10-7. Unsafe Macros

XtIsApplicationShell
XtIsComposite
XtIsConstraint
XtIsOverrideShell
XtIsRectObj
XtIsShell
XtIsTopLevelShell
XtIsTransientShell
XtIsVendorShell
XtIsWidget
XtIsWMShell

Table 10-8. Exported Data for libXt.

applicationShellClassRec[0x9c]
applicationShellWidgetClass[0x4]
colorConvertArgs[0x18]
compositeClassRec[0x88]
compositeWidgetClass[0x4]
constraintClassRec[0xa4]
constraintWidgetClass[0x4]
coreWidgetClass[0x4]
objectClass[0x4]
objectClassRec[0x74]
overrideShellClassRec[0x90]
overrideShellWidgetClass[0x4]
rectObjClass[0x4]
rectObjClassRec[0x74]
screenConvertArg[0xc]
shellClassRec[0x8c]
shellWidgetClass[0x4]
topLevelShellClassRec[0x98]
topLevelShellWidgetClass[0x4]
transientShellClassRec[0x98]
transientShellWidgetClass[0x4]
vendorShellClassRec[0x94]
vendorShellWidgetClass[0x4]
widgetClass[0x4]
widgetClassRec[0x74]
wmShellClassRec[0x90]
wmShellWidgetClass[0x4]
XtCXtToolkitError[0x4]
_XtInheritTranslations[1]
XtShellStrings[2]
XtStrings[3]

1. `_XtInheritTranslations` is only for use by widget programmers.
2. `XtShellStrings` and `XtStrings` are reserved for use by the X Toolkit Library but applications which are intended to be portable at the binary level must refrain from accessing these global symbols. The definition of these global data may change in incompatible ways in future releases of X.
3. See note number 3.

Figure 10-3: Manifest Constants and Data Types from <X11/Composite.h>

```
typedef struct _CompositeClassRec *CompositeWidgetClass;
typedef Cardinal (*XtOrderProc)();
```

Figure 10-4: Manifest Constants and Data Types from <X11/Constraint.h>

```
typedef struct _ConstraintClassRec *ConstraintWidgetClass;
```

Figure 10-5: Manifest Constants and Data Types from <X11/Core.h>

```
typedef struct _WidgetClassRec *CoreWidgetClass;
typedef struct _WidgetRec *CoreWidget
```

Figure 10-6: Manifest Constants and Data Types from <X11/Intrinsic.h>

```
#define XtSpecificationRelease                  5
typedef char                                    *String;
typedef struct _WidgetRec                       *Widget;
typedef Widget                                  *WidgetList;
typedef struct _WidgetClassRec                  *WidgetClass;
typedef struct _CompositeRec                    *CompositeWidget;
typedef struct _XtActionsRec                    *XtActionList;
typedef struct _XtEventRec                      *XtEventTable;
typedef struct _XtBoundAccActionRec             *XtBoundAccActions;
typedef struct _XtAppStruct                     *XtAppContext;
typedef unsigned long                           XtValueMask;
typedef unsigned long                           XtIntervalId;
typedef unsigned long                           XtInputId;
typedef unsigned long                           XtWorkProcId;
typedef unsigned int                            XtGeometryMask;
typedef unsigned long                           XtGCMask;   /* Mask of values that are used by widget*/
typedef unsigned long                           Pixel;      /* Index into colormap          */
typedef int                                     XtCacheType;
#define         XtCacheNone                     0x001
#define         XtCacheAll                      0x002
#define         XtCacheByDisplay                0x003
#define         XtCacheRefCount                 0x100
typedef char                                    Boolean;
typedef long                                    XtArgVal;
typedef unsigned char   XtEnum;
typedef unsigned int    Cardinal;
typedef unsigned short  Dimension;  /* Size in pixels               */
typedef short           Position;   /* Offset from 0 coordinate     */
typedef char*           XtPointer;
typedef XtPointer                                                       Opaque;
typedef struct _TranslationData                                         *XtTranslations;
typedef struct _TranslationData                                         *XtAccelerators;
typedef unsigned int                                                    Modifiers;
typedef void                                                            *XtActionProc)();
typedef XtActionProc* XtBoundActions;
typedef struct _XtActionsRec{String string;XtActionProc proc; XtActionsRec;
typedef enum {XtAddress,XtBaseOffset,XtImmediate,
   XtResourceString,XtResourceQuark, XtWidgetBaseOffset,XtProcedureArg} XtAddressMode;
typedef struct {XtAddressMode   address_mode;XtPointer      address_id;Cardinal       size;} XtConvertArgRec, *XtConvertArgList;
typedef void (*XtConvertArgProc)();
typedef struct {
   XtGeometryMask request_mode;
   Position x, y;
   Dimension width, height, border_width;
   Widget sibling;
   int stack_mode;   /* Above, Below, TopIf, BottomIf, Opposite, DontChange */
} XtWidgetGeometry;
#define XtCWQueryOnly   (1 << 7)
#define XtSMDontChange  5
typedef void (*XtConverter)(); /* obsolete */
typedef Boolean (*XtTypeConverter)();
typedef void (*XtDestructor)();
typedef Opaque XtCacheRef;
typedef Opaque XtActionHookId;
typedef void (*XtActionHookProc)();
typedef void (*XtKeyProc)();
typedef void (*XtCaseProc)();
typedef void (*XtEventHandler)();
```

```
typedef unsigned long EventMask;
typedef enum {XtListHead, XtListTail } XtListPosition;
typedef unsigned long   XtInputMask;

#define XtInputNoneMask         0L
#define XtInputReadMask         (1L<<0)
#define XtInputWriteMask        (1L<<1)
#define XtInputExceptMask       (1L<<2)

typedef void (*XtTimerCallbackProc)();
typedef void (*XtInputCallbackProc)();

typedef struct { String      name; XtArgVal    value;} Arg, *ArgList;
typedef XtPointer       XtVarArgsList;
typedef void (*XtCallbackProc)();

typedef struct _XtCallbackRec {
   XtCallbackProc  callback;
   XtPointer       closure;
} XtCallbackRec, *XtCallbackList;

typedef enum {
       XtCallbackNoList,
       XtCallbackHasNone,
       XtCallbackHasSome
} XtCallbackStatus;

typedef enum  {
   XtGeometryYes,       /* Request accepted. */
   XtGeometryNo,        /* Request denied. */
   XtGeometryAlmost,    /* Request denied, but willing to take replyBox. */
   XtGeometryDone       /* Request accepted and done. */
} XtGeometryResult;

typedef enum {XtGrabNone, XtGrabNonexclusive, XtGrabExclusive} XtGrabKind;

typedef struct {
   Widget  shell_widget;
   Widget  enable_widget;
} XtPopdownIDRec, *XtPopdownID;

typedef struct _XtResource {
   String      resource_name;  /* Resource name                        */
   String      resource_class; /* Resource class                       */
   String      resource_type;  /* Representation type desired          */
   Cardinal    resource_size;  /* Size in bytes of representation      */
   Cardinal    resource_offset;/* Offset from base to put resource value   */
   String      default_type;   /* representation type of specified default */
   XtPointer   default_addr;   /* Address of default resource          */
} XtResource, *XtResourceList;
typedef void (*XtResourceDefaultProc)();
typedef String (*XtLanguageProc)();
typedef void (*XtErrorMsgHandler)();
typedef void (*XtErrorHandler)();
typedef void (*XtCreatePopupChildProc)();
typedef Boolean (*XtWorkProc)();
typedef struct { char match; String substitution;} SubstitutionRec, *Substitution;
typedef Boolean (*XtFilePredicate)();
typedef XtPointer XtRequestId;
typedef Boolean (*XtConvertSelectionProc)();
typedef void (*XtLoseSelectionProc)();
typedef void (*XtSelectionDoneProc)();
typedef void (*XtSelectionCallbackProc)();
typedef void (*XtLoseSelectionIncrProc)();
typedef void (*XtSelectionDoneIncrProc)();
typedef Boolean (*XtConvertSelectionIncrProc)();
typedef void (*XtCancelConvertSelectionProc)();
#define XtAllEvents ((EventMask) -1L)
#define XtIMXEvent              1
#define XtIMTimer               2
#define XtIMAlternateInput      4
#define XtIMAll (XtIMXEvent | XtIMTimer | XtIMAlternateInput)
#define XtVaNestedList  "XtVaNestedList"
#define XtVaTypedArg    "XtVaTypedArg"
#define XtUnspecifiedPixmap     ((Pixmap)2)
#define XtUnspecifiedShellInt   (-1)
#define XtUnspecifiedWindow     ((Window)2)
#define XtUnspecifiedWindowGroup ((Window)3)
#define XtDefaultForeground     "XtDefaultForeground"
#define XtDefaultBackground     "XtDefaultBackground"
#define XtDefaultFont           "XtDefaultFont"
```

```
#define XtDefaultFontSet        “XtDefaultFontSet”
#define XT_CONVERT_FAIL (Atom)0x80000001
```

Figure 10-7: Manifest Constants and Data Types from <X11/Object.h>

```
typedef struct _ObjectRec *Object;
typedef struct _ObjectClassRec *ObjectClass;
```

Figure 10-8: Manifest Constants and Data Types from <X11/RectObj.h>

```
typedef struct _RectObjRec *RectObj;
typedef struct _RectObjClassRec *RectObjClass;
```

Figure 10-9: Manifest Constants and Data Types from <X11/Shell.h>

```
/* Shell Widget */
/* Shell-specific resources names, classes, and a representation type. */
/* The string definitions are automatically generated. */

#define XtNiconName “iconName”
#define XtCIconName “IconName”
#define XtNiconPixmap “iconPixmap”
#define XtCIconPixmap “IconPixmap”
#define XtNiconWindow “iconWindow”
#define XtCIconWindow “IconWindow”
#define XtNiconMask “iconMask”
#define XtCIconMask “IconMask”
#define XtNwindowGroup “windowGroup”
#define XtCWindowGroup “WindowGroup”
#define XtNvisual “visual”
#define XtCVisual “Visual”
#define XtNtitleEncoding “titleEncoding”
#define XtCTitleEncoding “TitleEncoding”
#define XtNsaveUnder “saveUnder”
#define XtCSaveUnder “SaveUnder”
#define XtNtransient “transient”
#define XtCTransient “Transient”
#define XtNoverrideRedirect “overrideRedirect”
#define XtCOverrideRedirect “OverrideRedirect”
#define XtNtransientFor “transientFor”
#define XtCTransientFor “TransientFor”
#define XtNiconNameEncoding “iconNameEncoding”
#define XtCIconNameEncoding “IconNameEncoding”
#define XtNallowShellResize “allowShellResize”
#define XtCAllowShellResize “AllowShellResize”
#define XtNcreatePopupChildProc “createPopupChildProc”
#define XtCCreatePopupChildProc “CreatePopupChildProc”
#define XtNtitle “title”
#define XtCTitle “Title”
#define XtRAtom “Atom”
#define XtNargc “argc”
#define XtCArgc “Argc”
#define XtNargv “argv”
#define XtCArgv “Argv”
#define XtNiconX “iconX”
#define XtCIconX “IconX”
#define XtNiconY “iconY”
#define XtCIconY “IconY”
#define XtNinput “input”
#define XtCInput “Input”
#define XtNiconic “iconic”
#define XtCIconic “Iconic”
#define XtNinitialState “initialState”
#define XtCInitialState “InitialState”
#define XtNgeometry “geometry”
#define XtCGeometry “Geometry”
#define XtNbaseWidth “baseWidth”
#define XtCBaseWidth “BaseWidth”
#define XtNbaseHeight “baseHeight”
#define XtCBaseHeight “BaseHeight”
#define XtNwinGravity “winGravity”
#define XtCWinGravity “WinGravity”
#define XtNminWidth “minWidth”
#define XtCMinWidth “MinWidth”
#define XtNminHeight “minHeight”
```

```
#define XtCMinHeight “MinHeight”
#define XtNmaxWidth “maxWidth”
#define XtCMaxWidth “MaxWidth”
#define XtNmaxHeight “maxHeight”
#define XtCMaxHeight “MaxHeight”
#define XtNwidthInc “widthInc”
#define XtCWidthInc “WidthInc”
#define XtNheightInc “heightInc”
#define XtCHeightInc “HeightInc”
#define XtNminAspectY “minAspectY”
#define XtCMinAspectY “MinAspectY”
#define XtNmaxAspectY “maxAspectY”
#define XtCMaxAspectY “MaxAspectY”
#define XtNminAspectX “minAspectX”
#define XtCMinAspectX “MinAspectX”
#define XtNmaxAspectX “maxAspectX”
#define XtCMaxAspectX “MaxAspectX”
#define XtNwmTimeout “wmTimeout”
#define XtCWmTimeout “WmTimeout”
#define XtNwaitForWm “waitforwm”
#define XtCWaitForWm “Waitforwm”

/* Class record constants */

typedef struct _ShellClassRec *ShellWidgetClass;
typedef struct _OverrideShellClassRec *OverrideShellWidgetClass;
typedef struct _WMShellClassRec *WMShellWidgetClass;
typedef struct _TransientShellClassRec *TransientShellWidgetClass;
typedef struct _TopLevelShellClassRec *TopLevelShellWidgetClass;
typedef struct _ApplicationShellClassRec *ApplicationShellWidgetClass;
```

Figure 10-10: Manifest Constants and Data Types from <X11/StringDefs.h>

```
#define XtNaccelerators “accelerators”
#define XtNallowHoriz “allowHoriz”
#define XtNallowVert “allowVert”
#define XtNancestorSensitive “ancestorSensitive”
#define XtNbackground “background”
#define XtNbackgroundPixmap “backgroundPixmap”
#define XtNbitmap “bitmap”
#define XtNborderColor “borderColor”
#define XtNborder “borderColor”
#define XtNborderPixmap “borderPixmap”
#define XtNborderWidth “borderWidth”
#define XtNcallback “callback”
#define XtNchildren “children”
#define XtNcolormap “colormap”
#define XtNdepth “depth”
#define XtNdestroyCallback “destroyCallback”
#define XtNeditType “editType”
#define XtNfile “file”
#define XtNfont “font”
#define XtNforceBars “forceBars”
#define XtNforeground “foreground”
#define XtNfunction “function”
#define XtNheight “height”
#define XtNhighlight “highlight”
#define XtNhSpace “hSpace”
#define XtNindex “index”
#define XtNinitialResourcesPersistent “initialResourcesPersistent”
#define XtNinnerHeight “innerHeight”
#define XtNinnerWidth “innerWidth”
#define XtNinnerWindow “innerWindow”
#define XtNinsertPosition “insertPosition”
#define XtNinternalHeight “internalHeight”
#define XtNinternalWidth “internalWidth”
#define XtNjumpProc “jumpProc”
#define XtNjustify “justify”
#define XtNknobHeight “knobHeight”
#define XtNknobIndent “knobIndent”
#define XtNknobPixel “knobPixel”
#define XtNknobWidth “knobWidth”
#define XtNlabel “label”
#define XtNlength “length”
#define XtNlowerRight “lowerRight”
#define XtNmappedWhenManaged “mappedWhenManaged”
#define XtNmenuEntry “menuEntry”
#define XtNname “name”
```

```
#define XtNnotify “notify”
#define XtNnumChildren “numChildren”
#define XtNorientation “orientation”
#define XtNparameter “parameter”
#define XtNpixmap “pixmap”
#define XtNpopupCallback “popupCallback”
#define XtNpopdownCallback “popdownCallback”
#define XtNresize “resize”
#define XtNreverseVideo “reverseVideo”
#define XtNscreen “screen”
#define XtNscrollProc “scrollProc”
#define XtNscrollDCursor “scrollDCursor”
#define XtNscrollHCursor “scrollHCursor”
#define XtNscrollLCursor “scrollLCursor”
#define XtNscrollRCursor “scrollRCursor”
#define XtNscrollUCursor “scrollUCursor”
#define XtNscrollVCursor “scrollVCursor”
#define XtNselection “selection”
#define XtNselectionArray “selectionArray”
#define XtNsensitive “sensitive”
#define XtNshown “shown”
#define XtNspace “space”
#define XtNstring “string”
#define XtNtextOptions “textOptions”
#define XtNtextSink “textSink”
#define XtNtextSource “textSource”
#define XtNthickness “thickness”
#define XtNthumb “thumb”
#define XtNthumbProc “thumbProc”
#define XtNtop “top”
#define XtNtranslations “translations”
#define XtNunrealizeCallback “unrealizeCallback”
#define XtNupdate “update”
#define XtNuseBottom “useBottom”
#define XtNuseRight “useRight”
#define XtNvalue “value”
#define XtNvSpace “vSpace”
#define XtNwidth “width”
#define XtNwindow “window”
#define XtNx “x”
#define XtNy “y”
#define XtCAccelerators “Accelerators”
#define XtCBackground “Background”
#define XtCBitmap “Bitmap”
#define XtCBoolean “Boolean”
#define XtCBorderColor “BorderColor”
#define XtCBorderWidth “BorderWidth”
#define XtCCallback “Callback”
#define XtCColormap “Colormap”
#define XtCColor “Color”
#define XtCCursor “Cursor”
#define XtCDepth “Depth”
#define XtCEditType “EditType”
#define XtCEventBindings “EventBindings”
#define XtCFile “File”
#define XtCFont “Font”
#define XtCForeground “Foreground”
#define XtCFraction “Fraction”
#define XtCFunction “Function”
#define XtCHeight “Height”
#define XtCHSpace “HSpace”
#define XtCIndex “Index”
#define XtCInitialResourcesPersistent “InitialResourcesPersistent”
#define XtCInsertPosition “InsertPosition”
#define XtCInterval “Interval”
#define XtCJustify “Justify”
#define XtCKnobIndent “KnobIndent”
#define XtCKnobPixel “KnobPixel”
#define XtCLabel “Label”
#define XtCLength “Length”
#define XtCMappedWhenManaged “MappedWhenManaged”
#define XtCMargin “Margin”
#define XtCMenuEntry “MenuEntry”
#define XtCNotify “Notify”
#define XtCOrientation “Orientation”
#define XtCParameter “Parameter”
#define XtCPixmap “Pixmap”
#define XtCPosition “Position”
#define XtCReadOnly “ReadOnly”
#define XtCResize “Resize”
#define XtCReverseVideo “ReverseVideo”
```

```
#define XtCScreen “Screen”
#define XtCScrollProc “ScrollProc”
#define XtCScrollDCursor “ScrollDCursor”
#define XtCScrollHCursor “ScrollHCursor”
#define XtCScrollLCursor “ScrollLCursor”
#define XtCScrollRCursor “ScrollRCursor”
#define XtCScrollUCursor “ScrollUCursor”
#define XtCScrollVCursor “ScrollVCursor”
#define XtCSelection “Selection”
#define XtCSensitive “Sensitive”
#define XtCSelectionArray “SelectionArray”
#define XtCSpace “Space”
#define XtCString “String”
#define XtCTextOptions “TextOptions”
#define XtCTextPosition “TextPosition”
#define XtCTextSink “TextSink”
#define XtCTextSource “TextSource”
#define XtCThickness “Thickness”
#define XtCThumb “Thumb”
#define XtCTranslations “Translations”
#define XtCValue “Value”
#define XtCVSpace “VSpace”
#define XtCWidth “Width”
#define XtCWindow “Window”
#define XtCX “X”
#define XtCY “Y”
#define XtRAcceleratorTable “AcceleratorTable”
#define XtRAtom “Atom”
#define XtRBitmap “Bitmap”
#define XtRBool “Bool”
#define XtRBoolean “Boolean”
#define XtRCallback “Callback”
#define XtRCallProc “CallProc”
#define XtRCardinal “Cardinal”
#define XtRColor “Color”
#define XtRColormap “Colormap”
#define XtRCursor “Cursor”
#define XtRDimension “Dimension”
#define XtRDisplay “Display”
#define XtREditMode “EditMode”
#define XtREnum “Enum”
#define XtRFile “File”
#define XtRFloat “Float”
#define XtRFont “Font”
#define XtRFontStruct “FontStruct”
#define XtRFunction “Function”
#define XtRGeometry “Geometry”
#define XtRImmediate “Immediate”
#define XtRInitialState “InitialState”
#define XtRInt “Int”
#define XtRJustify “Justify”
#define XtRLongBoolean “Bool”
#define XtRObject “Object”
#define XtROrientation “Orientation”
#define XtRPixel “Pixel”
#define XtRPixmap “Pixmap”
#define XtRPointer “Pointer”
#define XtRPosition “Position”
#define XtRScreen “Screen”
#define XtRShort “Short”
#define XtRString “String”
#define XtRStringArray “StringArray”
#define XtRStringTable “StringTable”
#define XtRUnsignedChar “UnsignedChar”
#define XtRTranslationTable “TranslationTable”
#define XtRVisual “Visual”
#define XtRWidget “Widget”
#define XtRWidgetClass “WidgetClass”
#define XtRWidgetList “WidgetList”
#define XtRWindow “Window”
#define XtEoff “off”
#define XtEfalse “false”
#define XtEno “no”
#define XtEon “on”
#define XtEtrue “true”
#define XtEyes “yes”
#define XtEvertical “vertical”
#define XtEhorizontal “horizontal”
#define XtEtextRead “read”
#define XtEtextAppend “append”
#define XtEtextEdit “edit”
```

```
#define XtExtdefaultbackground “xtdefaultbackground”
#define XtExtdefaultforeground “xtdefaultforeground”
#define XtExtdefaultfont “xtdefaultfont”
#define XtNfontSet “fontSet”
#define XtRFontSet “FontSet”
#define XtCFontSet “FontSet”
```

Figure 10-11: Manifest Constants and Data Types from <X11/Vendor.h>

```
typedef struct _VendorShellClassRec *VendorShellWidgetClass;
```

Subclassing Xt Widgets

Figure 10-12 through Figure 10-19 are intended to be used by widget programmers only. This information is included so widget programmers can subclass Xt widgets. This facilities are provided in the X Toolkit for the purpose of creating new widgets based on the Toolkit widgets. They are expected to be used only by code within widgets, not by code within ordinary applications. The structure of widgets should be opaque to the applications that use widgets but do not define them.

The subclassing of widgets is only supported for the Xt widgets. It is not supporting for either the OLIT widget set or the Motif widget set.

Figure 10-12: Manifest Constants and Data Types from <X11/CompositeP.h>

```
typedef struct _CompositePart {
    WidgetList  children;           /* array of ALL widget children         */
    Cardinal    num_children;       /* total number of widget children      */
    Cardinal    num_slots;          /* number of slots in children array    */
    XtOrderProc insert_position;    /* compute position of new child        */
} CompositePart,*CompositePtr;
typedef struct _CompositeRec {CorePart      core;  CompositePart composite;} CompositeRec;
typedef struct _CompositeClassPart {
    XtGeometryHandler geometry_manager;   /* geometry manager for children   */
    XtWidgetProc      change_managed;     /* change managed state of child   */
    XtWidgetProc      insert_child;       /* physically add child to parent  */
    XtWidgetProc      delete_child;       /* physically remove child         */
    XtPointer         extension;          /* pointer to extension record     */
} CompositeClassPart,*CompositePartPtr;
typedef struct {
    XtPointer next_extension;   /* 1st 4 mandated for all extension records */
    XrmQuark record_type;       /* NULLQUARK; on CompositeClassPart */
    long version;               /* must be XtCompositeExtensionVersion */
    Cardinal record_size;       /* sizeof(CompositeClassExtensionRec) */
    Boolean accepts_objects;
} CompositeClassExtensionRec, *CompositeClassExtension;
typedef struct _CompositeClassRec { CoreClassPart      core_class;CompositeClassPart composite_class;} CompositeClassRec;
#define XtCompositeExtensionVersion 1L
#define XtInheritGeometryManager ((XtGeometryHandler) _XtInherit)
#define XtInheritChangeManaged ((XtWidgetProc) _XtInherit)
#define XtInheritInsertChild ((XtWidgetProc) _XtInherit)
#define XtInheritDeleteChild ((XtWidgetProc) _XtInherit)
```

Figure 10-13: Manifest Constants and Data Types from <X11/ConstrainP.h>

```
typedef struct _ConstraintPart { XtPointer  mumble;} ConstraintPart;
typedef struct _ConstraintRec { CorePart  core; CompositePart   composite; ConstraintPart  constraint;} ConstraintRec, *ConstraintWidget;
typedef struct _ConstraintClassPart {
    XtResourceList resources;         /* constraint resource list           */
    Cardinal   num_resources;         /* number of constraints in list      */
    Cardinal   constraint_size;       /* size of constraint record          */
    XtInitProc initialize;            /* constraint initialization          */
    XtWidgetProc destroy;             /* constraint destroy proc            */
    XtSetValuesFunc set_values;       /* constraint set_values proc         */
    XtPointer       extension;        /* pointer to extension record        */
} ConstraintClassPart;
typedef struct {
    XtPointer next_extension;   /* 1st 4 mandated for all extension records */
    XrmQuark record_type;       /* NULLQUARK; on ConstraintClassPart */
    long version;               /* must be XtConstraintExtensionVersion */
    Cardinal record_size;       /* sizeof(ConstraintClassExtensionRec) */
    XtArgsProc get_values_hook;
} ConstraintClassExtensionRec, *ConstraintClassExtension;
typedef struct _ConstraintClassRec {CoreClassPart  core_class;CompositeClassPart  composite_class; ConstraintClassPart constraint_class;} ConstraintClassRec;
#define XtConstraintExtensionVersion 1L
```

Figure 10-14: Manifest Constants and Data Types from <X11/CoreP.h>

```
#define XtInheritTranslations  ((String) &_XtInheritTranslations)
#define XtInheritRealize ((XtRealizeProc) _XtInherit)
#define XtInheritResize ((XtWidgetProc) _XtInherit)
#define XtInheritExpose ((XtExposeProc) _XtInherit)
#define XtInheritSetValuesAlmost ((XtAlmostProc) _XtInherit)
#define XtInheritAcceptFocus ((XtAcceptFocusProc) _XtInherit)
#define XtInheritQueryGeometry ((XtGeometryHandler) _XtInherit)
#define XtInheritDisplayAccelerator ((XtStringProc) _XtInherit)
typedef struct _CorePart {
    Widget         self;              /* pointer to widget itself          */
    WidgetClass    widget_class;      /* pointer to Widget's ClassRec      */
    Widget         parent;            /* parent widget                     */
    XrmName        xrm_name;          /* widget resource name quarkified   */
    Boolean        being_destroyed;   /* marked for destroy                */
    XtCallbackList  destroy_callbacks; /* who to call when widget destroyed */
    XtPointer      constraints;       /* constraint record                 */
    Position       x, y;              /* window position                   */
    Dimension      width, height;     /* window dimensions                 */
    Dimension      border_width;      /* window border width               */
    Boolean        managed;           /* is widget geometry managed?       */
    Boolean        sensitive;         /* is widget sensitive to user events*/
    Boolean        ancestor_sensitive; /* are all ancestors sensitive?     */
    XtEventTable   event_table;       /* private to event dispatcher       */
    XtTMRec        tm;                /* translation management            */
    XtTranslations  accelerators;     /* accelerator translations          */
    Pixel          border_pixel;      /* window border pixel               */
    Pixmap         border_pixmap;     /* window border pixmap or NULL      */
    WidgetList     popup_list;        /* list of popups                    */
    Cardinal       num_popups;        /* how many popups                   */
    String         name;              /* widget resource name              */
    Screen         *screen;           /* window's screen                   */
    Colormap       colormap;          /* colormap                          */
    Window         window;            /* window ID                         */
    Cardinal       depth;             /* number of planes in window        */
    Pixel          background_pixel;  /* window background pixel           */
    Pixmap         background_pixmap;  /* window background pixmap or NULL  */
    Boolean        visible;           /* is window mapped and not occluded?*/
    Boolean        mapped_when_managed;/* map window if it's managed?      */
} CorePart;
typedef struct _WidgetRec {    CorePart    core; } WidgetRec, CoreRec;
typedef struct _CoreClassPart {
    WidgetClass    superclass;        /* pointer to superclass ClassRec   */
    String         class_name;        /* widget resource class name       */
    Cardinal       widget_size;       /* size in bytes of widget record   */
    XtProc         class_initialize;  /* class initialization proc        */
    XtWidgetClassProc class_part_initialize; /* dynamic initialization     */
    XtEnum         class_inited;      /* has class been initialized?      */
    XtInitProc     initialize;        /* initialize subclass fields       */
    XtArgsProc     initialize_hook;   /* notify that initialize called    */
    XtRealizeProc  realize;           /* XCreateWindow for widget         */
    XtActionList   actions;           /* widget semantics name to proc map */
    Cardinal       num_actions;       /* number of entries in actions     */
```

```
    XtResourceList  resources;          /* resources for subclass fields    */
    Cardinal        num_resources;      /* number of entries in resources   */
    XrmClass        xrm_class;          /* resource class quarkified        */
    Boolean         compress_motion;    /* compress MotionNotify for widget */
    XtEnum          compress_exposure;  /* compress Expose events for widget*/
    Boolean         compress_enterleave;/* compress enter and leave events  */
    Boolean         visible_interest;   /* select for VisibilityNotify      */
    XtWidgetProc    destroy;            /* free data for subclass pointers  */
    XtWidgetProc    resize;             /* geom manager changed widget size */
    XtExposeProc    expose;             /* rediplay window                  */
    XtSetValuesFunc set_values;         /* set subclass resource values     */
    XtArgsFunc      set_values_hook;    /* notify that set_values called    */
    XtAlmostProc    set_values_almost;  /* set_values got "Almost" geo reply */
    XtArgsProc      get_values_hook;    /* notify that get_values called    */
    XtAcceptFocusProc accept_focus;     /* assign input focus to widget     */
    XtVersionType   version;            /* version of intrinsics used       */
    XtPointer       callback_private;   /* list of callback offsets         */
    String          tm_table;           /* state machine                    */
    XtGeometryHandler query_geometry;   /* return preferred geometry        */
    XtStringProc    display_accelerator;/* display your accelerator         */
    XtPointer       extension;          /* pointer to extension record      */
 } CoreClassPart;
typedef struct _WidgetClassRec { CoreClassPart core_class;} WidgetClassRec, CoreClassRec;
#define coreClassRec widgetClassRec
```

Figure 10-15: Manifest Constants and Data Types from <X11/IntrinsicP.h>

```
typedef struct {
    XrmQuark    xrm_name;         /* Resource name quark               */
    XrmQuark    xrm_class;        /* Resource class quark              */
    XrmQuark    xrm_type;         /* Resource representation type quark */
    Cardinal    xrm_size;         /* Size in bytes of representation   */
    long int    xrm_offset;       /* -offset-1                         */
    XrmQuark    xrm_default_type; /* Default representation type quark  */
    XtPointer   xrm_default_addr; /* Default resource address          */
} XrmResource, *XrmResourceList;
typedef unsigned long XtVersionType;
#define XT_VERSION 11
#define XT_REVISION 5
#define XtVersion (XT_VERSION * 1000 + XT_REVISION)
#define XtVersionDontCheck 0
typedef void (*XtProc)();
typedef void (*XtWidgetClassProc)();
typedef void (*XtWidgetProc)();
typedef Boolean (*XtAcceptFocusProc)();
typedef void (*XtArgsProc)();
typedef void (*XtInitProc)();
typedef Boolean (*XtSetValuesFunc)();
typedef Boolean (*XtArgsFunc)();
typedef void (*XtAlmostProc)();
typedef void (*XtExposeProc)();
#define XtExposeNoCompress              ((XtEnum)False)
#define XtExposeCompressSeries          ((XtEnum)True)
#define XtExposeCompressMultiple        2
#define XtExposeCompressMaximal         3
#define XtExposeGraphicsExpose          0x10
#define XtExposeGraphicsExposeMerged    0x20
#define XtExposeNoExpose                0x40
typedef void (*XtRealizeProc)();
typedef XtGeometryResult (*XtGeometryHandler)();
typedef void (*XtStringProc)();
typedef struct _XtTMRec {
    XtTranslations  translations;       /* private to Translation Manager    */
    XtBoundActions  proc_table;         /* procedure bindings for actions    */
    struct _XtStateRec *current_state;  /* Translation Manager state ptr     */
    unsigned long   lastEventTime;
} XtTMRec, *XtTM;
extern Widget _XtWindowedAncestor( /* internal; implementation-dependent */);
extern void _XtInherit();
extern void XtCreateWindow();
extern void XtResizeWidget();
extern void XtMoveWidget();
extern void XtConfigureWidget();
extern void XtResizeWindow();
```

Figure 10-16: Data Types from <X11/ObjectP.h>

```
/*Object Instance Data Structures */
/* these fields match CorePart and can not be changed */

typedef struct _ObjectPart {
    Widget          self;               /* pointer to widget itself          */
    WidgetClass     widget_class;       /* pointer to Widget's ClassRec      */
    Widget          parent;             /* parent widget                     */
    XrmName         xrm_name;           /* widget resource name quarkified   */
    Boolean         being_destroyed;    /* marked for destroy                */
    XtCallbackList  destroy_callbacks; /* who to call when widget destroyed */
    XtPointer       constraints;        /* constraint record                 */
} ObjectPart;

typedef struct _ObjectRec {
    ObjectPart  object;
} ObjectRec;

/*Object Class Data Structures */
/* these fields match CoreClassPart and can not be changed */
/* ideally these structures would only contain the fields required;
   but because the CoreClassPart cannot be changed at this late date
   extraneous fields are necessary to make the field offsets match */

typedef struct _ObjectClassPart {
    WidgetClass     superclass;         /* pointer to superclass ClassRec   */
    String          class_name;         /* widget resource class name       */
    Cardinal        widget_size;        /* size in bytes of widget record   */
    XtProc          class_initialize;   /* class initialization proc        */
    XtWidgetClassProc class_part_initialize; /* dynamic initialization      */
    XtEnum          class_inited;       /* has class been initialized?      */
    XtInitProc      initialize;         /* initialize subclass fields       */
    XtArgsProc      initialize_hook;    /* notify that initialize called    */
    XtProc          obj1;               /* NULL                             */
    XtProc          obj2;               /* NULL                             */
    Cardinal        obj3;               /* NULL                             */
    XtResourceList  resources;          /* resources for subclass fields    */
    Cardinal        num_resources;      /* number of entries in resources   */
    XrmClass        xrm_class;          /* resource class quarkified        */
    Boolean         obj4;               /* NULL                             */
    Boolean         obj5;               /* NULL                             */
    Boolean         obj6;               /* NULL                             */
    Boolean         obj7;               /* NULL                             */
    XtWidgetProc    destroy;            /* free data for subclass pointers  */
    XtProc          obj8;               /* NULL                             */
    XtProc          obj9;               /* NULL                             */
    XtSetValuesFunc set_values;         /* set subclass resource values     */
    XtArgsFunc      set_values_hook;    /* notify that set_values called    */
    XtProc          obj10;              /* NULL                             */
    XtArgsProc      get_values_hook;    /* notify that get_values called    */
    XtProc          obj11;              /* NULL                             */
    XtVersionType   version;            /* version of intrinsics used       */
    XtPointer       callback_private;   /* list of callback offsets         */
    String          obj12;              /* NULL                             */
    XtProc          obj13;              /* NULL                             */
    XtProc          obj14;              /* NULL                             */
    XtPointer       extension;          /* pointer to extension record      */
}ObjectClassPart;

typedef struct _ObjectClassRec {
    ObjectClassPart object_class;
} ObjectClassRec;
```

Figure 10-17: Data Types from <X11/RectObjP.h>

```
/* Rectangle Object Instance Data Structures */
/* these fields match CorePart and can not be changed */

typedef struct _RectObjPart {
    Position        x, y;               /* rectangle position               */
    Dimension       width, height;      /* rectangle dimensions             */
    Dimension       border_width;       /* rectangle border width           */
    Boolean         managed;            /* is widget geometry managed?      */
    Boolean         sensitive;          /* is widget sensitive to user events*/
    Boolean         ancestor_sensitive; /* are all ancestors sensitive?     */
}RectObjPart;

typedef struct _RectObjRec {
    ObjectPart object;
    RectObjPart rectangle;
} RectObjRec;
```

```
/* Rectangle Object Class Data Structures */
/* these fields match CoreClassPart and can not be changed */
/* ideally these structures would only contain the fields required;
   but because the CoreClassPart cannot be changed at this late date
   extraneous fields are necessary to make the field offsets match */

typedef struct _RectObjClassPart {
    WidgetClass     superclass;         /* pointer to superclass ClassRec   */
    String          class_name;         /* widget resource class name       */
    Cardinal        widget_size;        /* size in bytes of widget record   */
    XtProc          class_initialize;   /* class initialization proc        */
    XtWidgetClassProc class_part_initialize; /* dynamic initialization      */
    XtEnum          class_inited;       /* has class been initialized?      */
    XtInitProc      initialize;         /* initialize subclass fields       */
    XtArgsProc      initialize_hook;    /* notify that initialize called    */
    XtProc          rect1;              /* NULL                             */
    XtPointer       rect2;              /* NULL                             */
    Cardinal        rect3;              /* NULL                             */
    XtResourceList  resources;          /* resources for subclass fields    */
    Cardinal        num_resources;      /* number of entries in resources   */
    XrmClass        xrm_class;          /* resource class quarkified        */
    Boolean         rect4;              /* NULL                             */
    Boolean         rect5;              /* NULL                             */
    Boolean         rect6;              /* NULL                             */
    Boolean         rect7;              /* NULL                             */
    XtWidgetProc    destroy;            /* free data for subclass pointers  */
    XtWidgetProc    resize;             /* geom manager changed widget size */
    XtExposeProc    expose;             /* rediplay rectangle               */
    XtSetValuesFunc set_values;         /* set subclass resource values     */
    XtArgsFunc      set_values_hook;    /* notify that set_values called    */
    XtAlmostProc    set_values_almost;  /* set values almost for geometry   */
    XtArgsProc      get_values_hook;    /* notify that get_values called    */
    XtProc          rect9;              /* NULL                             */
    XtVersionType   version;            /* version of intrinsics used       */
    XtPointer       callback_private;   /* list of callback offsets         */
    String          rect10;             /* NULL                             */
    XtGeometryHandler query_geometry;   /* return preferred geometry        */
    XtProc          rect11;             /* NULL                             */
    XtPointer       extension;          /* pointer to extension record      */
} RectObjClassPart;

typedef struct _RectObjClassRec {
    RectObjClassPart rect_class;
} RectObjClassRec;
```

Figure 10-18: Manifest Constants and Data Types from <X11/ShellP.h>

```
/* Shell Widget Private Data */
/* New fields for the Shell widget class record */

typedef struct {XtPointer extension;} ShellClassPart;

typedef struct {
        XtPointer                       next_extension;
        XrmQuark                        record_type;
        long                            version;
        Cardinal                        record_size;
        XtGeometryHandler               root_geometry_manager;
} ShellClassExtensionRec, *ShellClassExtension;

#define XtShellExtensionVersion 1L
#define XtInheritRootGeometryManager ((XtGeometryHandler)_XtInherit)

typedef struct _ShellClassRec {
        CoreClassPart                   core_class;
        CompositeClassPart              composite_class;
        ShellClassPart                  shell_class;
} ShellClassRec;

/* New fields for the shell widget */
typedef struct {
        char                            *geometry;
        XtCreatePopupChildProc          create_popup_child_proc;
        XtGrabKind                      grab_kind;
        Boolean                         spring_loaded;
        Boolean                         popped_up;
        Boolean                         allow_shell_resize;
```

```
            Boolean                                 client_specified; /* re-using old name */
#define _XtShellPositionValid                       (Boolean)(1<<0))
#define _XtShellNotReparented                       (Boolean)(1<<1))
#define _XtShellPPositionOK                         (Boolean)(1<<2))
#define _XtShellGeometryParsed                      (Boolean)(1<<3))
            Boolean                                 save_under;
            Boolean                                 override_redirect;
            XtCallbackList                          popup_callback;
            XtCallbackList                          popdown_callback;
            Visual*                                 visual;
} ShellPart;

typedef  struct {
            CorePart                        core;
            CompositePart                   composite;
            ShellPart                       shell;
} ShellRec, *ShellWidget;

/* OverrideShell Widget Private Data */
/* New fields for the OverrideShell widget class record */
typedef struct { XtPointer extension;} OverrideShellClassPart;

typedef struct _OverrideShellClassRec {
      CoreClassPart      core_class;
      CompositeClassPart composite_class;
      ShellClassPart  shell_class;
            OverrideShellClassPart  override_shell_class;
} OverrideShellClassRec;

/* No new fields for the override shell widget */
typedef struct {int frabjous;} OverrideShellPart;

typedef  struct {
            CorePart       core;
            CompositePart   composite;
            ShellPart       shell;
            OverrideShellPart override;
} OverrideShellRec, *OverrideShellWidget;
/* WMShell Widget Private Data , New fields for the WMShell widget class record */
typedef struct { XtPointer extension;} WMShellClassPart;

typedef struct _WMShellClassRec {
            CoreClassPart      core_class;
            CompositeClassPart composite_class;
            ShellClassPart  shell_class;
            WMShellClassPart wm_shell_class;
} WMShellClassRec;
/* New fields for the WM shell widget */
typedef struct {
            char       *title;
            int        wm_timeout;
            Boolean     wait_for_wm;
            Boolean     transient;
            Atom       wm_configure_denied,  wm_moved;
            struct _OldXSizeHints { /* pre-R4 Xlib structure */
                        long flags;
                        int x, y;
                        int width, height;
                        int min_width, min_height;
                        int max_width, max_height;
                        int width_inc, height_inc;
                        struct {int x; int y;} min_aspect, max_aspect;
            } size_hints;
            XWMHints    wm_hints;
            int base_width, base_height;
            int win_gravity;
            Atom title_encoding;
} WMShellPart;

typedef  struct {
            CorePart       core;
            CompositePart   composite;
      ShellPart       shell;
      WMShellPart     wm;
} WMShellRec, *WMShellWidget;

/* TransientShell Widget Private Data */
/* New fields for the TransientShell widget class record */
typedef struct { XtPointer       extension;} TransientShellClassPart;

typedef struct _TransientShellClassRec {
```

```
        CoreClassPart      core_class;
        CompositeClassPart composite_class;
        ShellClassPart  shell_class;
        WMShellClassPart   wm_shell_class;
        VendorShellClassPart vendor_shell_class;
        TransientShellClassPart transient_shell_class;
} TransientShellClassRec;

/* New fields for the transient shell widget */
typedef struct { Widget transient_for;} TransientShellPart;

typedef  struct {
        CorePart        core;
        CompositePart   composite;
        ShellPart       shell;
        WMShellPart     wm;
        VendorShellPart vendor;
        TransientShellPart transient;
} TransientShellRec, *TransientShellWidget;

/* TopLevelShell Widget Private Data */
/* New fields for the TopLevelShell widget class record */
typedef struct { XtPointer extension;} TopLevelShellClassPart;

typedef struct _TopLevelShellClassRec {
        CoreClassPart      core_class;
        CompositeClassPart composite_class;
        ShellClassPart  shell_class;
        WMShellClassPart   wm_shell_class;
        VendorShellClassPart vendor_shell_class;
        TopLevelShellClassPart top_level_shell_class;
} TopLevelShellClassRec;

/* New fields for the top level shell widget */
typedef struct {
        char       *icon_name;
        Boolean     iconic;
        Atom        icon_name_encoding;
} TopLevelShellPart;

typedef  struct {
        CorePart        core;
        CompositePart   composite;
        ShellPart       shell;
        WMShellPart     wm;
        VendorShellPart vendor;
        TopLevelShellPart topLevel;
} TopLevelShellRec, *TopLevelShellWidget;

/* ApplicationShell Widget Private Data */
/* New fields for the ApplicationShell widget class record */

typedef struct { XtPointer extension;} ApplicationShellClassPart;

typedef struct _ApplicationShellClassRec {
        CoreClassPart      core_class;
        CompositeClassPart composite_class;
        ShellClassPart  shell_class;
        WMShellClassPart   wm_shell_class;
        VendorShellClassPart vendor_shell_class;
        TopLevelShellClassPart top_level_shell_class;
        ApplicationShellClassPart application_shell_class;
} ApplicationShellClassRec;

/* New fields for the application shell widget */

typedef struct {
        char *class;
        XrmClass xrm_class;
        int argc;
        char **argv;
} ApplicationShellPart;

typedef  struct {
        CorePart        core;
        CompositePart   composite;
        ShellPart       shell;
        WMShellPart     wm;
        VendorShellPart vendor;
        TopLevelShellPart topLevel;
        ApplicationShellPart application;
```

```
} ApplicationShellRec, *ApplicationShellWidget;
```

Figure 10-19: Data Types from <X11/VendorP.h>

```
/* New fields for the VendorShell widget class record */

typedef struct {
                XtPointer       extension; /* pointer to extension record */
} VendorShellClassPart;

typedef struct _VendorShellClassRec {
      CoreClassPart      core_class;
      CompositeClassPart composite_class;
      ShellClassPart  shell_class;
      WMShellClassPart   wm_shell_class;
      VendorShellClassPart vendor_shell_class;
} VendorShellClassRec;

/* New fields for the vendor shell widget. */
typedef struct {int vendor_specific;} VendorShellPart;

typedef  struct {
      CorePart        core;
      CompositePart   composite;
      ShellPart       shell;
      WMShellPart     wm;
      VendorShellPart vendor;
} VendorShellRec, *VendorShellWidget;
```

The OPEN LOOK Widget Set

Overview

This chapter identifies binary interfaces for libXol. A source description for the entry points and exported data structures so identified may be found in the *OLIT Reference Manual* (Sun Microsystems, Part No. 800-6055-10, Revision A.).

The libXol Interfaces

The names listed below in Tables 10-9 and 10-10 have been included in SCD 2.4 as the names for the OPEN LOOK Widget Set REQUIRED INTERFACES, and must to be present on all conformant systems through the reference name */usr/lib/libXol.so.3*. Note that Table 10-10 defines the size of exported data objects as a hexadecimal byte count described in square brackets after each name. However, this interface set is also DEPRECATED effective November 1st, 1993 and may be removed from this specification as early as November 1st, 1996. No new applications should be developed to use the OPEN LOOK Widget Set.

Figures 10-27 and 10-28 detail the manifest constants associated with libXol and its visible data structures, respectively. The sizes of certain global data are deliberately hidden from programmers. These sizes are left unspecified because there is no attempt made to support subclassing of OLIT widgets.

The names listed below in Tables 10-9 and 10-10 have been included in SCD 2.4 as the names for the OPEN LOOK Widget Set REQUIRED INTERFACES, and must be present on all conformant systems through the reference name */usr/lib/libXol.so.3*. However, this interface set is also DEPRECATED effective November 1st, 1993, and may be removed from this specification as early as November 1st, 1996. No new applications should be developed to use the OPEN LOOK Widget Set.

Table 10-10 defines the size of exported data objects as a hexadecimal byte count in square brackets after each name. Some of the sizes are given as question marks. Where the size of an item is a question mark, that symbol is a reserved symbol which must not be used by an SCD-conforming application. They are widget class records, and are only used in order to subclass widgets. The subclassing of OLIT widgets is not supported by the SCD.

Rationale:

> The class records for OPEN LOOK widgets are of interest only for subclassing of these widgets. Programs that use these widgets without subclassing them need not and must not reference these symbols. Programs must also not use these symbols as external symbols for any other purpose because this will interfere with the Widget Library's use of them.
>
> Programs that do subclass OPEN LOOK widgets do not conform to the SCD. This is because the authors of the SCD cannot guarantee upward compatibility of widgets from one release to the next. The size of each widget class record is subject to being changed by the owner(s) of the code. Widget subclass records depend on the size of the class record of the superordinate class. They will be rendered invalid at the binary interface level if the size of the superordinate class record changes.

Table 10-9. libXol Contents

AllocateBuffer
AllocateTextBuffer
BackwardScanTextBuffer
CopyBuffer
CopyTextBufferBlock
EndCurrentTextBufferWord
ForwardScanTextBuffer
FreeBuffer
FreeTextBuffer
GetOlBusyCursor
GetOlDuplicateCursor
GetOlMoveCursor
GetOlPanCursor
GetOlQuestionCursor
GetOlSWGeometries
GetOlStandardCursor
GetOlTargetCursor
GetTextBufferBlock
GetTextBufferBuffer
GetTextBufferChar
GetTextBufferLine
GetTextBufferLocation
GrowBuffer
IncrementTextBufferLocation
InsertIntoBuffer
LastTextBufferLocation
LastTextBufferPosition
LineOfPosition
LocationOfPosition
LookupOlInputEvent
NextLocation
NextTextBufferWord
OlAddCallback
OlCallAcceptFocus
OlCallCallbacks
OlCanAcceptFocus
OlCategorySetPage
OlDragAndDrop
OlError
OlGet50PercentGrey
OlGet75PercentGrey
OlGetApplicationResources
OlGetApplicationValues
OlGetBeepVolume
OlGetCurrentFocusWidget
OlGrabDragPointer
OlHasCallbacks
OlHasFocus
OlInitialize
OlLayoutScrolledWindow
OlListItemPointer
OlMenuPopdown
OlMenuPopup
OlMenuPost
OlMenuUnpost
OlMoveFocus
OlQueryAcceleratorDisplay
OlQueryMnemonicDisplay
OlRegisterColorTupleListConverter
OlRegisterHelp
OlRemoveCallback
OlSetErrorHandler
OlSetGaugeValue
OlSetInputFocus
OlSetVaDisplayErrorMsgHandler
OlSetVaDisplayWarningMsgHandler
OlSetWarningHandler
OlTextEditClearBuffer
OlTextEditCopyBuffer
OlTextEditCopySelection
OlTextEditGetCursorPosition
OlTextEditGetLastPosition
OlTextEditInsert
OlTextEditPaste
OlTextEditReadSubString
OlTextEditRedraw
OlTextEditResize
OlTextEditSetCursorPosition
OlTextEditTextBuffer
OlTextEditUpdate
OlTextFieldCopyString
OlTextFieldGetString
OlToolkitInitialize
OlUngrabDragPointer
OlUpdateDisplay
OlVaDisplayErrorMsg
OlVaDisplayWarningMsg
OlWMProtocolAction
OlWarning
PositionOfLine
PositionOfLocation
PreviousLocation
PreviousTextBufferWord
ReadFileIntoBuffer
ReadFileIntoTextBuffer
ReadStringIntoBuffer
ReadStringIntoTextBuffer
RegisterTextBufferScanFunctions
RegisterTextBufferUpdate
RegisterTextBufferWordDefinition
ReplaceBlockInTextBuffer
ReplaceCharInTextBuffer
SaveTextBuffer
StartCurrentTextBufferWord
UnregisterTextBufferUpdate

Table 10-10. Exported Data in libXol

abbrevMenuButtonClassRec[?]
abbrevMenuButtonWidgetClass[0x4]
baseWindowShellClassRec[?]
baseWindowShellWidgetClass[0x4]
bulletinBoardClassRec[?]
bulletinBoardWidgetClass[0x4]
buttonClassRec[?]
buttonGadgetClass[0x4]
buttonGadgetClassRec[?]
buttonWidgetClass[0x4]
captionClassRec[?]
captionWidgetClass[0x4]
categoryClassRec[?]
categoryWidgetClass[0x4]
checkBoxClassRec[?]
checkBoxWidgetClass[0x4]
controlAreaWidgetClass[0x4]
controlClassRec[?]
eventObjClass[0x4]
eventObjClassRec[?]
exclusivesClassRec[?]
exclusivesWidgetClass[0x4]
footerPanelClassRec[?]
footerPanelWidgetClass[0x4]
formClassRec[?]
formWidgetClass[0x4]
gaugeClassRec[?]
gaugeWidgetClass[0x4]
helpClassRec[?]
helpWidgetClass[0x4]
listClassRec[?]
listPaneClassRec[?]
listPaneWidgetClass[0x4]
magClassRec[?]
magWidgetClass[0x4]
managerClassRec[?]
managerWidgetClass[0x4]
menuButtonClassRec[?]
menuButtonGadgetClass[0x4]
menuButtonGadgetClassRec[?]
menuButtonWidgetClass[0x4]
menuShellClassRec[?]
menuShellWidgetClass[0x4]
nonexclusivesClassRec[?]
nonexclusivesWidgetClass[0x4]
noticeShellClassRec[?]
noticeShellWidgetClass[0x4]
oblongButtonClassRec[?]
oblongButtonGadgetClass[0x4]
oblongButtonGadgetClassRec[?]
oblongButtonWidgetClass[0x4]
popupWindowShellClassRec[?]
popupWindowShellWidgetClass[0x4]
primitiveClassRec[?]
primitiveWidgetClass[0x4]
pushpinClassRec[?]
pushpinWidgetClass[0x4]
rectButtonClassRec[?]
rectButtonWidgetClass[0x4]
rubberTileClassRec[?]
rubberTileWidgetClass[0x4]
scrollbarClassRec[?]
scrollbarWidgetClass[0x4]
scrolledWindowClassRec[?]
scrolledWindowWidgetClass[0x4]
scrollingListWidgetClass[0x4]
sliderClassRec[?]
sliderWidgetClass[0x4]
staticTextWidgetClass[0x4]

Figure 10-27. libXol Manifest Constants

```
#define OleditDone                      0
#define OleditError                     1
#define OleditPosError                  2
#define OleditReject                    3
#define OL_ABSENT_PAIR                  0
#define OL_ALL                          1
#define OL_ALWAYS                       2
#define OL_ATOM_HELP                    3
#define OL_BOTH                         4
#define OL_BOTTOM                       5
#define OL_BUTTONSTACK                  6
#define OL_CENTER                       7
#define OL_CLASS_HELP                   8
#define OL_COLUMNS                      9
#define OL_COPY_MASK_VALUE              10
#define OL_COPY_SIZE                    11
#define OL_COPY_SOURCE_VALUE            12
#define OL_CURRENT                      13
#define OL_DEFAULT_PAIR                 14
#define OL_DISK_SOURCE                  15
#define OL_DISPLAY_FORM                 16
#define OL_DOWN                         17
#define OL_EXISTING_SOURCE              18
#define OL_FIXEDCOLS                    19
#define OL_FIXEDHEIGHT                  20
#define OL_FIXEDROWS                    21
#define OL_FIXEDWIDTH                   22
#define OL_HALFSTACK                    29
#define OL_HORIZONTAL                   30
#define OL_IMAGE                        31
#define OL_IN                           32
#define OL_INDIRECT_SOURCE              33
#define OL_LABEL                        34
#define OL_LEFT                         35
#define OL_MASK_PAIR                    36
#define OL_MAXIMIZE                     37
#define OL_MILLIMETERS                  38
#define OL_MINIMIZE                     39
#define OL_NEVER                        40
#define OL_NEXT                         41
#define OL_NONE                         42
#define OL_NONEBOTTOM                   43
#define OL_NONELEFT                     44
#define OL_NONERIGHT                    45
#define OL_NONETOP                      46
#define OL_NOTICES                      47
#define OL_OBLONG                       49
#define OL_OUT                          50
#define OL_OVERRIDE_PAIR                51
#define OL_PIXELS                       52
#define OL_POINTS                       53
#define OL_POPUP                        54
#define OL_PREVIOUS                     55
#define OL_PROG_DEFINED_SOURCE          56
#define OL_RECTBUTTON                   57
#define OL_RIGHT                        58
#define OL_ROWS                         59
#define OL_SOURCE_FORM                  60
#define OL_SOURCE_PAIR                  61
#define OL_STAYUP                       62
#define OL_STRING                       63
#define OL_STRING_SOURCE                64
#define OL_TEXT_APPEND                  65
#define OL_TEXT_EDIT                    66
#define OL_TEXT_READ                    67
#define OL_TOP                          68
#define OL_TRANSPARENT_SOURCE           69
#define OL_VERTICAL                     70
#define OL_WIDGET_HELP                  73
#define OL_WINDOW_HELP                  74
#define OL_WRAP_ANY                     75
#define OL_WRAP_WHITE_SPACE             76
#define OL_CONTINUOUS                   77
#define OL_GRANULARITY                  78
#define OL_RELEASE                      79
#define OL_TICKMARK                     80
#define OL_PERCENT                      81
#define OL_SLIDERVALUE                  82
#define OL_WT_BASE                      83
#define OL_WT_CMD                       84
#define OL_WT_NOTICE                    85
#define OL_WT_HELP                      86
#define OL_WT_OTHER                     87
#define OL_SUCCESS                      88
#define OL_BAD_KEY                      90
#define OL_MENU_FULL                    91
#define OL_MENU_LIMITED                 92
#define OL_MENU_CANCEL                  93
#define OL_MENUDEFAULT                  96
#define OL_HSBMENU                      98
#define OL_VSBMENU                      99
#define OL_NEXTAPP                      101
#define OL_NEXTWINDOW                   102
#define OL_PREVAPP                      103
#define OL_PREVWINDOW                   104
#define OL_WINDOWMENU                   105
#define OL_WORKSPACEMENU                106
#define OL_DEFAULTACTION                108
#define OL_TOGGLEPUSHPIN                111
#define OL_IMMEDIATE                    120
#define OL_CLICK_TO_TYPE                125
#define OL_REALESTATE                   126
#define OL_UNDERLINE                    127
#define OL_HIGHLIGHT                    128
#define OL_INACTIVE                     129
#define OL_DISPLAY                      130
#define OL_PROC                         131
#define OL_SIZE_PROC                    132
#define OL_DRAW_PROC                    133
#define OL_PINNED_MENU                  134
#define OL_PRESS_DRAG_MENU              135
#define OL_STAYUP_MENU                  136
#define OL_POINTER                      137
#define OL_INPUTFOCUS                   138
#define OL_QUIT                         142
#define OL_DESTROY                      143
#define OL_DISMISS                      144
#define OL_PRE                          145
#define OL_POST                         146

typedef enum {motionVerify, modVerify, leaveVerify} OlVerifyOpType;
typedef enum {OlsdLeft, OlsdRight} OlScanDirection;
typedef enum {OlstPositions, OlstWhiteSpace, OlstEOL, OlstParagraph, OlstLast} OlScanType;
typedef enum {NOTOPEN, READWRITE, READONLY, NEWFILE } TextFileStatus;
typedef enum {EDIT_FAILURE, EDIT_SUCCESS } EditResult;
typedef enum {SCAN_NOTFOUND, SCAN_WRAPPED, SCAN_FOUND, SCAN_INVALID } ScanResult;
typedef enum {SAVE_FAILURE, SAVE_SUCCESS } SaveResult;

#define                         TEXT_BUFFER_NOP (0)
#define                         TEXT_BUFFER_DELETE_START_LINE(1L<<0)
#define                         TEXT_BUFFER_DELETE_START_CHARS(1L<<1)
#define                         TEXT_BUFFER_DELETE_END_LINE(1L<<2)
#define                         TEXT_BUFFER_DELETE_END_CHARS(1L<<3)
#define                         TEXT_BUFFER_DELETE_JOIN_LINE(1L<<4)
#define                         TEXT_BUFFER_DELETE_SIMPLE(1L<<5)
#define                         TEXT_BUFFER_INSERT_SPLIT_LINE(1L<<6)
#define                         TEXT_BUFFER_INSERT_LINE(1L<<7)
#define                         TEXT_BUFFER_INSERT_CHARS(1L<<8)
#define                         CHANGE_BAR_WIDTH 3
#define                         CHANGE_BAR_HEIGHT 18
#define                         CHANGE_BAR_PAD 7
```

```
#define                 OL_DIM  1000
#define                 OL_NORMAL 1001
#define                 OL_PROPAGATE_TO_CONTROL_AREA0x0001
#define                 OL_PROPAGATE_TO_CATEGORY0x0002
#define                 OL_PROPAGATE (OL_PROPAGATE_TO_CONTROL_AREA \OL_PROPAGATE_TO_CATEGORY)
```

Figure 10-28. libXol Data Structures

```
typedef struct _CaptionClassRec                 CaptionWidgetClass;
typedef struct _CaptionRec                      *CaptionWidget;
typedef struct _CategoryClassRec                *CategoryWidgetClass;
typedef struct _CategoryRec                     *CategoryWidget;
typedef struct _CheckBoxClassRec                *CheckBoxWidgetClass;
typedef struct _CheckBoxRec                     *CheckBoxWidget;
typedef int                                     ControlLayout;
typedef int                                     OlSameSize;
typedef struct _ControlClassRec                 *ControlAreaWidgetClass;
typedef struct _ControlRec                      *ControlAreaWidget;
typedef struct _EventObjClassRec                *EventObjClass;
typedef struct _EventObjRec                     *EventObj;
typedef struct _ExclusivesClassRec              *ExclusivesWidgetClass;
typedef struct _ExclusivesRec                   *ExclusivesWidget;
typedef struct _FooterPanelClassRec             *FooterPanelWidgetClass;
typedef struct _FooterPanelRec                  *FooterPanelWidget;
typedef struct _FormClassRec                    *FormWidgetClass;
typedef struct _FormRec                         *FormWidget;
typedef struct _FormConstraintRec               *FormConstraints;
typedef struct _SliderClassRec                  *GaugeWidgetClass;
typedef struct _SliderRec                       *GaugeWidget;
typedef struct _HelpClassRec                    *HelpWidgetClass;
typedef struct _HelpRec                         *HelpWidget;
typedef struct _ListPaneClassRec                *ListPaneWidgetClass;
typedef struct _ListPaneRec                     *ListPaneWidget;
typedef struct _MagClassRec                     *MagWidgetClass;
typedef struct _MagRec                          *MagWidget;
typedef struct _ManagerClassRec                 *ManagerWidgetClass;
typedef struct _ManagerRec                      *ManagerWidget;
typedef struct _MenuShellClassRec               *MenuShellWidgetClass;
typedef struct _MenuShellRec                    *MenuShellWidget;
typedef struct _MenuButtonClassRec              *MenuButtonWidgetClass;
typedef struct _MenuButtonRec                   *MenuButtonWidget;
typedef struct _MenuButtonGadgetClassRec*MenuButtonGadgetClass;
typedef struct _MenuButtonGadgetRec             *MenuButtonGadget;
typedef struct _NonexclusivesClassRec           *NonexclusivesWidgetClass;
typedef struct _NonexclusivesRec                *NonexclusivesWidget;
typedef struct _NoticeShellClassRec             *NoticeShellWidgetClass;
typedef struct _NoticeShellRec                  *NoticeShellWidget;
typedef struct _OblongButtonClassRec            *OblongButtonWidgetClass;
typedef struct _OblongButtonRec                 *OblongButtonWidget;
typedef struct _OblongButtonGadgetClassRec *OblongButtonGadgetClass;
typedef struct _OblongButtonGadgetRec           *OblongButtonGadget;
typedef short                                   OlDefine;
typedef unsigned long                           OlBitMask;
typedef struct _PopupWindowShellClassRec        *PopupWindowShellWidgetClass;
typedef struct _PopupWindowShellRec             *PopupWindowShellWidget;
typedef struct _PrimitiveClassRec               *PrimitiveWidgetClass;
typedef struct _PrimitiveRec                    *PrimitiveWidget;
typedef struct _PushpinClassRec                 *PushpinWidgetClass;
typedef struct _PushpinRec                      *PushpinWidget;
typedef struct _RectButtonClassRec              *RectButtonWidgetClass;
typedef struct _RectButtonRec                   *RectButtonWidget;
typedef struct _RubberTileClassRec              *RubberTileWidgetClass;
typedef struct _RubberTileRec                   *RubberTileWidget;
typedef struct _ScrollbarClassRec               *ScrollbarWidgetClass;
typedef struct _ScrollbarRec                    *ScrollbarWidget;
```

```
typedef struct OlScrollbarVerify {
        int                             new_location;
        int                             new_page;
        Boolean                         ok;
        int                             slidermin;
        int                             slidermax;
        int                             delta;
        Boolean                         more_cb_pending;
} OlScrollbarVerify;
typedef struct _ScrolledWindowClassRec                          *ScrolledWindowWidgetClass;
typedef struct _ScrolledWindowRec                               *ScrolledWindowWidget;
typedef struct _OlSWGeometries {
        Widget                          sw;
        Widget                          vsb;
        Widget                          hsb;
        Dimension                       bb_border_width;
        Dimension                       vsb_width;
        Dimension                       vsb_min_height;
        Dimension                       hsb_height;
        Dimension                       hsb_min_width;
        Dimension                       sw_view_width;
        Dimension                       sw_view_height;
        Dimension                       bbc_width;
        Dimension                       bbc_height;
        Dimension                       bbc_real_width;
        Dimension                       bbc_real_height;
        Boolean                         force_hsb;
        Boolean                         force_vsb;
} OlSWGeometries;
typedef struct _OlListItem {
        OlDefine                        label_type;
        XtPointer                       label;
        XImage                          *glyph;
        OlBitMask                       attr;
        XtPointer                       user_data;
        unsigned        char            implementation_specific;
} OlListItem;
typedef struct _OlListToken *OlListToken;
typedef struct _OlListDelete { OlListToken *tokens; Cardinal num_tokens; } OlListDelete;
typedef struct _ListClassRec                    *ScrollingListWidgetClass;
typedef struct _ListRec                                         *ScrollingListWidget;
typedef struct _SliderClassRec                                  *SliderWidgetClass;
typedef struct _SliderRec                                       *SliderWidget;
typedef struct OlSliderVerify { int new_location; Boolean more_cb_pending; } OlSliderVerify;
typedef struct _StaticTextClassRec                              *StaticTextWidgetClass;
typedef struct _StaticTextRec                                   *StaticTextWidget;
typedef Dimension                                               *TabTable;
typedef struct {OlTextMarginHint hint; XRectangle *rect; } OlTextMarginCallData, *OlTextMarginCallDataPointer;
typedef struct {
        Boolean                         ok;
        TextPosition                    current_cursor;
        TextPosition                    new_cursor;
        TextPosition                    select_start;
        TextPosition                    select_end;
 } OlTextMotionCallData, *OlTextMotionCallDataPointer;
typedef struct {
        Booleanok;
        TextPosition                    current_cursor;
        TextPosition                    select_start;
        TextPosition                    select_end;
        TextPosition                    new_cursor;
        TextPosition                    new_select_start;
        TextPosition                    new_select_end;
        String                          text;
        int                             text_length;
} OlTextModifyCallData, *OlTextModifyCallDataPointer;
```

```
typedef struct {
        Boolean                         requestor;
        TextPosition                    new_cursor;
        TextPosition                    new_select_start;
        TextPosition                    new_select_end;
        String                          inserted;
        String                          deleted;
        TextLocation                    delete_start;
        TextLocation                    delete_end;
        TextLocation                    insert_start;
        TextLocation                    insert_end;
        TextPosition                    cursor_position;
} OlTextPostModifyCallData, *OlTextPostModifyCallDataPointer;
typedef struct _TextEditClassRec                        *TextEditWidgetClass;
typedef struct _TextEditRec                             *TextEditWidget;
typedef struct _TextFieldClassRec                       *TextFieldWidgetClass;
typedef struct _TextFieldRec                            *TextFieldWidget;
typedef struct { String string; Boolean ok; OlTextVerifyReason reason; } OlTextFieldVerify, *OlTextFieldVerifyPointer;
typedef char BufferElement;
typedef struct _Buffer { int size; int used; int esize; BufferElement *p; } Buffer;
typedef int             TextPosition;
typedef int             TextLine;
typedef int             TextPage;
typedef int             TextBlock;
typedef struct{ int size; int used; int esize; TextBlock *p; } BlockTable;
typedef struct {TextPage pageindex; unsigned long timestamp;} PageQueue;
typedef struct { TextPosition bytes; TextLine lines; TextPage qpos; BlockTable *dpos; } Page;
typedef struct { TextPage pageindex; Buffer *buffer; unsigned long userData; } Line;
typedef struct { int size; int used; int size; Page *p; } PageTable;
typedef struct { int size; int used; int esize; Line *p; } LineTable;
typedef struct _TextLocation { TextLine line; TextPosition offset; BufferElement *buffer; } TextLocation;
typedef int TextUndoHint;
typedef struct _TextUndoItem {
        String                          string;
        TextLocation                    start;
        TextLocation                    end;
        TextUndoHint                    hint;
} TextUndoItem;
typedef void (*TextUpdateFunction)();
typedef struct _TextUpdateCallback {TextUpdateFunction f; caddr_t d;} TextUpdateCallback;
typedef struct _TextBuffer {
        char                            *filename;
        FILE                            *tempfile;
        TextBlock                       blockcnt;
        TextBlock                       blocksize;
        LineTable                       lines;
        PageTable                       pages;
        BlockTable                      *free_list;
        PageQueue                       pqueue[PQLIMIT];
        TextPage                        pagecount;
        TextPage                        pageref;
        TextPage                        curpageno;
        Buffer                          *buffer;
        char                            dirty;
        TextFileStatus                  status;
        int                             refcount;
        TextUpdateCallback              *update;
        TextUndoItem                    deleted;
        TextUndoItem                    insert;
} TextBuffer;
```

Motif 1.2 Widget Set

Overview

This chapter contains the interfaces to the Motif 1.2 user interface environment. The Motif 1.2 interfaces are represented through the libXm and libMrm libraries.

The Motif 1.2 Interface is comprised of a set of Graphical User Interface components that together makeup a unique user interface environment. The components of this environment are: the toolkit, window manager, and user interface language. These user interface components are defined in the OSF/Motif *Programmer's Reference, Revision 1.2* (Open Software Foundation, Inc. 1992 - Prentice-Hall, ISBN 0-13-643115-1)

The Motif Interfaces

The interfaces listed below in Table 10-11, Table 10-12 and Table 10-13 have been included in SCD 2.4 because they are required to be present on all systems conforming to the SCD 2.4 REQUIRED interface definition for Motif 1.2, in the dynamic libraries */usr/lib/libXm.so.1.2*, */usr/lib/libXm.so.3*, */usr/dt/lib/libXm.so.1.2*, and */usr/dt/lib/libXm.so.3*; and */usr/lib/libMrm.so.1.2*, */usr/lib/libMrm.so.3*, */usr/dt/lib/libMrm.so.1.2*, and */usr/dt/lib/libMrm.so.3*."

Figure 10-29 through Figure 10-74 detail the manifest constants associated with libXm and libMrm and it's visible data structures, respectively.

In addition to the interfaces listed in the tables all SCD 2.4 compliant systems that offer Motif must have the uil(3) command and the mwm(3) window manager as defined in the *OSF/Motif Programmer's Reference, Release 1.2* (Prentice-Hall, ISBN 0-13-643115-1).

Table 10-12 defines the size of exported data objects as a hexadecimal byte count in square brackets after each name. Some of the sizes are given as question marks. Where the size of an item is a question mark, that symbol is a reserved symbol which must not be used by an SCD-conforming application. They are widget class records, and are only used in order to subclass widgets. The subclassing of Motif widgets is not supported by the SCD.

Rationale:

> The class records for Motif widgets are of interest only for subclassing of these widgets. Programs that use these widgets without subclassing them need not and must not reference these symbols. Programs must also not use these symbols as external symbols for any other purpose because this will interefere with the Widget Library's use of them.
>
> Programs that do subclass Motif widgets do not conform the the SCD. This is because the authors of the SCD cannot guarantee upward compatibility of widgets from one release to the next. The size of each widget class record is subject to being changed by the owner(s) of the code. Widget subclass records depend on the size of the class record of the superordinate class. They will be rendered invalid at the binary interface level if the size of the superordinate class record changes.

Table 10-11: Contents of libXm (1 of 2)

XmActivateProtocol
XmAddProtocolCallback
XmAddProtocols
XmAddTabGroup
XmCascadeButtonGadgetHighlight
XmCascadeButtonHighlight
XmChangeColor
XmClipboardCancelCopy
XmClipboardCopy
XmClipboardCopyByName
XmClipboardEndCopy
XmClipboardEndRetrieve
XmClipboardInquireCount
XmClipboardInquireFormat
XmClipboardInquireLength
XmClipboardInquirePendingItems
XmClipboardLock
XmClipboardRegisterFormat
XmClipboardRetrieve
XmClipboardStartCopy
XmClipboardStartRetrieve
XmClipboardUndoCopy
XmClipboardUnlock
XmClipboardWithdrawFormat
XmCommandAppendValue
XmCommandError
XmCommandGetChild
XmCommandSetValue
XmConvertUnits
XmCreateArrowButton
XmCreateArrowButtonGadget
XmCreateBulletinBoard
XmCreateBulletinBoardDialog
XmCreateCascadeButton
XmCreateCascadeButtonGadget
XmCreateCommand
XmCreateDialogShell
XmCreateDragIcon
XmCreateDrawingArea
XmCreateDrawnButton
XmCreateErrorDialog
XmCreateFileSelectionBox
XmCreateFileSelectionDialog
XmCreateForm
XmCreateFormDialog
XmCreateFrame
XmCreateInformationDialog
XmCreateLabel
XmCreateLabelGadget
XmCreateList
XmCreateMainWindow
XmCreateMenuBar
XmCreateMenuShell
XmCreateMessageBox
XmCreateMessageDialog
XmCreateOptionMenu
XmCreatePanedWindow
XmCreatePopupMenu
XmCreatePromptDialog
XmCreatePulldownMenu
XmCreatePushButton
XmCreatePushButtonGadget
XmCreateQuestionDialog
XmCreateRadioBox
XmCreateRowColumn
XmCreateScale
XmCreateScrollBar
XmCreateScrolledList
XmCreateScrolledText
XmCreateScrolledWindow
XmCreateSelectionBox
XmCreateSelectionDialog
XmCreateSeparator
XmCreateSeparatorGadget
XmCreateSimpleCheckBox
XmCreateSimpleMenuBar
XmCreateSimpleOptionMenu
XmCreateSimplePopupMenu
XmCreateSimplePulldownMenu
XmCreateSimpleRadioBox
XmCreateTemplateDialog
XmCreateText
XmCreateTextField
XmCreateToggleButton
XmCreateToggleButtonGadget
XmCreateWarningDialog
XmCreateWorkArea
XmCreateWorkingDialog
XmCvtCTToXmString
XmCvtStringToUnitType
XmCvtXmStringToCT
XmDeactivateProtocol
XmDestroyPixmap
XmDragCancel
XmDragStart
XmDropSiteConfigureStackingOrder
XmDropSiteEndUpdate
XmDropSiteQueryStackingOrder
XmDropSiteRegister
XmDropSiteRetrieve
XmDropSiteStartUpdate
XmDropSiteUnregister
XmDropSiteUpdate
XmDropTransferAdd
XmDropTransferStart
XmFileSelectionBoxGetChild
XmFileSelectionDoSearch
XmFontListAdd
XmFontListAppendEntry
XmFontListCopy
XmFontListCreate
XmFontListEntryCreate
XmFontListEntryFree
XmFontListEntryGetFont
XmFontListEntryGetTag
XmFontListEntryLoad
XmFontListFree
XmFontListFreeFontContext
XmFontListGetNextFont
XmFontListInitFontContext
XmFontListNextEntry
XmFontListRemoveEntry
XmGetAtomName
XmGetColorCalculation
XmGetColors
XmGetDestination
XmGetDragContext
XmGetFocusWidget
XmGetMenuCursor
XmGetPixmap
XmGetPixmapByDepth
XmGetPostedFromWidget
XmGetSecondaryResourceData
XmGetTabGroup
XmGetTearOffControl
XmGetVisibility
XmGetXmDisplay
XmGetXmScreen
XmInstallImage
XmInternAtom
XmIsMotifWMRunning
XmIsTraversable
XmListAddItem
XmListAddItems
XmListAddItemsUnselected
XmListAddItemUnselected
XmListDeleteAllItems
XmListDeleteItem
XmListDeleteItems
XmListDeleteItemsPos
XmListDeletePos
XmListDeletePositions
XmListDeselectAllItems
XmListDeselectItem
XmListDeselectPos
XmListGetKbdItemPos
XmListGetMatchPos
XmListGetSelectedPos
XmListItemExists
XmListItemPos
XmListPosSelected
XmListPosToBounds
XmListReplaceItems
XmListReplaceItemsPos
XmListReplaceItemsPosUnselected
XmListReplaceItemsUnselected
XmListReplacePositions
XmListSelectItem
XmListSelectPos
XmListSetAddMode
XmListSetBottomItem
XmListSetBottomPos
XmListSetHorizPos
XmListSetItem
XmListSetKbdItemPos
XmListSetPos
XmListUpdateSelectedList

Table 10-11: Contents of libXm (2 of 2)

XmListYToPos
XmMainWindowSep1
XmMainWindowSep2
XmMainWindowSep3
XmMainWindowSetAreas
XmMapSegmentEncoding
XmMenuPosition
XmMessageBoxGetChild
XmOptionButtonGadget
XmOptionLabelGadget
XmProcessTraversal
XmRegisterSegmentEncoding
XmRemoveProtocolCallback
XmRemoveProtocols
XmRemoveTabGroup
XmRepTypeAddReverse
XmRepTypeGetId
XmRepTypeGetNameList
XmRepTypeGetRecord
XmRepTypeGetRegistered
XmRepTypeInstallTearOffModelConverter
XmRepTypeRegister
XmRepTypeValidValue
XmResolveAllPartOffsets
XmResolvePartOffsets
XmScaleGetValue
XmScaleSetValue
XmScrollBarGetValues
XmScrollBarSetValues
XmScrolledWindowSetAreas
XmScrollVisible
XmSelectionBoxGetChild
XmSetColorCalculation
XmSetFontUnit
XmSetFontUnits
XmSetMenuCursor
XmSetProtocolHooks
XmStringBaseline
XmStringByteCompare
XmStringCompare
XmStringConcat
XmStringCopy
XmStringCreate
XmStringCreateLocalized
XmStringCreateLtoR
XmStringCreateSimple
XmStringDirectionCreate
XmStringDraw
XmStringDrawImage
XmStringDrawUnderline
XmStringEmpty
XmStringExtent
XmStringFree
XmStringFreeContext
XmStringGetLtoR
XmStringGetNextComponent
XmStringGetNextSegment
XmStringHasSubstring
XmStringHeight
XmStringInitContext
XmStringLength
XmStringLineCount
XmStringNConcat
XmStringNCopy
XmStringPeekNextComponent
XmStringSegmentCreate
XmStringSeparatorCreate
XmStringWidth
XmTargetsAreCompatible
XmTextClearSelection
XmTextCopy
XmTextCut
XmTextDisableRedisplay
XmTextEnableRedisplay
XmTextFieldClearSelection
XmTextFieldCopy
XmTextFieldCut
XmTextFieldGetBaseline
XmTextFieldGetEditable
XmTextFieldGetInsertionPosition
XmTextFieldGetLastPosition
XmTextFieldGetMaxLength
XmTextFieldGetSelection
XmTextFieldGetSelectionPosition
XmTextFieldGetSelectionWcs
XmTextFieldGetString
XmTextFieldGetStringWcs
XmTextFieldGetSubstring
XmTextFieldGetSubstringWcs
XmTextFieldInsert
XmTextFieldInsertWcs
XmTextFieldPaste
XmTextFieldPosToXY
XmTextFieldRemove
XmTextFieldReplace
XmTextFieldReplaceWcs
XmTextFieldSetAddMode
XmTextFieldSetEditable
XmTextFieldSetHighlight
XmTextFieldSetInsertionPosition
XmTextFieldSetMaxLength
XmTextFieldSetSelection
XmTextFieldSetString
XmTextFieldSetStringWcs
XmTextFieldShowPosition
XmTextFieldXYToPos
XmTextFindString
XmTextFindStringWcs
XmTextGetBaseLine
XmTextGetBaseline
XmTextGetEditable
XmTextGetInsertionPosition
XmTextGetLastPosition
XmTextGetMaxLength
XmTextGetSelection
XmTextGetSelectionPosition
XmTextGetSelectionWcs
XmTextGetSource
XmTextGetString
XmTextGetStringWcs
XmTextGetSubstring
XmTextGetSubstringWcs
XmTextGetTopCharacter
XmTextInsert
XmTextInsertWcs
XmTextPaste
XmTextPosToXY
XmTextRemove
XmTextReplace
XmTextReplaceWcs
XmTextScroll
XmTextSetAddMode
XmTextSetEditable
XmTextSetHighlight
XmTextSetInsertionPosition
XmTextSetMaxLength
XmTextSetSelection
XmTextSetSource
XmTextSetString
XmTextSetStringWcs
XmTextSetTopCharacter
XmTextShowPosition
XmTextXYToPos
XmToggleButtonGadgetGetState
XmToggleButtonGadgetSetState
XmToggleButtonGetState
XmToggleButtonSetState
XmTrackingEvent
XmTrackingLocate
XmTranslateKey
XmUninstallImage
XmUpdateDisplay
XmVaCreateSimpleCheckBox
XmVaCreateSimpleMenuBar
XmVaCreateSimpleOptionMenu
XmVaCreateSimplePopupMenu
XmVaCreateSimplePulldownMenu
XmVaCreateSimpleRadioBox
XmWidgetGetBaselines
XmWidgetGetDisplayRect

Table 10-12: Exported Data for Motif 1.2

vendorShellClassRec[?]
vendorShellWidgetClass[0x4]
xmArrowButtonClassRec[?]
xmArrowButtonGadgetClass[0x4]
xmArrowButtonGadgetClassRec[?]
xmArrowButtonWidgetClass[0x4]
xmBulletinBoardClassRec[?]
xmBulletinBoardWidgetClass[0x4]
xmCascadeButtonClassRec[?]
xmCascadeButtonGadgetClass[0x4]
xmCascadeButtonGadgetClassRec[?]
xmCascadeButtonGCacheObjClassRec[?]
xmCascadeButtonWidgetClass[0x4]
xmCommandClassRec[?]
xmCommandWidgetClass[0x4]
xmDesktopClass[0x4]
xmDesktopClassRec[?]
xmDesktopObjectClass[0x4]
xmDialogShellClassRec[?]
xmDialogShellExtClassRec[?]
xmDialogShellExtObjectClass[0x4]
xmDialogShellWidgetClass[0x4]
xmDisplayClass[0x4]
xmDisplayClassRec[?]
xmDisplayObjectClass[0x4]
xmDragContextClass[0x4]
xmDragContextClassRec[?]
xmDragIconClassRec[?]
xmDragIconObjectClass[0x4]
xmDragOverShellClassRec[?]
xmDragOverShellWidgetClass[0x4]
xmDrawingAreaClassRec[?]
xmDrawingAreaWidgetClass[0x4]
xmDrawnButtonClassRec[?]
xmDrawnButtonWidgetClass[0x4]
xmDropSiteManagerClassRec[?]
xmDropSiteManagerObjectClass[0x4]
xmDropTransferClassRec[?]
xmDropTransferObjectClass[0x4]
xmExtClassRec[?]
xmExtObjectClass[0x4]
xmFileSelectionBoxClassRec[?]
xmFileSelectionBoxWidgetClass[0x4]
xmFormClassRec[?]
xmFormWidgetClass[0x4]
xmFrameClassRec[?]
xmFrameWidgetClass[0x4]
xmGadgetClass[0x4]
xmGadgetClassRec[?]
xmLabelClassRec[?]
xmLabelGadgetClass[0x4]
xmLabelGadgetClassRec[?]
xmLabelGCacheObjClassRec[?]
xmLabelWidgetClass[0x4]
xmListClassRec[?]
xmListWidgetClass[0x4]
xmMainWindowClassRec[?]
xmMainWindowWidgetClass[0x4]
xmManagerClassRec[?]
xmManagerWidgetClass[0x4]
xmMenuShellClassRec[?]
xmMenuShellWidgetClass[0x4]
xmMessageBoxClassRec[?]
xmMessageBoxWidgetClass[0x4]
xmPanedWindowClassRec[?]
xmPanedWindowWidgetClass[0x4]
xmPrimitiveClassRec[?]
xmPrimitiveWidgetClass[0x4]
xmProtocolClassRec[?]
xmProtocolObjectClass[0x4]
xmPushButtonClassRec[?]
xmPushButtonGadgetClass[0x4]
xmPushButtonGadgetClassRec[?]
xmPushButtonGCacheObjClassRec[?]
xmPushButtonWidgetClass[0x4]
XmQmotif[0x4]
xmRowColumnClassRec[?]
xmRowColumnWidgetClass[0x4]
xmSashClassRec[?]
xmSashWidgetClass[0x4]
xmScaleClassRec[?]
xmScaleWidgetClass[0x4]
xmScreenClass[0x4]
xmScreenClassRec[?]
xmScreenObjectClass[0x4]
xmScrollBarClassRec[?]
xmScrollBarWidgetClass[0x4]
xmScrolledWindowClassRec[?]
xmScrolledWindowWidgetClass[0x4]
xmSelectionBoxClassRec[?]
xmSelectionBoxWidgetClass[0x4]
xmSeparatorClassRec[?]
xmSeparatorGadgetClass[0x4]
xmSeparatorGadgetClassRec[?]
xmSeparatorGCacheObjClassRec[?]
xmSeparatorWidgetClass[0x4]
xmShellExtClassRec[?]
xmShellExtObjectClass[0x4]
xmTearOffButtonClassRec[?]
xmTearOffButtonWidgetClass[0x4]
xmTextClassRec[?]
xmTextFieldClassRec[?]
xmTextFieldWidgetClass[0x4]
xmTextWidgetClass[0x4]
xmToggleButtonClassRec[?]
xmToggleButtonGadgetClass[0x4]
xmToggleButtonGadgetClassRec[?]
xmToggleButtonGCacheObjClassRec[?]
xmToggleButtonWidgetClass[0x4]
xmVendorShellExtClassRec[?]
xmVendorShellExtObjectClass[0x4]
xmWorldClass[0x4]
xmWorldClassRec[?]
xmWorldObjectClass[0x4]

Table 10-13: libMrm Contents

MrmCloseHierarchy
MrmFetchBitmapLiteral
MrmFetchColorLiteral
MrmFetchIconLiteral
MrmFetchLiteral
MrmFetchSetValues
MrmFetchWidget
MrmFetchWidgetOverride
MrmInitialize
MrmOpenHierarchy
MrmOpenHierarchyPerDisplay
MrmRegisterClass
MrmRegisterNames
MrmRegisterNamesInHierarchy

Figure 10-29. Motif 1.2 Data Structures from ArrowB.h

```
typedef struct _XmArrowButtonClassRec       * XmArrowButtonWidgetClass;
typedef struct _XmArrowButtonRec            * XmArrowButtonWidget;
```

Figure 10-30. Motif 1.2 Data Structures from ArrowBG.h

```
typedef struct _XmArrowButtonGadgetClassRec     * XmArrowButtonGadgetClass;
typedef struct _XmArrowButtonGadgetRec          * XmArrowButtonGadget;
```

Figure 10-31. Motif 1.2 Data Structures from BulletinB.h

```
typedef struct _XmBulletinBoardClassRec     * XmBulletinBoardWidgetClass;
typedef struct _XmBulletinBoardRec          * XmBulletinBoardWidget;
```

Figure 10-32. Motif 1.2 Data Structures from CascadeB.h

```
typedef struct _XmCascadeButtonRec          * XmCascadeButtonWidget;
typedef struct _XmCascadeButtonClassRec     * XmCascadeButtonWidgetClass;
```

Figure 10-33. Motif 1.2 Data Structures from CascadeBG.h

```
typedef struct _XmCascadeButtonGadgetClassRec   * XmCascadeButtonGadgetClass;
typedef struct _XmCascadeButtonGadgetRec        * XmCascadeButtonGadget;
typedef struct _XmCascadeButtonGCacheObjRec     * XmCascadeButtonGCacheObject;
```

Figure 10-34. Motif 1.2 Data Structures from Command.h

```
typedef struct _XmCommandClassRec           * XmCommandWidgetClass;
typedef struct _XmCommandRec                * XmCommandWidget;
```

Figure 10-35. Motif 1.2 Manifest Constants and Data Structures from CutPaste.h

```
#define XmClipboardFail                     0
#define XmClipboardSuccess                  1
#define XmClipboardTruncate                 2
#define XmClipboardLocked                   4
#define XmClipboardBadFormat                5
#define XmClipboardNoData                   6
#define ClipboardFail                       0
#define ClipboardSuccess                    1
#define ClipboardTruncate                   2
#define ClipboardLocked                     4
#define ClipboardBadFormat                  5
#define ClipboardNoData                     6
typedef struct {long DataId; long PrivateId;} XmClipboardPendingRec, *XmClipboardPendingList;
```

Figure 10-36. Motif 1.2 Data Structures from DialogS.h

```
typedef struct _XmDialogShellClassRec      * XmDialogShellWidgetClass;
typedef struct _XmDialogShellRec           * XmDialogShellWidget;
```

Figure 10-37. Motif 1.2 Manifest Constants and Data Structures from Display.h

```
enum {
      XmDRAG_NONE,                              XmDRAG_DROP_ONLY,
      XmDRAG_PREFER_PREREGISTER,                XmDRAG_PREREGISTER,
      XmDRAG_PREFER_DYNAMIC,                    XmDRAG_DYNAMIC,
      XmDRAG_PREFER_RECEIVER
};
typedef struct _XmDisplayRec                    *XmDisplay;
typedef struct _XmDisplayClassRec               *XmDisplayClass;
```

Figure 10-38. Motif 1.2 Manifest Constants and Data Structures from DragC.h

```
#define XmDROP_MOVE                             (1L << 0)
#define XmDROP_COPY                             (1L << 1)
#define XmDROP_LINK                             (1L << 2)
#define XmHELP                                  2
typedef unsigned int                            XmID;
#define _XA_MOTIF_DROP                          "_MOTIF_DROP"
#define _XA_DRAG_FAILURE                        "_MOTIF_DRAG_FAILURE"
#define _XA_DRAG_SUCCESS                        "_MOTIF_DRAG_SUCCESS"
enum{   XmTOP_LEVEL_ENTER,                      XmTOP_LEVEL_LEAVE,
      XmDRAG_MOTION,                            XmDROP_SITE_ENTER,
      XmDROP_SITE_LEAVE,                        XmDROP_START,
      XmDROP_FINISH,                            XmDRAG_DROP_FINISH,    XmOPERATION_CHANGED } ;
enum{   XmDROP,                 XmDROP_HELP,    XmDROP_CANCEL,     XmDROP_INTERRUPT       } ;
#define XmDROP_NOOP     0L
enum{   XmBLEND_ALL,  XmBLEND_STATE_SOURCE, XmBLEND_JUST_SOURCE,          XmBLEND_NONE  } ;
enum{   XmDROP_FAILURE,             XmDROP_SUCCESS      } ;
enum{   XmCR_TOP_LEVEL_ENTER,         XmCR_TOP_LEVEL_LEAVE,
      XmCR_DRAG_MOTION,             XmCR_DROP_SITE_ENTER,
      XmCR_DROP_SITE_LEAVE,         XmCR_DROP_START,
      XmCR_DROP_FINISH,             XmCR_DRAG_DROP_FINISH,
      XmCR_OPERATION_CHANGED,       _XmNUMBER_DND_CB_REASONS      } ;
typedef struct _XmDragContextClassRec           *XmDragContextClass;
typedef struct _XmDragContextRec                *XmDragContext;
typedef struct _XmAnyICCCallbackStruct{
   int              reason;
   XEvent           *event;
   Time             timeStamp;
}XmAnyICCCallbackStruct, *XmAnyICCCallback;
typedef struct _XmTopLevelEnterCallbackStruct{
   int              reason;
   XEvent           *event;
   Time             timeStamp;
   Screen           *screen;
   Window           window;
   Position         x, y;
   unsigned char    dragProtocolStyle;
   Atom             iccHandle;
}XmTopLevelEnterCallbackStruct, *XmTopLevelEnterCallback;
typedef struct _XmTopLevelLeaveCallbackStruct{
   int              reason;
   XEvent           *event;
   Time             timeStamp;
   Screen           *screen;
   Window           window;
}XmTopLevelLeaveCallbackStruct, *XmTopLevelLeaveCallback;

typedef struct _XmDropSiteEnterCallbackStruct{
   int              reason;
   XEvent           *event;
   Time             timeStamp;
   unsigned char    operation;
   unsigned char    operations;
   unsigned char    dropSiteStatus;
   Position         x, y;
}XmDropSiteEnterCallbackStruct, *XmDropSiteEnterCallback;

typedef struct _XmDropSiteLeaveCallbackStruct{
   int              reason;
```

```
    XEvent              *event;
    Time                timeStamp;
}XmDropSiteLeaveCallbackStruct, *XmDropSiteLeaveCallback;

typedef struct _XmDragMotionCallbackStruct{
    int                 reason;
    XEvent              *event;
    Time                timeStamp;
    unsigned char       operation;
    unsigned char       operations;
    unsigned char       dropSiteStatus;
    Position            x, y;
}XmDragMotionCallbackStruct, *XmDragMotionCallback;

typedef struct _XmOperationChangedCallbackStruct{
    int                 reason;
    XEvent              *event;
    Time                timeStamp;
    unsigned char       operation;
    unsigned char       operations;
    unsigned char       dropSiteStatus;
}XmOperationChangedCallbackStruct, *XmOperationChangedCallback;
typedef struct _XmDropStartCallbackStruct{
    int                 reason;
    XEvent              *event;
    Time                timeStamp;
    unsigned char       operation;
    unsigned char       operations;
    unsigned char       dropSiteStatus;
    unsigned char       dropAction;
    Position            x, y;
    Window              window;
    Atom                iccHandle;
}XmDropStartCallbackStruct, *XmDropStartCallback;
typedef struct _XmDropFinishCallbackStruct{
    int                 reason;
    XEvent              *event;
    Time                timeStamp;
    unsigned char       operation;
    unsigned char       operations;
    unsigned char       dropSiteStatus;
    unsigned char       dropAction;
    unsigned char       completionStatus;
}XmDropFinishCallbackStruct, *XmDropFinishCallback;
typedef struct _XmDragDropFinishCallbackStruct{int reason;XEvent   *event; Time  timeStamp; }XmDragDropFinishCallbackStruct, *XmDragDropFinishCallback;
```

Figure 10-39. Motif 1.2 Manifest Constants and Data Structures from DragIcon.h

```
enum {
        XmATTACH_NORTH_WEST,        XmATTACH_NORTH,
        XmATTACH_NORTH_EAST,        XmATTACH_EAST,
        XmATTACH_SOUTH_EAST,        XmATTACH_SOUTH,
        XmATTACH_SOUTH_WEST,        XmATTACH_WEST,
        XmATTACH_CENTER,        XmATTACH_HOT
};
typedef struct _XmDragIconRec *XmDragIconObject;
typedef struct _XmDragIconClassRec *XmDragIconObjectClass;
```

Figure 10-40. Motif 1.2 Data Structures from DragOverS.h

```
typedef struct _XmDragOverShellRec      *XmDragOverShellWidget;
typedef struct _XmDragOverShellClassRec         *XmDragOverShellWidgetClass;
```

Figure 10-41. Motif 1.2 Data Structures from DrawingA.h

```
typedef struct _XmDrawingAreaClassRec * XmDrawingAreaWidgetClass;
typedef struct _XmDrawingAreaRec      * XmDrawingAreaWidget;
```

Figure 10-42. Motif 1.2 Data Structures from DrawnB.h

```
typedef struct _XmDrawnButtonClassRec *XmDrawnButtonWidgetClass;
typedef struct _XmDrawnButtonRec      *XmDrawnButtonWidget;
```

Figure 10-43. Motif 1.2 Manifest Constants and Data Structures from DropSMgr.h

```
#define XmCR_DROP_SITE_LEAVE_MESSAGE  1
#define XmCR_DROP_SITE_ENTER_MESSAGE  2
#define XmCR_DROP_SITE_MOTION_MESSAGE 3
#define XmCR_DROP_MESSAGE             4
#define XmNO_DROP_SITE                          1
#define XmINVALID_DROP_SITE                     2
#define XmVALID_DROP_SITE                       3
enum { XmDRAG_UNDER_NONE, XmDRAG_UNDER_PIXMAP,
   XmDRAG_UNDER_SHADOW_IN, XmDRAG_UNDER_SHADOW_OUT,
   XmDRAG_UNDER_HIGHLIGHT };
enum { XmDROP_SITE_SIMPLE, XmDROP_SITE_COMPOSITE,
   XmDROP_SITE_SIMPLE_CLIP_ONLY = 128,
   XmDROP_SITE_COMPOSITE_CLIP_ONLY };
enum { XmABOVE, XmBELOW };
enum { XmDROP_SITE_ACTIVE, XmDROP_SITE_INACTIVE };
typedef struct _XmDragProcCallbackStruct {
   int                  reason;
   XEvent *             event;
   Time                    timeStamp;
   Widget               dragContext;
   Position             x, y;
   unsigned char        dropSiteStatus;
   unsigned char        operation;
   unsigned char        operations;
   Boolean              animate;
} XmDragProcCallbackStruct, * XmDragProcCallback;

typedef struct _XmDropProcCallbackStruct {
   int                  reason;
   XEvent *             event;
   Time                    timeStamp;
   Widget               dragContext;
   Position             x, y;
   unsigned char        dropSiteStatus;
   unsigned char        operation;
   unsigned char        operations;
   unsigned char   dropAction;
} XmDropProcCallbackStruct, * XmDropProcCallback;
typedef struct _XmDropSiteVisualsRec {
      Pixel   background;
      Pixel   foreground;
      Pixel   topShadowColor;
      Pixmap  topShadowPixmap;
      Pixel   bottomShadowColor;
      Pixmap  bottomShadowPixmap;
      Dimension       shadowThickness;
      Pixel   highlightColor;
      Pixmap  highlightPixmap;
      Dimension       highlightThickness;
      Dimension       borderWidth;
} XmDropSiteVisualsRec, * XmDropSiteVisuals;


/* DropSite Widget */

typedef struct _XmDropSiteManagerClassRec *XmDropSiteManagerObjectClass;
typedef struct _XmDropSiteManagerRec *XmDropSiteManagerObject;
```

Figure 10-44. Motif 1.2 Manifest Constants and Data Structures from DropTrans.h

```
#define XmTRANSFER_FAILURE 0
#define XmTRANSFER_SUCCESS 1

typedef struct _XmDropTransferClassRec * XmDropTransferObjectClass;
typedef struct _XmDropTransferRec      * XmDropTransferObject;


typedef struct _XmDropTransferEntryRec {
      XtPointer       client_data;
      Atom            target;
} XmDropTransferEntryRec, * XmDropTransferEntry;
```

Figure 10-45. Motif 1.2 Data Structures from FileSB.h

```
typedef struct _XmFileSelectionBoxClassRec * XmFileSelectionBoxWidgetClass;
typedef struct _XmFileSelectionBoxRec      * XmFileSelectionBoxWidget;
```

Figure 10-46. Motif 1.2 Data Structures from Form.h

```
typedef struct _XmFormClassRec * XmFormWidgetClass;
typedef struct _XmFormRec      * XmFormWidget;
```

Figure 10-47. Motif 1.2 Data Structures from Frame.h

```
typedef struct _XmFrameClassRec * XmFrameWidgetClass;
typedef struct _XmFrameRec      * XmFrameWidget;
```

Figure 10-48. Motif 1.2 Data Structures from Label.h

```
typedef struct _XmLabelClassRec                 * XmLabelWidgetClass;
typedef struct _XmLabelRec                      * XmLabelWidget;
```

Figure 10-49. Motif 1.2 Data Structures from LabelG.h

```
typedef struct _XmLabelGadgetClassRec * XmLabelGadgetClass;
typedef struct _XmLabelGadgetRec      * XmLabelGadget;
typedef struct _XmLabelGCacheObjRec   * XmLabelGCacheObject;
```

Figure 10-50. Motif 1.2 Manifest Constants and Data Structures from List.h

```
#define XmINITIAL      0
#define XmADDITION     1
#define XmMODIFICATION 2

typedef struct _XmListClassRec * XmListWidgetClass;
typedef struct _XmListRec      * XmListWidget;
```

Figure 10-51. Motif 1.2 Data Structures from MainW.h

```
typedef struct _XmMainWindowClassRec * XmMainWindowWidgetClass;
typedef struct _XmMainWindowRec      * XmMainWindowWidget;
```

Figure 10-52. Motif 1.2 Data Structures from MenuShell.h

```
typedef struct _XmMenuShellClassRec       * XmMenuShellWidgetClass;
typedef struct _XmMenuShellWidgetRec      * XmMenuShellWidget;
```

Figure 10-53. Motif 1.2 Data Structures from MessageB.h

```
typedef struct _XmMessageBoxClassRec * XmMessageBoxWidgetClass;
typedef struct _XmMessageBoxRec      * XmMessageBoxWidget;
```

Figure 10-54. Motif 1.2 Manifest Constants and Data Structures from MrmPublic.h

```
#define MrmSUCCESS                1
#define MrmCREATE_NEW             3
#define MrmINDEX_RETRY            5    /* Retry on entering index required */
#define MrmINDEX_GT               7    /* Index orders greater-than entry */
#define MrmINDEX_LT               9    /* Index orders less-than entry */
#define MrmPARTIAL_SUCCESS        11   /* operation partly succeeded */
#define MrmFAILURE                0
#define MrmNOT_FOUND              2
#define MrmEXISTS                 4
#define MrmNUL_GROUP              6
#define MrmNUL_TYPE               8
#define MrmWRONG_GROUP            10
#define MrmWRONG_TYPE             12
#define MrmOUT_OF_RANGE           14   /* Record number too big */
#define MrmBAD_RECORD             16   /* Record number wrong type */
#define MrmNULL_DATA              18   /* No data for entry */
#define MrmBAD_DATA_INDEX         20   /* Data index in RID out of range */
```

```
#define MrmBAD_ORDER                    22    /* Bad ordering specifier */
#define MrmBAD_CONTEXT                  24    /* Invalid Mrm context */
#define MrmNOT_VALID                    26    /* Validation failure */
#define MrmBAD_BTREE                    28    /* GT/LT pointer error in BTree */
#define MrmBAD_WIDGET_REC               30    /* Validation failure on widget record */
#define MrmBAD_CLASS_TYPE               32    /* Class type not a valid Mrmwc... value */
#define MrmNO_CLASS_NAME                34    /* User class name is null */
#define MrmTOO_MANY                     36    /* Too many entries requested in some list */
#define MrmBAD_IF_MODULE                38    /* invalid interface module */
#define MrmNULL_DESC                    40    /* Arglist or children descriptor null */
#define MrmOUT_OF_BOUNDS                42    /* Argument index out of arglist bounds */
#define MrmBAD_COMPRESS                 44    /* Invalid compression code */
#define MrmBAD_ARG_TYPE                 46    /* Invalid type, not in RGMrType... */
#define MrmNOT_IMP                      48    /* Not yet implemented */
#define MrmNULL_INDEX                   50    /* empty index string */
#define MrmBAD_KEY_TYPE                 52    /* key must be MrmrIndex or MrmrRID */
#define MrmBAD_CALLBACK                 54    /* Invalid callback descriptor */
#define MrmNULL_ROUTINE                 56    /* Empty callback routine name string */
#define MrmVEC_TOO_BIG                  58    /* too many elements in vector */
#define MrmBAD_HIERARCHY                60    /* invalid Mrm file hierarchy */
#define MrmBAD_CLASS_CODE               62    /* Class code not found in Mrmwc... */
#define MrmDISPLAY_NOT_OPENED           63    /* Display not yet created */
#define MrmEOF                          64    /* End of file */
#define MrmUNRESOLVED_REFS              65    /* Unresolved widget refs in callback*/
#define MrmNcreateCallback              "createCallback"
#define MrmCR_CREATE                    XmCR_CREATE
#define MrmwcUnknown                    1
#define MrmRtypeMin                     1
#define MrmRtypeInteger                 1     /* int */
#define MrmRtypeBoolean                 2
#define MrmRtypeChar8                   3     /* a nul-terminated string */
#define MrmRtypeChar8Vector             4     /* a vector of char_8 strings */
#define MrmRtypeCString                 5     /* a compound string (DDIS) */
#define MrmRtypeCStringVector           6     /* a vector of compound strings */
#define MrmRtypeFloat                   7     /* 8 = TypeCompressed now unused */
#define MrmRtypeCallback                9     /* code for a callback descriptor */
#define MrmRtypePixmapImage             10    /* Pixmap in image form */
#define MrmRtypePixmapDDIF              11    /* Pixmap in DDIF form */
#define MrmRtypeResource                12    /* Mrm resource descriptor */
#define MrmRtypeNull                    13    /* no value given */
#define MrmRtypeAddrName                14    /* nul-terminated string to be interpreted as runtime address */
#define MrmRtypeIconImage               15    /* icon image */
#define MrmRtypeFont                    16    /* Mrm font structure */
#define MrmRtypeFontList                17    /* Mrm font list */
#define MrmRtypeColor                   18    /* Mrm color descriptor */
#define MrmRtypeColorTable              19    /* Mrm color table */
#define MrmRtypeAny                     20    /* Any is allowed in UID file */
#define MrmRtypeTransTable              21    /* Translation table (ASCIZ string) */
#define MrmRtypeClassRecName            22    /* class record name (ASCIZ string) */
#define MrmRtypeIntegerVector           23    /* a vector of integers */
#define MrmRtypeXBitmapFile             24    /* X bitmap file to make pixmap with */
#define MrmRtypeCountedVector           25    /* vector with associated count */
#define MrmRtypeKeysym                  26    /* X keysym data type */
#define MrmRtypeSingleFloat             27    /* single float data type */
#define MrmRtypeWideCharacter           28    /* wide_character string type */
#define MrmRtypeFontSet                 29
#define MrmRtypeMax                     30
typedef short int                       MrmCode ;       /* Used for codes, e.g. Mrmcr... */
typedef unsigned char                   MrmSCode ;      /* Short code for small ranges */
typedef unsigned short int              MrmOffset ;  /* Used for offsets in records */
typedef short int                       MrmType ;       /* Used for types, e.g. MrmrType... */
typedef unsigned short int              MrmSize ;       /* For size fields */
typedef short int                       MrmCount ;      /* For counter fields */
typedef unsigned char                   MrmFlag ;       /* flag fields */
typedef long int                        MrmResource_id ;        /* Resource id in IDB files */
typedef short int                       MrmGroup ;      /* For Mrm resource groups */
#define MrmMaxResourceSize              65535   /* (2)16 - 1 */
#define MrmOsOpenParamVersion           1
typedef struct  {Cardinal  version;  char *default_fname;
      union { unsigned long related_nam; Boolean  clobber_flg; } nam_flg;
      Display               *display;
} MrmOsOpenParam, *MrmOsOpenParamPtr ;
typedef struct MrmHierarchyDescStruct *MrmHierarchy;
typedef struct {String name ;   XtPointer   value ;} MRMRegisterArg, MrmRegisterArg, *MrmRegisterArglist ;
#define URMwcUnknown    1
```

Figure 10-55. Motif 1.2 Manifest Constants and Data Structures from MwmUtil.h

```
typedef struct {long flags; long   functions; long decorations; int input_mode; long  status;} MotifWmHints;
```

```
typedef MotifWmHints                                    MwmHints;
#define MWM_HINTS_FUNCTIONS                             (1L << 0)
#define MWM_HINTS_DECORATIONS                           (1L << 1)
#define MWM_HINTS_INPUT_MODE                            (1L << 2)
#define MWM_HINTS_STATUS                                (1L << 3)
#define MWM_FUNC_ALL                                    (1L << 0)
#define MWM_FUNC_RESIZE                                 (1L << 1)
#define MWM_FUNC_MOVE                                   (1L << 2)
#define MWM_FUNC_MINIMIZE                               (1L << 3)
#define MWM_FUNC_MAXIMIZE                               (1L << 4)
#define MWM_FUNC_CLOSE                                  (1L << 5)
#define MWM_DECOR_ALL                                   (1L << 0)
#define MWM_DECOR_BORDER                                (1L << 1)
#define MWM_DECOR_RESIZEH                               (1L << 2)
#define MWM_DECOR_TITLE                                 (1L << 3)
#define MWM_DECOR_MENU                                  (1L << 4)
#define MWM_DECOR_MINIMIZE                              (1L << 5)
#define MWM_DECOR_MAXIMIZE                              (1L << 6)
#define MWM_INPUT_MODELESS                              0
#define MWM_INPUT_PRIMARY_APPLICATION_MODAL             1
#define MWM_INPUT_SYSTEM_MODAL                          2
#define MWM_INPUT_FULL_APPLICATION_MODAL                3
#define MWM_TEAROFF_WINDOW                              (1L << 0)
#define MWM_INPUT_APPLICATION_MODAL                     MWM_INPUT_PRIMARY_APPLICATION_MODAL
typedef struct{    long       flags;    Window      wm_window;}   MotifWmInfo;
typedef MotifWmInfo                                     MwmInfo;
#define MWM_INFO_STARTUP_STANDARD                       (1L << 0)
#define MWM_INFO_STARTUP_CUSTOM                         (1L << 1)
typedef struct{CARD32 flags; CARD32  functions; CARD32 decorations; INT32 inputMode; CARD32 status;} PropMotifWmHints;
typedef PropMotifWmHints                                PropMwmHints;
#define PROP_MOTIF_WM_HINTS_ELEMENTS                    5
#define PROP_MWM_HINTS_ELEMENTS                         PROP_MOTIF_WM_HINTS_ELEMENTS
#define _XA_MOTIF_WM_HINTS                              "_MOTIF_WM_HINTS"
#define _XA_MWM_HINTS                                   _XA_MOTIF_WM_HINTS
#define _XA_MOTIF_WM_MESSAGES                           "_MOTIF_WM_MESSAGES"
#define _XA_MWM_MESSAGES                                _XA_MOTIF_WM_MESSAGES
#define _XA_MOTIF_WM_OFFSET                             "_MOTIF_WM_OFFSET"
#define _XA_MOTIF_WM_MENU                               "_MOTIF_WM_MENU"
#define _XA_MWM_MENU                                    _XA_MOTIF_WM_MENU
typedef struct { CARD32 flags;  CARD32 wmWindow;}       PropMotifWmInfo;
typedef PropMotifWmInfo                                 PropMwmInfo;
#define PROP_MOTIF_WM_INFO_ELEMENTS                     2
#define PROP_MWM_INFO_ELEMENTS                          PROP_MOTIF_WM_INFO_ELEMENTS
#define _XA_MOTIF_WM_INFO                               "_MOTIF_WM_INFO"
#define _XA_MWM_INFO                                    _XA_MOTIF_WM_INFO
#define _XA_MOTIF_BINDINGS                              "_MOTIF_BINDINGS"
```

Figure 10-56. Motif 1.2 Data Structures from PanedW.h

```
typedef struct _XmPanedWindowClassRec  *XmPanedWindowWidgetClass;
typedef struct _XmPanedWindowRec       *XmPanedWindowWidget;
```

Figure 10-57. Motif 1.2 Data Structures from PushB.h

```
typedef struct _XmPushButtonClassRec *XmPushButtonWidgetClass;
typedef struct _XmPushButtonRec      *XmPushButtonWidget;
```

Figure 10-58. Motif 1.2 Data Structures from PushBG.h

```
typedef struct _XmPushButtonGadgetClassRec   *XmPushButtonGadgetClass;
typedef struct _XmPushButtonGadgetRec        *XmPushButtonGadget;
typedef struct _XmPushButtonGCacheObjRec     *XmPushButtonGCacheObject;
```

Figure 10-59. Motif 1.2 Manifest Constants and Data Structures from RepType.h

```
#define XmREP_TYPE_INVALID            0x1FFF
typedef unsigned short XmRepTypeId ;
typedef struct{
   String rep_type_name ;
   String *value_names ;
   unsigned char *values ;
   unsigned char num_values ;
   Boolean reverse_installed ;
   XmRepTypeId rep_type_id ;
   }XmRepTypeEntryRec, *XmRepTypeEntry, XmRepTypeListRec, *XmRepTypeList ;
```

Figure 10-60. Motif 1.2 Data Structures from RowColumn.h

```
typedef struct _XmRowColumnClassRec * XmRowColumnWidgetClass;
typedef struct _XmRowColumnRec      * XmRowColumnWidget;
```

Figure 10-61. Motif 1.2 Data Structures from Scale.h

```
/* fast XtIsSubclass define */

typedef struct _XmScaleClassRec * XmScaleWidgetClass;
typedef struct _XmScaleRec      * XmScaleWidget;
```

Figure 10-62. Motif 1.2 Data Structures from Screen.h

```
typedef struct _XmScreenRec *XmScreen;
typedef struct _XmScreenClassRec *XmScreenClass;
```

Figure 10-63. Motif 1.2 Data Structures from ScrollBar.h

```
typedef struct _XmScrollBarClassRec * XmScrollBarWidgetClass;
typedef struct _XmScrollBarRec      * XmScrollBarWidget;
```

Figure 10-64. Motif 1.2 Data Structures from ScrolledW.h

```
typedef struct _XmScrolledWindowClassRec * XmScrolledWindowWidgetClass;
typedef struct _XmScrolledWindowRec      * XmScrolledWindowWidget;
```

Figure 10-65. Motif 1.2 Data Structures from SelectioB.h

```
typedef struct _XmSelectionBoxClassRec * XmSelectionBoxWidgetClass;
typedef struct _XmSelectionBoxRec      * XmSelectionBoxWidget;
```

Figure 10-66. Motif 1.2 Data Structures from SeparatoG.h

```
typedef struct _XmSeparatorGadgetClassRec * XmSeparatorGadgetClass;
typedef struct _XmSeparatorGadgetRec      * XmSeparatorGadget;
typedef struct _XmSeparatorGCacheObjRec   * XmSeparatorGCacheObject;
```

Figure 10-67. Motif 1.2 Data Structures from Separator.h

```
typedef struct _XmSeparatorClassRec * XmSeparatorWidgetClass;
typedef struct _XmSeparatorRec      * XmSeparatorWidget;
```

Figure 10-68. Motif 1.2 Data Structures from Text.h

```
typedef struct _XmTextSourceRec *XmTextSource;
typedef struct _XmTextClassRec *XmTextWidgetClass;
typedef struct _XmTextRec *XmTextWidget;
```

Figure 10-69. Motif 1.2 Data Structures from TextF.h

```
typedef struct _XmTextFieldClassRec *XmTextFieldWidgetClass;
typedef struct _XmTextFieldRec *XmTextFieldWidget;
```

Figure 10-70. Motif 1.2 Data Structures from ToggleB.h

```
typedef struct _XmToggleButtonClassRec *XmToggleButtonWidgetClass;
typedef struct _XmToggleButtonRec      *XmToggleButtonWidget;
```

Figure 10-71. Motif 1.2 Data Structures from ToggleBG.h

```
typedef struct _XmToggleButtonGadgetClassRec     *XmToggleButtonGadgetClass;
typedef struct _XmToggleButtonGadgetRec          *XmToggleButtonGadget;
typedef struct _XmToggleButtonGCacheObjRec       *XmToggleButtonGCacheObject;
```

Figure 10-72. Motif 1.2 Data Structures from VendorS.h

```
typedef struct _XmVendorShellRec *XmVendorShellWidget;
typedef struct _XmVendorShellClassRec *XmVendorShellWidgetClass;
```

Figure 10-73. Motif 1.2 Manifest Constants from VirtKeys.h

```
#define _OSF_Keysyms
#define osfXK_BackSpace                         0x1004FF08
#define osfXK_Insert                            0x1004FF63
#define osfXK_Delete                            0x1004FFFF
#define osfXK_Copy                              0x1004FF02
#define osfXK_Cut                               0x1004FF03
#define osfXK_Paste                             0x1004FF04
#define osfXK_AddMode                           0x1004FF31
#define osfXK_PrimaryPaste                      0x1004FF32
#define osfXK_QuickPaste                        0x1004FF33
#define osfXK_PageLeft                          0x1004FF40
#define osfXK_PageUp                            0x1004FF41
#define osfXK_PageDown                          0x1004FF42
#define osfXK_PageRight                         0x1004FF43
#define osfXK_EndLine                           0x1004FF57
#define osfXK_BeginLine                         0x1004FF58
#define osfXK_Activate                          0x1004FF44
#define osfXK_MenuBar                           0x1004FF45
#define osfXK_Clear                             0x1004FF0B
#define osfXK_Cancel                            0x1004FF69
#define osfXK_Help                              0x1004FF6A
#define osfXK_Menu                              0x1004FF67
#define osfXK_Select                            0x1004FF60
#define osfXK_Undo                              0x1004FF65
#define osfXK_Left                              0x1004FF51
#define osfXK_Up                                0x1004FF52
#define osfXK_Right                             0x1004FF53
#define osfXK_Down                              0x1004FF54
Motif 1.2 Manifest Constants and Data Structures from Xm.h
#define XmUNSPECIFIED_PIXMAP                    2
#define XmSTRING_OS_CHARSET                     XmSTRING_ISO8859_1
#ifndef XmFALLBACK_CHARSET
#define XmFALLBACK_CHARSET                      XmSTRING_ISO8859_1
#endif
#define XmDEFAULT_FONT                          _XmSDEFAULT_FONT
#define XmDEFAULT_BACKGROUND                    _XmSDEFAULT_BACKGROUND
#define XmDEFAULT_DARK_THRESHOLD                15
#define XmDEFAULT_LIGHT_THRESHOLD                                       77
#define XmDEFAULT_FOREGROUND_THRESHOLD                                  35
typedef enum{ XmFONT_IS_FONT, XmFONT_IS_FONTSET } XmFontType;
enum{  XmSTRING_DIRECTION_L_TO_R,      XmSTRING_DIRECTION_R_TO_L       } ;
#define XmSTRING_DIRECTION_DEFAULT  ((XmStringDirection) 255)
typedef unsigned char                           * XmString;             /* opaque to outside */
typedef XmString                                *XmStringTable;         /* opaque to outside */
typedef char                                    *XmStringCharSet;       /* Null term string */
typedef unsigned char                           XmStringComponentType;  /* component tags */
typedef unsigned char                           XmStringDirection;
typedef struct _XmFontListRec                   *XmFontListEntry;  /* opaque to outside */
typedef struct _XmFontListRec                   *XmFontList;       /* opaque to outside */
typedef struct __XmStringContextRec             *_XmStringContext; /* opaque to outside */
typedef struct __XmStringRec                    *_XmString;        /* opaque to outside */
typedef struct _XmtStringContextRec             *XmStringContext;  /* opaque to outside */
typedef struct _XmFontListContextRec            *XmFontContext;   /* opaque to outside */
enum{   XmSTRING_COMPONENT_UNKNOWN,     XmSTRING_COMPONENT_CHARSET,
        XmSTRING_COMPONENT_TEXT,        XmSTRING_COMPONENT_DIRECTION,
        XmSTRING_COMPONENT_SEPARATOR,   XmSTRING_COMPONENT_LOCALE_TEXT /* 6-125 reserved */ } ;
#define XmSTRING_COMPONENT_END          ((XmStringComponentType) 126)
#define XmSTRING_COMPONENT_USER_BEGIN   ((XmStringComponentType) 128)  /* 128-255 are user tags */
#define XmSTRING_COMPONENT_USER_END     ((XmStringComponentType) 255)
typedef struct _XmPrimitiveClassRec * XmPrimitiveWidgetClass;
typedef struct _XmPrimitiveRec      * XmPrimitiveWidget;
typedef struct _XmGadgetClassRec * XmGadgetClass;
typedef struct _XmGadgetRec      * XmGadget;
typedef struct _XmManagerClassRec * XmManagerWidgetClass;
typedef struct _XmManagerRec      * XmManagerWidget;
enum{ XmCHANGE_ALL,                 XmCHANGE_NONE, XmCHANGE_WIDTH, XmCHANGE_HEIGHT} ;
enum{ XmPIXELS, Xm100TH_MILLIMETERS, Xm1000TH_INCHES, Xm100TH_POINTS, Xm100TH_FONT_UNITS} ;
enum{ XmDESTROY, XmUNMAP,  XmDO_NOTHING       } ;
enum{ XmEXPLICIT,                   XmPOINTER       } ;
enum{ XmNONE,   XmTAB_GROUP, XmSTICKY_TAB_GROUP, XmEXCLUSIVE_TAB_GROUP } ;
#define XmDYNAMIC_DEFAULT_TAB_GROUP     ((XmNavigationType) 255)
enum{ /* XmNONE */                  XmBELL = 1       } ;
```

```
enum{ XmNO_ORIENTATION,              XmVERTICAL, XmHORIZONTAL} ;
enum{ XmWORK_AREA,  XmMENU_BAR,  XmMENU_PULLDOWN, XmMENU_POPUP, XmMENU_OPTION } ;
enum{ XmNO_PACKING,                  XmPACK_TIGHT, XmPACK_COLUMN,                 XmPACK_NONE } ;
enum{/* XmALIGNMENT_BASELINE_TOP,       XmALIGNMENT_CENTER,
      XmALIGNMENT_BASELINE_BOTTOM, */ XmALIGNMENT_CONTENTS_TOP = 3,
      XmALIGNMENT_CONTENTS_BOTTOM       } ;
enum{   XmTEAR_OFF_ENABLED,            XmTEAR_OFF_DISABLED       } ;
enum{   XmUNPOST,                    XmUNPOST_AND_REPLAY       } ;
enum{   XmLAST_POSITION = -1,          XmFIRST_POSITION       } ;
enum{   XmALIGNMENT_BEGINNING,         XmALIGNMENT_CENTER,       XmALIGNMENT_END       } ;
enum{   XmALIGNMENT_BASELINE_TOP,    /* XmALIGNMENT_CENTER, */
      XmALIGNMENT_BASELINE_BOTTOM = 2, XmALIGNMENT_WIDGET_TOP,
      XmALIGNMENT_WIDGET_BOTTOM       } ;
enum{ XmFRAME_GENERIC_CHILD,         XmFRAME_WORKAREA_CHILD,       XmFRAME_TITLE_CHILD       } ;
enum{ XmN_OF_MANY = 1,               XmONE_OF_MANY       } ;
enum{ XmATTACH_NONE,                 XmATTACH_FORM,
      XmATTACH_OPPOSITE_FORM,        XmATTACH_WIDGET,
      XmATTACH_OPPOSITE_WIDGET,      XmATTACH_POSITION,        XmATTACH_SELF       } ;
enum{   XmRESIZE_NONE,               XmRESIZE_GROW,       XmRESIZE_ANY       } ;
enum{   XmCR_NONE,                   XmCR_HELP,
      XmCR_VALUE_CHANGED,            XmCR_INCREMENT,
      XmCR_DECREMENT,                XmCR_PAGE_INCREMENT,
      XmCR_PAGE_DECREMENT,           XmCR_TO_TOP,
      XmCR_TO_BOTTOM,                XmCR_DRAG,
      XmCR_ACTIVATE,                 XmCR_ARM,
      XmCR_DISARM,                   XmCR_MAP = 16,
      XmCR_UNMAP,                    XmCR_FOCUS,
      XmCR_LOSING_FOCUS,             XmCR_MODIFYING_TEXT_VALUE,
      XmCR_MOVING_INSERT_CURSOR,     XmCR_EXECUTE,
      XmCR_SINGLE_SELECT,            XmCR_MULTIPLE_SELECT,
      XmCR_EXTENDED_SELECT,          XmCR_BROWSE_SELECT,
      XmCR_DEFAULT_ACTION,           XmCR_CLIPBOARD_DATA_REQUEST,
      XmCR_CLIPBOARD_DATA_DELETE,    XmCR_CASCADING,
      XmCR_OK,                     XmCR_CANCEL,
      XmCR_APPLY = 34,               XmCR_NO_MATCH,
      XmCR_COMMAND_ENTERED,          XmCR_COMMAND_CHANGED,
      XmCR_EXPOSE,                   XmCR_RESIZE,
      XmCR_INPUT,                  XmCR_GAIN_PRIMARY,
      XmCR_LOSE_PRIMARY,             XmCR_CREATE,
      XmCR_TEAR_OFF_ACTIVATE,        XmCR_TEAR_OFF_DEACTIVATE,
      XmCR_OBSCURED_TRAVERSAL
      } ;
typedef struct{ int reason;  XEvent  *event; } XmAnyCallbackStruct;
typedef struct{ int reason;  XEvent  *event; int     click_count;} XmArrowButtonCallbackStruct;
typedef struct{ int reason;  XEvent  *event; Window  window;} XmDrawingAreaCallbackStruct;
typedef struct{ int reason;  XEvent  *event; Window  window;    int     click_count;} XmDrawnButtonCallbackStruct;
typedef struct{ int reason;  XEvent  *event; int     click_count;} XmPushButtonCallbackStruct;
typedef struct{ int reason;  XEvent  *event; Widget  widget;    char    *data; char  *callbackstruct;} XmRowColumnCallbackStruct;
typedef struct{ int reason;  XEvent  *event; int value;   int pixel;} XmScrollBarCallbackStruct;
typedef struct{ int reason;  XEvent  *event; int set;} XmToggleButtonCallbackStruct;
typedef struct{
  int       reason;
  XEvent    *event;
  XmString  item;
  int       item_length;
  int       item_position;
  XmString  *selected_items;
  int       selected_item_count;
  int       *selected_item_positions;
  char      selection_type;
} XmListCallbackStruct;
typedef struct{    int reason;    XEvent     *event;    XmString    value;    int        length;} XmSelectionBoxCallbackStruct;
typedef struct{    int reason;    XEvent     *event;    XmString    value;    int        length;} XmCommandCallbackStruct;
typedef struct{
   int                                          reason;
   XEvent                                       *event;
   XmString                                     value;
   int                                          length;
   XmString                                     mask;
   int                                          mask_length;
   XmString                                     dir ;
   int                                          dir_length ;
   XmString                                     pattern ;
   int                                          pattern_length ;
} XmFileSelectionBoxCallbackStruct;
typedef struct {   int reason;   XEvent * event;    int value;} XmScaleCallbackStruct;
enum{ XmMULTICLICK_DISCARD,          XmMULTICLICK_KEEP       } ;
enum{ XmSHADOW_IN = 7,               XmSHADOW_OUT       } ;
enum{ XmARROW_UP,                  XmARROW_DOWN, XmARROW_LEFT,  XmARROW_RIGHT } ;
enum{ XmNO_LINE,                   XmSINGLE_LINE,
      XmDOUBLE_LINE,                 XmSINGLE_DASHED_LINE,
```

```
        XmDOUBLE_DASHED_LINE,          XmSHADOW_ETCHED_IN,
        XmSHADOW_ETCHED_OUT,           XmSHADOW_ETCHED_IN_DASH,
        XmSHADOW_ETCHED_OUT_DASH,      XmINVALID_SEPARATOR_TYPE
        } ;
enum{   XmPIXMAP = 1,                  XmSTRING       } ;
enum{   XmWINDOW,                  /* XmPIXMAP, */     XmCURSOR = 2       } ;
enum{   XmMAX_ON_TOP, XmMAX_ON_BOTTOM, XmMAX_ON_LEFT, XmMAX_ON_RIGHT} ;
enum{   XmSINGLE_SELECT, XmMULTIPLE_SELECT,
XmEXTENDED_SELECT, XmBROWSE_SELECT} ;
enum{  XmSTATIC,                   XmDYNAMIC       } ;
enum{  XmVARIABLE,                 XmCONSTANT,       XmRESIZE_IF_POSSIBLE       } ;
enum{  XmAUTOMATIC,                XmAPPLICATION_DEFINED       } ;
enum{  /* XmSTATIC */              XmAS_NEEDED = 1       } ;
#define SW_TOP                                      1
#define SW_BOTTOM                                   0
#define SW_LEFT                                     2
#define SW_RIGHT                                    0
#define XmTOP_LEFT                                  (SW_TOP | SW_LEFT)
#define XmBOTTOM_LEFT                               (SW_BOTTOM  | SW_LEFT)
#define XmTOP_RIGHT                                 (SW_TOP | SW_RIGHT)
#define XmBOTTOM_RIGHT                              (SW_BOTTOM  | SW_RIGHT)
enum{   XmCOMMAND_ABOVE_WORKSPACE,     XmCOMMAND_BELOW_WORKSPACE       } ;
enum{   XmMULTI_LINE_EDIT,             XmSINGLE_LINE_EDIT       } ;
typedef enum{       XmTEXT_FORWARD,       XmTEXT_BACKWARD       } XmTextDirection;
typedef long                                        XmTextPosition;
typedef Atom                                        XmTextFormat;
#define XmFMT_8_BIT                                 ((XmTextFormat) XA_STRING)     /* 8-bit text. */
#define XmFMT_16_BIT                                ((XmTextFormat) 2)             /* 16-bit text. */
#define FMT8BIT                                     XmFMT_8_BIT    /* For backwards compatibility only.*/
#define FMT16BIT                                    XmFMT_16_BIT   /* For backwards compatibility only.*/
typedef enum{
        XmSELECT_POSITION, XmSELECT_WHITESPACE,
        XmSELECT_WORD,      XmSELECT_LINE,
        XmSELECT_ALL,       XmSELECT_PARAGRAPH
        } XmTextScanType ;
typedef enum{
        XmHIGHLIGHT_NORMAL,            XmHIGHLIGHT_SELECTED,
        XmHIGHLIGHT_SECONDARY_SELECTED
        } XmHighlightMode ;
typedef struct {char *ptr;int length;XmTextFormat format;} XmTextBlockRec, *XmTextBlock;
typedef struct{
    int reason;
    XEvent  *event;
    Boolean doit;
    long currInsert, newInsert;
    long startPos, endPos;
    XmTextBlock text;
} XmTextVerifyCallbackStruct, *XmTextVerifyPtr;
typedef struct { wchar_t *wcsptr;  int length;} XmTextBlockRecWcs, *XmTextBlockWcs;
typedef struct{
    int reason;
    XEvent  *event;
    Boolean doit;
    long currInsert, newInsert;
    long startPos, endPos;
    XmTextBlockWcs text;
} XmTextVerifyCallbackStructWcs, *XmTextVerifyPtrWcs;
#define XmTextGetTopPosition               XmTextGetTopCharacter
#define XmTextSetTopPosition               XmTextSetTopCharacter

#define XmCOPY_FAILED          0
#define XmCOPY_SUCCEEDED       1
#define XmCOPY_TRUNCATED       2
enum{   XmDIALOG_NONE,                 XmDIALOG_APPLY_BUTTON,
        XmDIALOG_CANCEL_BUTTON,        XmDIALOG_DEFAULT_BUTTON,
        XmDIALOG_OK_BUTTON,            XmDIALOG_FILTER_LABEL,
        XmDIALOG_FILTER_TEXT,          XmDIALOG_HELP_BUTTON,
        XmDIALOG_LIST,                 XmDIALOG_LIST_LABEL,
        XmDIALOG_MESSAGE_LABEL,        XmDIALOG_SELECTION_LABEL,
        XmDIALOG_SYMBOL_LABEL,         XmDIALOG_TEXT,
        XmDIALOG_SEPARATOR,            XmDIALOG_DIR_LIST,
        XmDIALOG_DIR_LIST_LABEL
        } ;
#define XmDIALOG_HISTORY_LIST          XmDIALOG_LIST
#define XmDIALOG_PROMPT_LABEL          XmDIALOG_SELECTION_LABEL
#define XmDIALOG_VALUE_TEXT            XmDIALOG_TEXT
#define XmDIALOG_COMMAND_TEXT          XmDIALOG_TEXT
#define XmDIALOG_FILE_LIST             XmDIALOG_LIST
#define XmDIALOG_FILE_LIST_LABEL       XmDIALOG_LIST_LABEL
enum{   XmDIALOG_MODELESS,             XmDIALOG_PRIMARY_APPLICATION_MODAL,
        XmDIALOG_FULL_APPLICATION_MODAL,XmDIALOG_SYSTEM_MODAL
```

```
    } ;
#define XmDIALOG_APPLICATION_MODAL      XmDIALOG_PRIMARY_APPLICATION_MODAL
enum{   XmPLACE_TOP, XmPLACE_ABOVE_SELECTION, XmPLACE_BELOW_SELECTION} ;
#define XmFILE_DIRECTORY (1 << 0)
#define XmFILE_REGULAR   (1 << 1)
#define XmFILE_ANY_TYPE  (XmFILE_DIRECTORY | XmFILE_REGULAR)
enum{   XmDIALOG_WORK_AREA,             XmDIALOG_PROMPT,
    XmDIALOG_SELECTION,             XmDIALOG_COMMAND,
    XmDIALOG_FILE_SELECTION
    } ;
enum{   XmDIALOG_TEMPLATE,              XmDIALOG_ERROR,
    XmDIALOG_INFORMATION,           XmDIALOG_MESSAGE,
    XmDIALOG_QUESTION,              XmDIALOG_WARNING,
    XmDIALOG_WORKING
    } ;
typedef enum{
    XmVISIBILITY_UNOBSCURED,        XmVISIBILITY_PARTIALLY_OBSCURED,
    XmVISIBILITY_FULLY_OBSCURED
    } XmVisibility ;
typedef enum{
    XmTRAVERSE_CURRENT,             XmTRAVERSE_NEXT,
    XmTRAVERSE_PREV,                XmTRAVERSE_HOME,
    XmTRAVERSE_NEXT_TAB_GROUP,      XmTRAVERSE_PREV_TAB_GROUP,
    XmTRAVERSE_UP,                  XmTRAVERSE_DOWN,
    XmTRAVERSE_LEFT,                XmTRAVERSE_RIGHT
    } XmTraversalDirection ;
typedef struct _XmTraverseObscuredCallbackStruct{
  int               reason ;
  XEvent                                        *       event ;
  Widget            traversal_destination ;
  XmTraversalDirection  direction ;
  } XmTraverseObscuredCallbackStruct ;
typedef unsigned char                           XmNavigationType;
typedef unsigned char                           XmButtonType;
typedef XmButtonType                            * XmButtonTypeTable;
typedef KeySym                                  * XmKeySymTable;
typedef XmStringCharSet                         * XmStringCharSetTable;
enum{   XmPUSHBUTTON = 1,                       XmTOGGLEBUTTON,
    XmRADIOBUTTON,                              XmCASCADEBUTTON,
    XmSEPARATOR,                                XmDOUBLE_SEPARATOR,
    XmTITLE
    } ;
#define XmCHECKBUTTON                           XmTOGGLEBUTTON
typedef struct _XmSecondaryResourceDataRec{
  XmResourceBaseProc                            base_proc;
  XtPointer                                     client_data;
  String                                        name;
  String                                        res_class;
  XtResourceList                                resources;
  Cardinal                                      num_resources;
}XmSecondaryResourceDataRec, *XmSecondaryResourceData;
typedef long                                    XmOffset;
typedef XmOffset                                *XmOffsetPtr;
```

Figure 10-74. Motif 1.2 Manifest Constants from XmStrDefs.h

```
#define XmS                                     ""
#define XmCAccelerator                          "Accelerator"
#define XmCAcceleratorText                      "AcceleratorText"
#define XmCAdjustLast                           "AdjustLast"
#define XmCAdjustMargin                         "AdjustMargin"
#define XmCAlignment                            "Alignment"
#define XmCAllowOverlap                         "AllowOverlap"
#define XmCAnimationMask                        "AnimationMask"
#define XmCAnimationPixmap                      "AnimationPixmap"
#define XmCAnimationPixmapDepth                 "AnimationPixmapDepth"
#define XmCAnimationStyle                       "AnimationStyle"
#define XmCApplyLabelString                     "ApplyLabelString"
#define XmCArmCallback                          "ArmCallback"
#define XmCArmColor                             "ArmColor"
#define XmCArmPixmap                            "ArmPixmap"
#define XmCArrowDirection                       "ArrowDirection"
#define XmCAttachment                           "Attachment"
#define XmCAudibleWarning                       "AudibleWarning"
#define XmCAutoShowCursorPosition               "AutoShowCursorPosition"
#define XmCAutoUnmanage                         "AutoUnmanage"
#define XmCAutomaticSelection                   "AutomaticSelection"
#define XmCAvailability                         "Availability"
#define XmCBackgroundPixmap                     "BackgroundPixmap"
```

```
#define XmCBlendModel                   "BlendModel"
#define XmCBlinkRate                    "BlinkRate"
#define XmCBottomShadowColor            "BottomShadowColor"
#define XmCBottomShadowPixmap           "BottomShadowPixmap"
#define XmCButtonAcceleratorText        "ButtonAcceleratorText"
#define XmCButtonAccelerators           "ButtonAccelerators"
#define XmCButtonCount                  "ButtonCount"
#define XmCButtonFontList               "ButtonFontList"
#define XmCButtonMnemonicCharSets       "ButtonMnemonicCharSets"
#define XmCButtonMnemonics              "ButtonMnemonics"
#define XmCButtonSet                    "ButtonSet"
#define XmCButtonType                   "ButtonType"
#define XmCButtons                      "Buttons"
#define XmCCancelLabelString            "CancelLabelString"
#define XmCChildHorizontalAlignment     "ChildHorizontalAlignment"
#define XmCChildHorizontalSpacing       "ChildHorizontalSpacing"
#define XmCChildPlacement               "ChildPlacement"
#define XmCChildType                    "ChildType"
#define XmCChildVerticalAlignment       "ChildVerticalAlignment"
#define XmCChildren                     "Children"
#define XmCClientData                   "ClientData"
#define XmCClipWindow                   "ClipWindow"
#define XmCColumns                      "Columns"
#define XmCCommandWindow                "CommandWindow"
#define XmCCommandWindowLocation        "CommandWindowLocation"
#define XmCConvertProc                  "ConvertProc"
#define XmCCursorBackground             "CursorBackground"
#define XmCCursorForeground             "CursorForeground"
#define XmCCursorPosition               "CursorPosition"
#define XmCCursorPositionVisible        "CursorPositionVisible"
#define XmCDarkThreshold                "DarkThreshold"
#define XmCDecimalPoints                "DecimalPoints"
#define XmCDefaultButtonShadowThickness "DefaultButtonShadowThickness"
#define XmCDefaultButtonType            "DefaultButtonType"
#define XmCDefaultCopyCursorIcon        "DefaultCopyCursorIcon"
#define XmCDefaultFontList              "DefaultFontList"
#define XmCDefaultInvalidCursorIcon     "DefaultInvalidCursorIcon"
#define XmCDefaultLinkCursorIcon        "DefaultLinkCursorIcon"
#define XmCDefaultMoveCursorIcon        "DefaultMoveCursorIcon"
#define XmCDefaultNoneCursorIcon        "DefaultNoneCursorIcon"
#define XmCDefaultPosition              "DefaultPosition"
#define XmCDefaultSourceCursorIcon "DefaultSourceCursorIcon"
#define XmCDefaultValidCursorIcon "DefaultValidCursorIcon"
#define XmCDeleteResponse "DeleteResponse"
#define XmCDesktopParent "DesktopParent"
#define XmCDialogStyle "DialogStyle"
#define XmCDialogTitle "DialogTitle"
#define XmCDialogType "DialogType"
#define XmCDirListItemCount "DirListItemCount"
#define XmCDirListItems "DirListItems"
#define XmCDirListLabelString "DirListLabelString"
#define XmCDirMask "DirMask"
#define XmCDirSearchProc "DirSearchProc"
#define XmCDirSpec "DirSpec"
#define XmCDirectory "Directory"
#define XmCDirectoryValid "DirectoryValid"
#define XmCDisarmCallback "DisarmCallback"
#define XmCDoubleClickInterval "DoubleClickInterval"
#define XmCDragContextClass "DragContextClass"
#define XmCDragDropFinishCallback "DragDropFinishCallback"
#define XmCDragIconClass "DragIconClass"
#define XmCDragInitiatorProtocolStyle "DragInitiatorProtocolStyle"
#define XmCDragMotionCallback "DragMotionCallback"
#define XmCDragOperations "DragOperations"
#define XmCDragOverMode "DragOverMode"
#define XmCDragProc "DragProc"
#define XmCDragReceiverProtocolStyle "DragReceiverProtocolStyle"
#define XmCDropProc "DropProc"
#define XmCDropRectangles "DropRectangles"
#define XmCDropSiteActivity "DropSiteActivity"
#define XmCDropSiteEnterCallback "DropSiteEnterCallback"
#define XmCDropSiteLeaveCallback "DropSiteLeaveCallback"
#define XmCDropSiteManagerClass "DropSiteManagerClass"
#define XmCDropSiteOperations "DropSiteOperations"
#define XmCDropSiteType "DropSiteType"
#define XmCDropStartCallback "DropStartCallback"
#define XmCDropTransferClass "DropTransferClass"
#define XmCDropTransfers "DropTransfers"
#define XmCEditable "Editable"
#define XmCEntryBorder "EntryBorder"
#define XmCEntryClass "EntryClass"
```

```
#define XmCExportTargets “ExportTargets”
#define XmCExposeCallback “ExposeCallback”
#define XmCExtensionType “ExtensionType”
#define XmCFileListItemCount “FileListItemCount”
#define XmCFileListItems “FileListItems”
#define XmCFileListLabelString “FileListLabelString”
#define XmCFileSearchProc “FileSearchProc”
#define XmCFileTypeMask “FileTypeMask”
#define XmCFillOnArm “FillOnArm”
#define XmCFillOnSelect “FillOnSelect”
#define XmCFilterLabelString “FilterLabelString”
#define XmCFontList “FontList”
#define XmCForegroundThreshold “ForegroundThreshold”
#define XmCHelpLabelString “HelpLabelString”
#define XmCHighlightColor “HighlightColor”
#define XmCHighlightOnEnter “HighlightOnEnter”
#define XmCHighlightPixmap “HighlightPixmap”
#define XmCHighlightThickness “HighlightThickness”
#define XmCHorizontalFontUnit “HorizontalFontUnit”
#define XmCHorizontalScrollBar “HorizontalScrollBar”
#define XmCHot “Hot”
#define XmCICCHandle “ICCHandle”
#define XmCImportTargets “ImportTargets”
#define XmCIncrement “Increment”
#define XmCIncremental “Incremental”
#define XmCIndicatorOn “IndicatorOn”
#define XmCIndicatorSize “IndicatorSize”
#define XmCIndicatorType “IndicatorType”
#define XmCInitialDelay “InitialDelay”
#define XmCInitialFocus “InitialFocus”
#define XmCInputCreate “InputCreate”
#define XmCInputMethod “InputMethod”
#define XmCInvalidCursorForeground “InvalidCursorForeground”
#define XmCIsAligned “IsAligned”
#define XmCIsHomogeneous “IsHomogeneous”
#define XmCItemCount “ItemCount”
#define XmCItems “Items”
#define XmCKeyboardFocusPolicy “KeyboardFocusPolicy”
#define XmCLabelFontList “LabelFontList”
#define XmCLabelInsensitivePixmap “LabelInsensitivePixmap”
#define XmCLabelPixmap “LabelPixmap”
#define XmCLabelString “LabelString”
#define XmCLabelType “LabelType”
#define XmCLightThreshold “LightThreshold”
#define XmCListLabelString “ListLabelString”
#define XmCListMarginHeight “ListMarginHeight”
#define XmCListMarginWidth “ListMarginWidth”
#define XmCListSizePolicy “ListSizePolicy”
#define XmCListSpacing “ListSpacing”
#define XmCListUpdated “ListUpdated”
#define XmCLogicalParent “LogicalParent”
#define XmCMainWindowMarginHeight “MainWindowMarginHeight”
#define XmCMainWindowMarginWidth “MainWindowMarginWidth”
#define XmCMappingDelay “MappingDelay”
#define XmCMarginBottom “MarginBottom”
#define XmCMarginHeight “MarginHeight”
#define XmCMarginLeft “MarginLeft”
#define XmCMarginRight “MarginRight”
#define XmCMarginTop “MarginTop”
#define XmCMarginWidth “MarginWidth”
#define XmCMask “Mask”
#define XmCMaxItems “MaxItems”
#define XmCMaxLength “MaxLength”
#define XmCMaxValue “MaxValue”
#define XmCMaximum “Maximum”
#define XmCMenuBar “MenuBar”
#define XmCMenuPost “MenuPost”
#define XmCMenuWidget “MenuWidget”
#define XmCMessageProc “MessageProc”
#define XmCMessageWindow “MessageWindow”
#define XmCMinimizeButtons “MinimizeButtons”
#define XmCMinimum “Minimum”
#define XmCMnemonic “Mnemonic”
#define XmCMnemonicCharSet “MnemonicCharSet”
#define XmCMoveOpaque “MoveOpaque”
#define XmCMultiClick “MultiClick”
#define XmCMustMatch “MustMatch”
#define XmCMwmDecorations “MwmDecorations”
#define XmCMwmFunctions “MwmFunctions”
#define XmCMwmInputMode “MwmInputMode”
#define XmCMwmMenu “MwmMenu”
```

```
#define XmCMwmMessages “MwmMessages”
#define XmCNavigationType “NavigationType”
#define XmCNeedsMotion “NeedsMotion”
#define XmCNoMatchString “NoMatchString”
#define XmCNoResize “NoResize”
#define XmCNoneCursorForeground “NoneCursorForeground”
#define XmCNotifyProc “NotifyProc”
#define XmCNumChildren “NumChildren”
#define XmCNumColumns “NumColumns”
#define XmCNumDropRectangles “NumDropRectangles”
#define XmCNumDropTransfers “NumDropTransfers”
#define XmCNumExportTargets “NumExportTargets”
#define XmCNumImportTargets “NumImportTargets”
#define XmCOffset “Offset”
#define XmCOkLabelString “OkLabelString”
#define XmCOperationChangedCallback “OperationChangedCallback”
#define XmCOperationCursorIcon “OperationCursorIcon”
#define XmCOptionLabel “OptionLabel”
#define XmCOptionMnemonic “OptionMnemonic”
#define XmCOutputCreate “OutputCreate”
#define XmCPacking “Packing”
#define XmCPageIncrement “PageIncrement”
#define XmCPaneMaximum “PaneMaximum”
#define XmCPaneMinimum “PaneMinimum”
#define XmCPattern “Pattern”
#define XmCPendingDelete “PendingDelete”
#define XmCPopupEnabled “PopupEnabled”
#define XmCPositionIndex “PositionIndex”
#define XmCPostFromButton “PostFromButton”
#define XmCPostFromCount “PostFromCount”
#define XmCPostFromList “PostFromList”
#define XmCPreeditType “PreeditType”
#define XmCProcessingDirection “ProcessingDirection”
#define XmCPromptString “PromptString”
#define XmCProtocolCallback “ProtocolCallback”
#define XmCPushButtonEnabled “PushButtonEnabled”
#define XmCQualifySearchDataProc “QualifySearchDataProc”
#define XmCRadioAlwaysOne “RadioAlwaysOne”
#define XmCRadioBehavior “RadioBehavior”
#define XmCRecomputeSize “RecomputeSize”
#define XmCRectangles “Rectangles”
#define XmCRepeatDelay “RepeatDelay”
#define XmCResizeCallback “ResizeCallback”
#define XmCResizeHeight “ResizeHeight”
#define XmCResizePolicy “ResizePolicy”
#define XmCResizeWidth “ResizeWidth”
#define XmCRowColumnType “RowColumnType”
#define XmCRows “Rows”
#define XmCRubberPositioning “RubberPositioning”
#define XmCSashHeight “SashHeight”
#define XmCSashIndent “SashIndent”
#define XmCSashWidth “SashWidth”
#define XmCScaleHeight “ScaleHeight”
#define XmCScaleMultiple “ScaleMultiple”
#define XmCScaleWidth “ScaleWidth”
#define XmCScroll “Scroll”
#define XmCScrollBarDisplayPolicy “ScrollBarDisplayPolicy”
#define XmCScrollBarPlacement “ScrollBarPlacement”
#define XmCScrollSide “ScrollSide”
#define XmCScrolledWindowMarginHeight “ScrolledWindowMarginHeight”
#define XmCScrolledWindowMarginWidth “ScrolledWindowMarginWidth”
#define XmCScrollingPolicy “ScrollingPolicy”
#define XmCSelectColor “SelectColor”
#define XmCSelectInsensitivePixmap “SelectInsensitivePixmap”
#define XmCSelectPixmap “SelectPixmap”
#define XmCSelectThreshold “SelectThreshold”
#define XmCSelectedItemCount “SelectedItemCount”
#define XmCSelectedItems “SelectedItems”
#define XmCSelectionArrayCount “SelectionArrayCount”
#define XmCSelectionLabelString “SelectionLabelString”
#define XmCSelectionPolicy “SelectionPolicy”
#define XmCSeparatorOn “SeparatorOn”
#define XmCSeparatorType “SeparatorType”
#define XmCSet “Set”
#define XmCShadowThickness “ShadowThickness”
#define XmCShadowType “ShadowType”
#define XmCShellUnitType “ShellUnitType”
#define XmCShowArrows “ShowArrows”
#define XmCShowAsDefault “ShowAsDefault”
#define XmCShowSeparator “ShowSeparator”
#define XmCShowValue “ShowValue”
```

```
#define XmCSimpleCheckBox “SimpleCheckBox”
#define XmCSimpleMenuBar “SimpleMenuBar”
#define XmCSimpleOptionMenu “SimpleOptionMenu”
#define XmCSimplePopupMenu “SimplePopupMenu”
#define XmCSimplePulldownMenu “SimplePulldownMenu”
#define XmCSimpleRadioBox “SimpleRadioBox”
#define XmCSizePolicy “SizePolicy”
#define XmCSliderSize “SliderSize”
#define XmCSource “Source”
#define XmCSourceCursorIcon “SourceCursorIcon”
#define XmCSourceIsExternal “SourceIsExternal”
#define XmCSourcePixmapIcon “SourcePixmapIcon”
#define XmCSourceWidget “SourceWidget”
#define XmCSourceWindow “SourceWindow”
#define XmCSpacing “Spacing”
#define XmCStartTime “StartTime”
#define XmCStateCursorIcon “StateCursorIcon”
#define XmCStringDirection “StringDirection”
#define XmCTearOffModel “TearOffModel”
#define XmCTextFontList “TextFontList”
#define XmCTextString “TextString”
#define XmCTextValue “TextValue”
#define XmCTitleString “TitleString”
#define XmCTopCharacter “TopCharacter”
#define XmCTopItemPosition “TopItemPosition”
#define XmCTopLevelEnterCallback “TopLevelEnterCallback”
#define XmCTopLevelLeaveCallback “TopLevelLeaveCallback”
#define XmCTopShadowColor “TopShadowColor”
#define XmCTopShadowPixmap “TopShadowPixmap”
#define XmCTransferProc “TransferProc”
#define XmCTransferStatus “TransferStatus”
#define XmCTraversalOn “TraversalOn”
#define XmCTraversalType “TraversalType”
#define XmCTreeUpdateProc “TreeUpdateProc”
#define XmCTroughColor “TroughColor”
#define XmCUnitType “UnitType”
#define XmCUnpostBehavior “UnpostBehavior”
#define XmCUnselectPixmap “UnselectPixmap”
#define XmCUpdateSliderSize “UpdateSliderSize”
#define XmCUseAsyncGeometry “UseAsyncGeometry”
#define XmCUserData “UserData”
#define XmCValidCursorForeground “ValidCursorForeground”
#define XmCValueChangedCallback “ValueChangedCallback”
#define XmCValueWcs “ValueWcs”
#define XmCVerifyBell “VerifyBell”
#define XmCVerticalAlignment “VerticalAlignment”
#define XmCVerticalFontUnit “VerticalFontUnit”
#define XmCVerticalScrollBar “VerticalScrollBar”
#define XmCVisibleItemCount “VisibleItemCount”
#define XmCVisibleWhenOff “VisibleWhenOff”
#define XmCVisualPolicy “VisualPolicy”
#define XmCWhichButton “WhichButton”
#define XmCWordWrap “WordWrap”
#define XmCWorkWindow “WorkWindow”
#define XmCXmString “XmString”
#define XmNaccelerator “accelerator”
#define XmNacceleratorText “acceleratorText”
#define XmNactivateCallback “activateCallback”
#define XmNadjustLast “adjustLast”
#define XmNadjustMargin “adjustMargin”
#define XmNalignment “alignment”
#define XmNallowOverlap “allowOverlap”
#define XmNallowResize “allowResize”
#define XmNanimationMask “animationMask”
#define XmNanimationPixmap “animationPixmap”
#define XmNanimationPixmapDepth “animationPixmapDepth”
#define XmNanimationStyle “animationStyle”
#define XmNapplyCallback “applyCallback”
#define XmNapplyLabelString “applyLabelString”
#define XmNarmCallback “armCallback”
#define XmNarmColor “armColor”
#define XmNarmPixmap “armPixmap”
#define XmNarrowDirection “arrowDirection”
#define XmNattachment “attachment”
#define XmNaudibleWarning “audibleWarning”
#define XmNautoShowCursorPosition “autoShowCursorPosition”
#define XmNautoUnmanage “autoUnmanage”
#define XmNautomaticSelection “automaticSelection”
#define XmNavailability “availability”
#define XmNblendModel “blendModel”
#define XmNblinkRate “blinkRate”
```

```
#define XmNbottomAttachment “bottomAttachment”
#define XmNbottomOffset “bottomOffset”
#define XmNbottomPosition “bottomPosition”
#define XmNbottomShadowColor “bottomShadowColor”
#define XmNbottomShadowPixmap “bottomShadowPixmap”
#define XmNbottomWidget “bottomWidget”
#define XmNbrowseSelectionCallback “browseSelectionCallback”
#define XmNbuttonAcceleratorText “buttonAcceleratorText”
#define XmNbuttonAccelerators “buttonAccelerators”
#define XmNbuttonCount “buttonCount”
#define XmNbuttonFontList “buttonFontList”
#define XmNbuttonMnemonicCharSets “buttonMnemonicCharSets”
#define XmNbuttonMnemonics “buttonMnemonics”
#define XmNbuttonSet “buttonSet”
#define XmNbuttonType “buttonType”
#define XmNbuttons “buttons”
#define XmNcancelButton “cancelButton”
#define XmNcancelCallback “cancelCallback”
#define XmNcancelLabelString “cancelLabelString”
#define XmNcascadePixmap “cascadePixmap”
#define XmNcascadingCallback “cascadingCallback”
#define XmNchildHorizontalAlignment “childHorizontalAlignment”
#define XmNchildHorizontalSpacing “childHorizontalSpacing”
#define XmNchildPlacement “childPlacement”
#define XmNchildPosition “childPosition”
#define XmNchildType “childType”
#define XmNchildVerticalAlignment “childVerticalAlignment”
#define XmNclientData “clientData”
#define XmNclipWindow “clipWindow”
#define XmNcolumns “columns”
#define XmNcommand “command”
#define XmNcommandChangedCallback “commandChangedCallback”
#define XmNcommandEnteredCallback “commandEnteredCallback”
#define XmNcommandWindow “commandWindow”
#define XmNcommandWindowLocation “commandWindowLocation”
#define XmNconvertProc “convertProc”
#define XmNcursorBackground “cursorBackground”
#define XmNcursorForeground “cursorForeground”
#define XmNcursorPosition “cursorPosition”
#define XmNcursorPositionVisible “cursorPositionVisible”
#define XmNdarkThreshold “darkThreshold”
#define XmNdecimalPoints “decimalPoints”
#define XmNdecrementCallback “decrementCallback”
#define XmNdefaultActionCallback “defaultActionCallback”
#define XmNdefaultButton “defaultButton”
#define XmNdefaultButtonShadowThickness “defaultButtonShadowThickness”
#define XmNdefaultButtonType “defaultButtonType”
#define XmNdefaultCopyCursorIcon “defaultCopyCursorIcon”
#define XmNdefaultFontList “defaultFontList”
#define XmNdefaultInvalidCursorIcon “defaultInvalidCursorIcon”
#define XmNdefaultLinkCursorIcon “defaultLinkCursorIcon”
#define XmNdefaultMoveCursorIcon “defaultMoveCursorIcon”
#define XmNdefaultNoneCursorIcon “defaultNoneCursorIcon”
#define XmNdefaultPosition “defaultPosition”
#define XmNdefaultSourceCursorIcon “defaultSourceCursorIcon”
#define XmNdefaultValidCursorIcon “defaultValidCursorIcon”
#define XmNdeleteResponse “deleteResponse”
#define XmNdesktopParent “desktopParent”
#define XmNdialogStyle “dialogStyle”
#define XmNdialogTitle “dialogTitle”
#define XmNdialogType “dialogType”
#define XmNdirListItemCount “dirListItemCount”
#define XmNdirListItems “dirListItems”
#define XmNdirListLabelString “dirListLabelString”
#define XmNdirMask “dirMask”
#define XmNdirSearchProc “dirSearchProc”
#define XmNdirSpec “dirSpec”
#define XmNdirectory “directory”
#define XmNdirectoryValid “directoryValid”
#define XmNdisarmCallback “disarmCallback”
#define XmNdoubleClickInterval “doubleClickInterval”
#define XmNdragCallback “dragCallback”
#define XmNdragContextClass “dragContextClass”
#define XmNdragDropFinishCallback “dragDropFinishCallback”
#define XmNdragIconClass “dragIconClass”
#define XmNdragInitiatorProtocolStyle “dragInitiatorProtocolStyle”
#define XmNdragMotionCallback “dragMotionCallback”
#define XmNdragOperations “dragOperations”
#define XmNdragOverMode “dragOverMode”
#define XmNdragProc “dragProc”
#define XmNdragReceiverProtocolStyle “dragReceiverProtocolStyle”
```

```
#define XmNdropFinishCallback “dropFinishCallback”
#define XmNdropProc “dropProc”
#define XmNdropRectangles “dropRectangles”
#define XmNdropSiteActivity “dropSiteActivity”
#define XmNdropSiteEnterCallback “dropSiteEnterCallback”
#define XmNdropSiteLeaveCallback “dropSiteLeaveCallback”
#define XmNdropSiteManagerClass “dropSiteManagerClass”
#define XmNdropSiteOperations “dropSiteOperations”
#define XmNdropSiteType “dropSiteType”
#define XmNdropStartCallback “dropStartCallback”
#define XmNdropTransferClass “dropTransferClass”
#define XmNdropTransfers “dropTransfers”
#define XmNeditMode “editMode”
#define XmNeditable “editable”
#define XmNentryAlignment “entryAlignment”
#define XmNentryBorder “entryBorder”
#define XmNentryCallback “entryCallback”
#define XmNentryClass “entryClass”
#define XmNentryVerticalAlignment “entryVerticalAlignment”
#define XmNexportTargets “exportTargets”
#define XmNexposeCallback “exposeCallback”
#define XmNextendedSelectionCallback “extendedSelectionCallback”
#define XmNextensionType “extensionType”
#define XmNfileListItemCount “fileListItemCount”
#define XmNfileListItems “fileListItems”
#define XmNfileListLabelString “fileListLabelString”
#define XmNfileSearchProc “fileSearchProc”
#define XmNfileTypeMask “fileTypeMask”
#define XmNfillOnArm “fillOnArm”
#define XmNfillOnSelect “fillOnSelect”
#define XmNfilterLabelString “filterLabelString”
#define XmNfocusCallback “focusCallback”
#define XmNfocusMovedCallback “focusMovedCallback”
#define XmNfocusPolicyChanged “focusPolicyChanged”
#define XmNfontList “fontList”
#define XmNforegroundThreshold “foregroundThreshold”
#define XmNfractionBase “fractionBase”
#define XmNgainPrimaryCallback “gainPrimaryCallback”
#define XmNhelpCallback “helpCallback”
#define XmNhelpLabelString “helpLabelString”
#define XmNhighlightColor “highlightColor”
#define XmNhighlightOnEnter “highlightOnEnter”
#define XmNhighlightPixmap “highlightPixmap”
#define XmNhighlightThickness “highlightThickness”
#define XmNhistoryItemCount “historyItemCount”
#define XmNhistoryItems “historyItems”
#define XmNhistoryMaxItems “historyMaxItems”
#define XmNhistoryVisibleItemCount “historyVisibleItemCount”
#define XmNhorizontalFontUnit “horizontalFontUnit”
#define XmNhorizontalScrollBar “horizontalScrollBar”
#define XmNhorizontalSpacing “horizontalSpacing”
#define XmNhotX “hotX”
#define XmNhotY “hotY”
#define XmNiccHandle “iccHandle”
#define XmNimportTargets “importTargets”
#define XmNincrement “increment”
#define XmNincrementCallback “incrementCallback”
#define XmNincremental “incremental”
#define XmNindicatorOn “indicatorOn”
#define XmNindicatorSize “indicatorSize”
#define XmNindicatorType “indicatorType”
#define XmNinitialDelay “initialDelay”
#define XmNinitialFocus “initialFocus”
#define XmNinputCallback “inputCallback”
#define XmNinputCreate “inputCreate”
#define XmNinputMethod “inputMethod”
#define XmNinvalidCursorForeground “invalidCursorForeground”
#define XmNisAligned “isAligned”
#define XmNisHomogeneous “isHomogeneous”
#define XmNitemCount “itemCount”
#define XmNitems “items”
#define XmNkeyboardFocusPolicy “keyboardFocusPolicy”
#define XmNlabelFontList “labelFontList”
#define XmNlabelInsensitivePixmap “labelInsensitivePixmap”
#define XmNlabelPixmap “labelPixmap”
#define XmNlabelString “labelString”
#define XmNlabelType “labelType”
#define XmNleftAttachment “leftAttachment”
#define XmNleftOffset “leftOffset”
#define XmNleftPosition “leftPosition”
#define XmNleftWidget “leftWidget”
```

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#define XmNlightThreshold “lightThreshold”
#define XmNlineSpace “lineSpace”
#define XmNlistItemCount “listItemCount”
#define XmNlistItems “listItems”
#define XmNlistLabelString “listLabelString”
#define XmNlistMarginHeight “listMarginHeight”
#define XmNlistMarginWidth “listMarginWidth”
#define XmNlistSizePolicy “listSizePolicy”
#define XmNlistSpacing “listSpacing”
#define XmNlistUpdated “listUpdated”
#define XmNlistVisibleItemCount “listVisibleItemCount”
#define XmNlogicalParent “logicalParent”
#define XmNlosePrimaryCallback “losePrimaryCallback”
#define XmNlosingFocusCallback “losingFocusCallback”
#define XmNmainWindowMarginHeight “mainWindowMarginHeight”
#define XmNmainWindowMarginWidth “mainWindowMarginWidth”
#define XmNmapCallback “mapCallback”
#define XmNmappingDelay “mappingDelay”
#define XmNmargin “margin”
#define XmNmarginBottom “marginBottom”
#define XmNmarginHeight “marginHeight”
#define XmNmarginLeft “marginLeft”
#define XmNmarginRight “marginRight”
#define XmNmarginTop “marginTop”
#define XmNmarginWidth “marginWidth”
#define XmNmask “mask”
#define XmNmaxLength “maxLength”
#define XmNmaximum “maximum”
#define XmNmenuAccelerator “menuAccelerator”
#define XmNmenuBar “menuBar”
#define XmNmenuCursor “menuCursor”
#define XmNmenuHelpWidget “menuHelpWidget”
#define XmNmenuHistory “menuHistory”
#define XmNmenuPost “menuPost”
#define XmNmessageAlignment “messageAlignment”
#define XmNmessageProc “messageProc”
#define XmNmessageString “messageString”
#define XmNmessageWindow “messageWindow”
#define XmNminimizeButtons “minimizeButtons”
#define XmNminimum “minimum”
#define XmNmnemonic “mnemonic”
#define XmNmnemonicCharSet “mnemonicCharSet”
#define XmNmodifyVerifyCallback “modifyVerifyCallback”
#define XmNmodifyVerifyCallbackWcs “modifyVerifyCallbackWcs”
#define XmNmotionVerifyCallback “motionVerifyCallback”
#define XmNmoveOpaque “moveOpaque”
#define XmNmultiClick “multiClick”
#define XmNmultipleSelectionCallback “multipleSelectionCallback”
#define XmNmustMatch “mustMatch”
#define XmNmwmDecorations “mwmDecorations”
#define XmNmwmFunctions “mwmFunctions”
#define XmNmwmInputMode “mwmInputMode”
#define XmNmwmMenu “mwmMenu”
#define XmNmwmMessages “mwmMessages”
#define XmNnavigationType “navigationType”
#define XmNneedsMotion “needsMotion”
#define XmNnoMatchCallback “noMatchCallback”
#define XmNnoMatchString “noMatchString”
#define XmNnoResize “noResize”
#define XmNnoneCursorForeground “noneCursorForeground”
#define XmNnotifyProc “notifyProc”
#define XmNnumColumns “numColumns”
#define XmNnumDropRectangles “numDropRectangles”
#define XmNnumDropTransfers “numDropTransfers”
#define XmNnumExportTargets “numExportTargets”
#define XmNnumImportTargets “numImportTargets”
#define XmNnumRectangles “numRectangles”
#define XmNoffsetX “offsetX”
#define XmNoffsetY “offsetY”
#define XmNokCallback “okCallback”
#define XmNokLabelString “okLabelString”
#define XmNoperationChangedCallback “operationChangedCallback”
#define XmNoperationCursorIcon “operationCursorIcon”
#define XmNoptionLabel “optionLabel”
#define XmNoptionMnemonic “optionMnemonic”
#define XmNoutputCreate “outputCreate”
#define XmNpacking “packing”
#define XmNpageDecrementCallback “pageDecrementCallback”
#define XmNpageIncrement “pageIncrement”
#define XmNpageIncrementCallback “pageIncrementCallback”
#define XmNpaneMaximum “paneMaximum”
```

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#define XmNpaneMinimum “paneMinimum”
#define XmNpattern “pattern”
#define XmNpendingDelete “pendingDelete”
#define XmNpopupEnabled “popupEnabled”
#define XmNpositionIndex “positionIndex”
#define XmNpostFromButton “postFromButton”
#define XmNpostFromCount “postFromCount”
#define XmNpostFromList “postFromList”
#define XmNpreeditType “preeditType”
#define XmNprocessingDirection “processingDirection”
#define XmNpromptString “promptString”
#define XmNprotocolCallback “protocolCallback”
#define XmNpushButtonEnabled “pushButtonEnabled”
#define XmNqualifySearchDataProc “qualifySearchDataProc”
#define XmNradioAlwaysOne “radioAlwaysOne”
#define XmNradioBehavior “radioBehavior”
#define XmNrealizeCallback “realizeCallback”
#define XmNrecomputeSize “recomputeSize”
#define XmNrectangles “rectangles”
#define XmNrefigureMode “refigureMode”
#define XmNrepeatDelay “repeatDelay”
#define XmNresizable “resizable”
#define XmNresizeCallback “resizeCallback”
#define XmNresizeHeight “resizeHeight”
#define XmNresizePolicy “resizePolicy”
#define XmNresizeWidth “resizeWidth”
#define XmNrightAttachment “rightAttachment”
#define XmNrightOffset “rightOffset”
#define XmNrightPosition “rightPosition”
#define XmNrightWidget “rightWidget”
#define XmNrowColumnType “rowColumnType”
#define XmNrows “rows”
#define XmNrubberPositioning “rubberPositioning”
#define XmNsashHeight “sashHeight”
#define XmNsashIndent “sashIndent”
#define XmNsashShadowThickness “sashShadowThickness”
#define XmNsashWidth “sashWidth”
#define XmNscaleHeight “scaleHeight”
#define XmNscaleMultiple “scaleMultiple”
#define XmNscaleWidth “scaleWidth”
#define XmNscrollBarDisplayPolicy “scrollBarDisplayPolicy”
#define XmNscrollBarPlacement “scrollBarPlacement”
#define XmNscrollHorizontal “scrollHorizontal”
#define XmNscrollLeftSide “scrollLeftSide”
#define XmNscrollTopSide “scrollTopSide”
#define XmNscrollVertical “scrollVertical”
#define XmNscrolledWindowMarginHeight “scrolledWindowMarginHeight”
#define XmNscrolledWindowMarginWidth “scrolledWindowMarginWidth”
#define XmNscrollingPolicy “scrollingPolicy”
#define XmNselectColor “selectColor”
#define XmNselectInsensitivePixmap “selectInsensitivePixmap”
#define XmNselectPixmap “selectPixmap”
#define XmNselectThreshold “selectThreshold”
#define XmNselectedItemCount “selectedItemCount”
#define XmNselectedItems “selectedItems”
#define XmNselectionArrayCount “selectionArrayCount”
#define XmNselectionLabelString “selectionLabelString”
#define XmNselectionPolicy “selectionPolicy”
#define XmNseparatorOn “separatorOn”
#define XmNseparatorType “separatorType”
#define XmNset “set”
#define XmNshadow “shadow”
#define XmNshadowThickness “shadowThickness”
#define XmNshadowType “shadowType”
#define XmNshellUnitType “shellUnitType”
#define XmNshowArrows “showArrows”
#define XmNshowAsDefault “showAsDefault”
#define XmNshowSeparator “showSeparator”
#define XmNshowValue “showValue”
#define XmNsimpleCallback “simpleCallback”
#define XmNsingleSelectionCallback “singleSelectionCallback”
#define XmNsizePolicy “sizePolicy”
#define XmNskipAdjust “skipAdjust”
#define XmNsliderSize “sliderSize”
#define XmNsource “source”
#define XmNsourceCursorIcon “sourceCursorIcon”
#define XmNsourceIsExternal “sourceIsExternal”
#define XmNsourcePixmapIcon “sourcePixmapIcon”
#define XmNsourceWidget “sourceWidget”
#define XmNsourceWindow “sourceWindow”
#define XmNspacing “spacing”
```

```
#define XmNspotLocation “spotLocation”
#define XmNstartTime “startTime”
#define XmNstateCursorIcon “stateCursorIcon”
#define XmNstringDirection “stringDirection”
#define XmNsubMenuId “subMenuId”
#define XmNsymbolPixmap “symbolPixmap”
#define XmNtearOffMenuActivateCallback “tearOffMenuActivateCallback”
#define XmNtearOffMenuDeactivateCallback “tearOffMenuDeactivateCallback”
#define XmNtearOffModel “tearOffModel”
#define XmNtextAccelerators “textAccelerators”
#define XmNtextColumns “textColumns”
#define XmNtextFontList “textFontList”
#define XmNtextString “textString”
#define XmNtextTranslations “textTranslations”
#define XmNtextValue “textValue”
#define XmNtitleString “titleString”
#define XmNtoBottomCallback “toBottomCallback”
#define XmNtoPositionCallback “toPositionCallback”
#define XmNtoTopCallback “toTopCallback”
#define XmNtopAttachment “topAttachment”
#define XmNtopCharacter “topCharacter”
#define XmNtopItemPosition “topItemPosition”
#define XmNtopLevelEnterCallback “topLevelEnterCallback”
#define XmNtopLevelLeaveCallback “topLevelLeaveCallback”
#define XmNtopOffset “topOffset”
#define XmNtopPosition “topPosition”
#define XmNtopShadowColor “topShadowColor”
#define XmNtopShadowPixmap “topShadowPixmap”
#define XmNtopWidget “topWidget”
#define XmNtransferProc “transferProc”
#define XmNtransferStatus “transferStatus”
#define XmNtraversalCallback “traversalCallback”
#define XmNtraversalOn “traversalOn”
#define XmNtraversalType “traversalType”
#define XmNtraverseObscuredCallback “traverseObscuredCallback”
#define XmNtreeUpdateProc “treeUpdateProc”
#define XmNtroughColor “troughColor”
#define XmNunitType “unitType”
#define XmNunmapCallback “unmapCallback”
#define XmNunpostBehavior “unpostBehavior”
#define XmNunselectPixmap “unselectPixmap”
#define XmNupdateSliderSize “updateSliderSize”
#define XmNuseAsyncGeometry “useAsyncGeometry”
#define XmNuserData “userData”
#define XmNvalidCursorForeground “validCursorForeground”
#define XmNvalueChangedCallback “valueChangedCallback”
#define XmNvalueWcs “valueWcs”
#define XmNverifyBell “verifyBell”
#define XmNverticalFontUnit “verticalFontUnit”
#define XmNverticalScrollBar “verticalScrollBar”
#define XmNverticalSpacing “verticalSpacing”
#define XmNvisibleItemCount “visibleItemCount”
#define XmNvisibleWhenOff “visibleWhenOff”
#define XmNvisualPolicy “visualPolicy”
#define XmNwhichButton “whichButton”
#define XmNwordWrap “wordWrap”
#define XmNworkWindow “workWindow”
#define XmRAlignment “Alignment”
#define XmRAnimationMask “AnimationMask”
#define XmRAnimationPixmap “AnimationPixmap”
#define XmRAnimationStyle “AnimationStyle”
#define XmRArrowDirection “ArrowDirection”
#define XmRAtomList “AtomList”
#define XmRAttachment “Attachment”
#define XmRAudibleWarning “AudibleWarning”
#define XmRAvailability “Availability”
#define XmRBackgroundPixmap “BackgroundPixmap”
#define XmRBlendModel “BlendModel”
#define XmRBooleanDimension “BooleanDimension”
#define XmRBottomShadowPixmap “BottomShadowPixmap”
#define XmRButtonType “ButtonType”
#define XmRCallbackProc “CallbackProc”
#define XmRChar “Char”
#define XmRCharSetTable “CharSetTable”
#define XmRChildHorizontalAlignment “ChildHorizontalAlignment”
#define XmRChildPlacement “ChildPlacement”
#define XmRChildType “ChildType”
#define XmRChildVerticalAlignment “ChildVerticalAlignment”
#define XmRCommandWindowLocation “CommandWindowLocation”
#define XmRCompoundText “CompoundText”
#define XmRDefaultButtonType “DefaultButtonType”
```

```
#define XmRDeleteResponse “DeleteResponse”
#define XmRDialogStyle “DialogStyle”
#define XmRDialogType “DialogType”
#define XmRDoubleClickInterval “DoubleClickInterval”
#define XmRDragInitiatorProtocolStyle “DragInitiatorProtocolStyle”
#define XmRDragReceiverProtocolStyle “DragReceiverProtocolStyle”
#define XmRDropSiteActivity “DropSiteActivity”
#define XmRDropSiteOperations “DropSiteOperations”
#define XmRDropSiteType “DropSiteType”
#define XmRDropTransfers “DropTransfers”
#define XmRExtensionType “ExtensionType”
#define XmRFileTypeMask “FileTypeMask”
#define XmRFontList “FontList”
#define XmRGadgetPixmap “GadgetPixmap”
#define XmRHighlightPixmap “HighlightPixmap”
#define XmRHorizontalDimension “HorizontalDimension”
#define XmRHorizontalInt “HorizontalInt”
#define XmRHorizontalPosition “HorizontalPosition”
#define XmRIconAttachment “IconAttachment”
#define XmRImportTargets “ImportTargets”
#define XmRIndicatorType “IndicatorType”
#define XmRItemCount “ItemCount”
#define XmRItems “Items”
#define XmRKeySym “KeySym”
#define XmRKeySymTable “KeySymTable”
#define XmRKeyboardFocusPolicy “KeyboardFocusPolicy”
#define XmRLabelType “LabelType”
#define XmRListMarginHeight “ListMarginHeight”
#define XmRListMarginWidth “ListMarginWidth”
#define XmRListSizePolicy “ListSizePolicy”
#define XmRListSpacing “ListSpacing”
#define XmRManBottomShadowPixmap “ManBottomShadowPixmap”
#define XmRManForegroundPixmap “ManForegroundPixmap”
#define XmRManHighlightPixmap “ManHighlightPixmap”
#define XmRManTopShadowPixmap “ManTopShadowPixmap”
#define XmRMenuWidget “MenuWidget”
#define XmRMnemonic “Mnemonic”
#define XmRMultiClick “MultiClick”
#define XmRNavigationType “NavigationType”
#define XmRPacking “Packing”
#define XmRPrimForegroundPixmap “PrimForegroundPixmap”
#define XmRProc “Proc”
#define XmRProcessingDirection “ProcessingDirection”
#define XmRRectangleList “RectangleList”
#define XmRResizePolicy “ResizePolicy”
#define XmRRowColumnType “RowColumnType”
#define XmRScrollBarDisplayPolicy “ScrollBarDisplayPolicy”
#define XmRScrollBarPlacement “ScrollBarPlacement”
#define XmRScrollingPolicy “ScrollingPolicy”
#define XmRSelectedItemCount “SelectedItemCount”
#define XmRSelectedItems “SelectedItems”
#define XmRSelectionPolicy “SelectionPolicy”
#define XmRSelectionType “SelectionType”
#define XmRSeparatorType “SeparatorType”
#define XmRShadowType “ShadowType”
#define XmRShellHorizDim “ShellHorizDim”
#define XmRShellHorizPos “ShellHorizPos”
#define XmRShellUnitType “ShellUnitType”
#define XmRShellVertDim “ShellVertDim”
#define XmRShellVertPos “ShellVertPos”
#define XmRSizePolicy “SizePolicy”
#define XmRStringDirection “StringDirection”
#define XmRTearOffModel “TearOffModel”
#define XmRTopShadowPixmap “TopShadowPixmap”
#define XmRTransferStatus “TransferStatus”
#define XmRTraversalType “TraversalType”
#define XmRUnitType “UnitType”
#define XmRUnpostBehavior “UnpostBehavior”
#define XmRValueWcs “ValueWcs”
#define XmRVerticalAlignment “VerticalAlignment”
#define XmRVerticalDimension “VerticalDimension”
#define XmRVerticalInt “VerticalInt”
#define XmRVerticalPosition “VerticalPosition”
#define XmRVirtualBinding “VirtualBinding”
#define XmRVisibleItemCount “VisibleItemCount”
#define XmRVisualPolicy “VisualPolicy”
#define XmRWhichButton “WhichButton”
#define XmRXmBackgroundPixmap “XmBackgroundPixmap”
#define XmRXmString “XmString”
#define XmRXmStringCharSet “XmStringCharSet”
#define XmRXmStringTable “XmStringTable”
```

```
#define XmVosfActivate “osfActivate”
#define XmVosfAddMode “osfAddMode”
#define XmVosfBackSpace “osfBackSpace”
#define XmVosfBeginLine “osfBeginLine”
#define XmVosfCancel “osfCancel”
#define XmVosfClear “osfClear”
#define XmVosfCopy “osfCopy”
#define XmVosfCut “osfCut”
#define XmVosfDelete “osfDelete”
#define XmVosfDown “osfDown”
#define XmVosfEndLine “osfEndLine”
#define XmVosfHelp “osfHelp”
#define XmVosfInsert “osfInsert”
#define XmVosfLeft “osfLeft”
#define XmVosfMenu “osfMenu”
#define XmVosfMenuBar “osfMenuBar”
#define XmVosfPageDown “osfPageDown”
#define XmVosfPageLeft “osfPageLeft”
#define XmVosfPageRight “osfPageRight”
#define XmVosfPageUp “osfPageUp”
#define XmVosfPaste “osfPaste”
#define XmVosfPrimaryPaste “osfPrimaryPaste”
#define XmVosfQuickPaste “osfQuickPaste”
#define XmVosfRight “osfRight”
#define XmVosfSelect “osfSelect”
#define XmVosfUndo “osfUndo”
#define XmVosfUp “osfUp”
#define XmSFONTLIST_DEFAULT_TAG_STRING “FONTLIST_DEFAULT_TAG_STRING”
#define XmSXmFONTLIST_DEFAULT_TAG_STRING “XmFONTLIST_DEFAULT_TAG_STRING”
#define _XmConst /**/
#define XmSTRING_DEFAULT_CHARSET       XmS
#define XmSTRING_ISO8859_1             “ISO8859-1”
#define XmFONTLIST_DEFAULT_TAG         XmSFONTLIST_DEFAULT_TAG_STRING
#define XmFONTLIST_DEFAULT_TAG_STRING  XmSXmFONTLIST_DEFAULT_TAG_STRING
#define XmVaCASCADEBUTTON              “cascadeButton”
#define XmVaCHECKBUTTON                “checkButton”
#define XmVaDOUBLE_SEPARATOR           “doubleSeparator”
#define XmVaPUSHBUTTON                 “pushButton”
#define XmVaRADIOBUTTON                “radioButton”
#define XmVaSEPARATOR                  “separator”
#define XmVaSINGLE_SEPARATOR           “singleSeparator”
#define XmVaTOGGLEBUTTON               “checkButton”
#define XmVaTITLE                      XtNtitle
#define XtCKeyboardFocusPolicy         XmCKeyboardFocusPolicy
#define XtCShellUnitType               XmCShellUnitType
#define XtNkeyboardFocusPolicy         XmNkeyboardFocusPolicy
#define XtNshellUnitType               XmNshellUnitType
#define XtRKeyboardFocusPolicy         XmRKeyboardFocusPolicy
#define XmRPrimBottomShadowPixmap      XmRBottomShadowPixmap
#define XmRPrimHighlightPixmap         XmRHighlightPixmap
#define XmRPrimTopShadowPixmap         XmRTopShadowPixmap
#define XmCAccelerators                XtCAccelerators
#define XmCAllowShellResize            XtCAllowShellResize
#define XmCArgc                        XtCArgc
#define XmCArgv                        XtCArgv
#define XmCBackground                  XtCBackground
#define XmCBaseHeight                  XtCBaseHeight
#define XmCBaseHeight                  XtCBaseHeight
#define XmCBaseWidth                   XtCBaseWidth
#define XmCBaseWidth                   XtCBaseWidth
#define XmCBitmap                      XtCBitmap
#define XmCBoolean                     XtCBoolean
#define XmCBorderColor                 XtCBorderColor
#define XmCBorderWidth                 XtCBorderWidth
#define XmCCallback                    XtCCallback
#define XmCColor                       XtCColor
#define XmCColormap                    XtCColormap
#define XmCCreatePopupChildProc        XtCCreatePopupChildProc
#define XmCCursor                      XtCCursor
#define XmCDepth                       XtCDepth
#define XmCDimension                   XtRDimension
#define XmCEditMode                    XtREditMode
#define XmCEditType                    XtCEditType
#define XmCEventBindings               XtCEventBindings
#define XmCFile                        XtCFile
#define XmCFont                        XtCFont
#define XmCFontSet                     XtCFontSet
#define XmCForeground                  XtCForeground
#define XmCFraction                    XtCFraction
#define XmCFunction                    XtCFunction
#define XmCGeometry                    XtCGeometry
```

```
#define XmCHSpace                       XtCHSpace
#define XmCHeight                       XtCHeight
#define XmCHeightInc                    XtCHeightInc
#define XmCIconMask                     XtCIconMask
#define XmCIconName                     XtCIconName
#define XmCIconNameEncoding             XtCIconNameEncoding
#define XmCIconPixmap                   XtCIconPixmap
#define XmCIconWindow                   XtCIconWindow
#define XmCIconX                        XtCIconX
#define XmCIconY                        XtCIconY
#define XmCIconic                       XtCIconic
#define XmCIndex                        XtCIndex
#define XmCInitialResourcesPersistent   XtCInitialResourcesPersistent
#define XmCInitialState                 XtCInitialState
#define XmCInput                        XtCInput
#define XmCInsertPosition               XtCInsertPosition
#define XmCInterval                     XtCInterval
#define XmCJustify                      XtCJustify
#define XmCLabel                        XtCLabel
#define XmCLength                       XtCLength
#define XmCMappedWhenManaged            XtCMappedWhenManaged
#define XmCMargin                       XtCMargin
#define XmCMaxAspectX                   XtCMaxAspectX
#define XmCMaxAspectY                   XtCMaxAspectY
#define XmCMaxHeight                    XtCMaxHeight
#define XmCMaxWidth                     XtCMaxWidth
#define XmCMenuEntry                    XtCMenuEntry
#define XmCMinAspectX                   XtCMinAspectX
#define XmCMinAspectY                   XtCMinAspectY
#define XmCMinHeight                    XtCMinHeight
#define XmCMinWidth                     XtCMinWidth
#define XmCNotify                       XtCNotify
#define XmCOrientation                  XtCOrientation
#define XmCOverrideRedirect             XtCOverrideRedirect
#define XmCParameter                    XtCParameter
#define XmCPixmap                       XtCPixmap
#define XmCPosition                     XtCPosition
#define XmCReadOnly                     XtCReadOnly
#define XmCResize                       XtCResize
#define XmCReverseVideo                 XtCReverseVideo
#define XmCSaveUnder                    XtCSaveUnder
#define XmCScreen                       XtCScreen
#define XmCScrollDCursor                XtCScrollDCursor
#define XmCScrollHCursor                XtCScrollHCursor
#define XmCScrollLCursor                XtCScrollLCursor
#define XmCScrollProc                   XtCScrollProc
#define XmCScrollRCursor                XtCScrollRCursor
#define XmCScrollUCursor                XtCScrollUCursor
#define XmCScrollVCursor                XtCScrollVCursor
#define XmCSelection                    XtCSelection
#define XmCSelectionArray               XtCSelectionArray
#define XmCSensitive                    XtCSensitive
#define XmCSpace                        XtCSpace
#define XmCString                       XtCString
#define XmCTextOptions                  XtCTextOptions
#define XmCTextPosition                 XtCTextPosition
#define XmCTextSink                     XtCTextSink
#define XmCTextSource                   XtCTextSource
#define XmCThickness                    XtCThickness
#define XmCThumb                        XtCThumb
#define XmCTitle                        XtCTitle
#define XmCTitleEncoding                XtCTitleEncoding
#define XmCTransient                    XtCTransient
#define XmCTransientFor                 XtCTransientFor
#define XmCTranslations                 XtCTranslations
#define XmCVSpace                       XtCVSpace
#define XmCValue                        XtCValue
#define XmCVisual                       XtCVisual
#define XmCWaitForWm                    XtCWaitForWm
#define XmCWidget                       XtRWidget
#define XmCWidth                        XtCWidth
#define XmCWidthInc                     XtCWidthInc
#define XmCWinGravity                   XtCWinGravity
#define XmCWindow                       XtCWindow
#define XmCWindowGroup                  XtCWindowGroup
#define XmCWmTimeout                    XtCWmTimeout
#define XmCX                            XtCX
#define XmCY                            XtCY
#define XmNaccelerators                 XtNaccelerators
#define XmNallowShellResize             XtNallowShellResize
#define XmNancestorSensitive            XtNancestorSensitive
```

```
#define XmNargc                         XtNargc
#define XmNargv                         XtNargv
#define XmNbackground                   XtNbackground
#define XmNbackgroundPixmap             XtNbackgroundPixmap
#define XmNbaseHeight                   XtNbaseHeight
#define XmNbaseHeight                   XtNbaseHeight
#define XmNbaseWidth                    XtNbaseWidth
#define XmNbaseWidth                    XtNbaseWidth
#define XmNbitmap                       XtNbitmap
#define XmNborder                       XtNborder
#define XmNborderColor                  XtNborderColor
#define XmNborderPixmap                 XtNborderPixmap
#define XmNborderWidth                  XtNborderWidth
#define XmNcallback                     XtNcallback
#define XmNchildren                     XtNchildren
#define XmNcolormap                     XtNcolormap
#define XmNcreatePopupChildProc         XtNcreatePopupChildProc
#define XmNdepth                        XtNdepth
#define XmNdestroyCallback              XtNdestroyCallback
#define XmNeditType                     XtNeditType
#define XmNfile                         XtNfile
#define XmNfont                         XtNfont
#define XmNfontSet                      XtNfontSet
#define XmNforceBars                    XtNforceBars
#define XmNforeground                   XtNforeground
#define XmNfunction                     XtNfunction
#define XmNgeometry                     XtNgeometry
#define XmNheight                       XtNheight
#define XmNheightInc                    XtNheightInc
#define XmNhighlight                    XtNhighlight
#define XmNiconMask                     XtNiconMask
#define XmNiconName                     XtNiconName
#define XmNiconNameEncoding             XtNiconNameEncoding
#define XmNiconPixmap                   XtNiconPixmap
#define XmNiconWindow                   XtNiconWindow
#define XmNiconX                        XtNiconX
#define XmNiconY                        XtNiconY
#define XmNiconic                       XtNiconic
#define XmNindex                        XtNindex
#define XmNinitialResourcesPersistent   XtNinitialResourcesPersistent
#define XmNinitialState                 XtNinitialState
#define XmNinnerHeight                  XtNinnerHeight
#define XmNinnerWidth                   XtNinnerWidth
#define XmNinnerWindow                  XtNinnerWindow
#define XmNinput                        XtNinput
#define XmNinsertPosition               XtNinsertPosition
#define XmNinternalHeight               XtNinternalHeight
#define XmNinternalWidth                XtNinternalWidth
#define XmNjumpProc                     XtNjumpProc
#define XmNjustify                      XtNjustify
#define XmNlength                       XtNlength
#define XmNlowerRight                   XtNlowerRight
#define XmNmappedWhenManaged            XtNmappedWhenManaged
#define XmNmaxAspectX                   XtNmaxAspectX
#define XmNmaxAspectY                   XtNmaxAspectY
#define XmNmaxHeight                    XtNmaxHeight
#define XmNmaxWidth                     XtNmaxWidth
#define XmNmenuEntry                    XtNmenuEntry
#define XmNminAspectX                   XtNminAspectX
#define XmNminAspectY                   XtNminAspectY
#define XmNminHeight                    XtNminHeight
#define XmNminWidth                     XtNminWidth
#define XmNname                         XtNname
#define XmNnotify                       XtNnotify
#define XmNnumChildren                  XtNnumChildren
#define XmNorientation                  XtNorientation
#define XmNoverrideRedirect             XtNoverrideRedirect
#define XmNparameter                    XtNparameter
#define XmNpixmap                       XtNpixmap
#define XmNpopdownCallback              XtNpopdownCallback
#define XmNpopupCallback                XtNpopupCallback
#define XmNresize                       XtNresize
#define XmNreverseVideo                 XtNreverseVideo
#define XmNsaveUnder                    XtNsaveUnder
#define XmNscreen                       XtNscreen
#define XmNscrollDCursor                XtNscrollDCursor
#define XmNscrollHCursor                XtNscrollHCursor
#define XmNscrollLCursor                XtNscrollLCursor
#define XmNscrollProc                   XtNscrollProc
#define XmNscrollRCursor                XtNscrollRCursor
#define XmNscrollUCursor                XtNscrollUCursor
```

```
#define XmNscrollVCursor          XtNscrollVCursor
#define XmNselection              XtNselection
#define XmNselectionArray         XtNselectionArray
#define XmNsensitive              XtNsensitive
#define XmNshown                  XtNshown
#define XmNspace                  XtNspace
#define XmNstring                 XtNstring
#define XmNtextOptions            XtNtextOptions
#define XmNtextSink               XtNtextSink
#define XmNtextSource             XtNtextSource
#define XmNthickness              XtNthickness
#define XmNthumb                  XtNthumb
#define XmNthumbProc              XtNthumbProc
#define XmNtitle                  XtNtitle
#define XmNtitleEncoding          XtNtitleEncoding
#define XmNtop                    XtNtop
#define XmNtransient              XtNtransient
#define XmNtransientFor           XtNtransientFor
#define XmNtransientFor           XtNtransientFor
#define XmNtranslations           XtNtranslations
#define XmNupdate                 XtNupdate
#define XmNuseBottom              XtNuseBottom
#define XmNuseRight               XtNuseRight
#define XmNvalue                  XtNvalue
#define XmNvisual                 XtNvisual
#define XmNwaitForWm              XtNwaitForWm
#define XmNwidth                  XtNwidth
#define XmNwidthInc               XtNwidthInc
#define XmNwinGravity             XtNwinGravity
#define XmNwindow                 XtNwindow
#define XmNwindowGroup            XtNwindowGroup
#define XmNwmTimeout              XtNwmTimeout
#define XmNx                      XtNx
#define XmNy                      XtNy
#define XmRAcceleratorTable       XtRAcceleratorTable
#define XmRAtom                   XtRAtom
#define XmRBitmap                 XtRBitmap
#define XmRBool                   XtRBool
#define XmRBoolean                XtRBoolean
#define XmRCallProc               XtRCallProc
#define XmRCallback               XtRCallback
#define XmRCardinal               XtRCardinal
#define XmRColor                  XtRColor
#define XmRColormap               XtRColormap
#define XmRCursor                 XtRCursor
#define XmRDimension              XtRDimension
#define XmRDisplay                XtRDisplay
#define XmREditMode               XtREditMode
#define XmREnum                   XtREnum
#define XmRFile                   XtRFile
#define XmRFloat                  XtRFloat
#define XmRFont                   XtRFont
#define XmRFontSet                XtRFontSet
#define XmRFontStruct             XtRFontStruct
#define XmRFunction               XtRFunction
#define XmRGeometry               XtRGeometry
#define XmRImmediate              XtRImmediate
#define XmRInitialState           XtRInitialState
#define XmRInt                    XtRInt
#define XmRJustify                XtRJustify
#define XmRLongBoolean            XtRLongBoolean
#define XmROrientation            XtROrientation
#define XmRObject                 XtRObject
#define XmRPixel                  XtRPixel
#define XmRPixmap                 XtRPixmap
#define XmRPointer                XtRPointer
#define XmRPosition               XtRPosition
#define XmRScreen                 XtRScreen
#define XmRShort                  XtRShort
#define XmRString                 XtRString
#define XmRStringArray            XtRStringArray
#define XmRStringTable            XtRStringTable
#define XmRTextPosition           XtCTextPosition
#define XmRTranslationTable       XtRTranslationTable
#define XmRUnsignedChar           XtRUnsignedChar
#define XmRVisual                 XtRVisual
#define XmRWidget                 XtRWidget
#define XmRWidgetClass            XtRWidgetClass
#define XmRWidgetList             XtRWidgetList
#define XmRWindow                 XtRWindow
```

Windowing and Terminal Interface (64-bit psABI) - ~~EXPERIMENTAL~~

Overview

The following table identifies the actual version numbers and reference names for 64-bit ABI windowing and terminal shared interfaces:

Library	Reference Name
libMrm	**/usr/dt/lib/sparcv9/libMrm.so.3**
libX11	**/usr/lib/sparcv9/libX11.so.5**
libXext	**/usr/lib/sparcv9/libXext.so.0**
libXol	**/usr/lib/sparcv9/libXol.so.3**
libXm	**/usr/dt/lib/sparcv9/libXm.so.3**
libXt	**/usr/lib/sparcv9/libXol.so.5**

CHAPTER 11: Development Environments

SCD 2.4.1

Development Environments

Overview

This chapter is common to both the 32-bit ABI and 64-bit ABI, except that the 64-bit ABI is EXPERIMENTAL.

It contains the commands for application programs as listed in the *System V Application Binary Interface (Third Edition)*, and described in the *System V Interface Definition, (Third Edition).*

.

Table 11-1. Software Packaging tools

`pkgproto`	`pkgtrans`	`pkgmk`

Development Environments Changes

#	Facility	Location	Description
1	Commands	gABI	Remove command section page 11-1, 11-2, 11-3: The SCD places no requirements on the nature of the development tools, if any, that are provided on a system. In particular, the six commands as, cc, ld, m4, lex, and yacc are not part of the SCD.

CHAPTER 12: Networking

SCD 2.4.1

Networking

Overview

All information regarding File System Structure and Contents may be found in Chapter 12 of the *System V Application Binary Interface (Third Edition*).

Networking Changes

The following are changes to the *System V Application Binary Interface (Third Edition)*, the *System V Application Binary Interface - SPARC Processor Supplement (Third Edition)*, and the *System V Interface Definition (Third Edition)* as reported to SPARC International.

#	Facility	Location	Description
1	Required STREAMS Devices and Modules	gABI	Addition - To Figure 12-1 on page 12-2, add */dev/icmp* and */dev/arp*.

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SCD 2.4.1

Symbols

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% 3P-11, 3P-22
%29 3P-11
%4 3P-11
%asi 3P-7, 3P-10, 3P-21, 3P-22, 3P-24
%ccr 3P-7, 3P-10, 3P-21, 3P-22
%d 3P-12
%d0 3P-10, 3P-11, 3P-13, 3P-15, 3P-22
%d0..%d10 3P-12
%d10 3P-11
%d12 3P-11
%d12..%d30 3P-12
%d14 3P-11
%d16 3P-11, 3P-15
%d18 3P-11
%d2 3P-10, 3P-11
%d20 3P-11, 3P-14
%d22 3P-11
%d24 3P-11
%d26 3P-11
%d28 3P-11
%d30 3P-10, 3P-11
%d32 3P-10
%d4 3P-11, 3P-14
%d6 3P-10, 3P-11, 3P-15
%d62 3P-10
%d8 3P-11, 3P-14
%f 3P-12
%f0 3P-10, 3P-11, 3P-13, 3P-15
%f1 3P-10, 3P-11, 3P-14
%f10 3P-11
%f11 3P-11, 3P-14, 3P-15
%f12 3P-11
%f13 3P-11, 3P-14
%f14 3P-11
%f15 3P-11
%f16 3P-11
%f17 3P-11
%f18 3P-11
%f19 3P-11
%f2 3P-10, 3P-11
%f20 3P-11
%f21 3P-11
%f22 3P-11
%f23 3P-11
%f24 3P-11
%f25 3P-11
%f26 3P-11
%f27 3P-11
%f28 3P-11
%f29 3P-10, 3P-11
%f3 3P-10, 3P-11, 3P-14, 3P-15
%f30 3P-11
%f31 3P-10, 3P-11
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%f6 3P-11
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%f8 3P-11
%f9 3P-11
%fp 3P-6, 3P-10, 3P-25
%fp+BIAS 3P-33
%fp+BIAS+176 3P-14
%fp+BIAS+184 3P-14
%fprs 3P-10, 3P-22
%fpsr 3P-7
%fsr 3P-7, 3P-10, 3P-22
%g0 3P-7, 3P-10, 3P-15, 3P-21, 3P-30, 3P-32
%g1 3P-7, 3P-10, 3P-20, 3P-25, 5P-5
%g2 3P-7, 3P-10
%g3 3P-7, 3P-10
%g4 3P-7, 3P-10
%g5 3P-7, 3P-10, 3P-32
%g6 3P-7, 3P-10
%g7 3P-7, 3P-10
%hh 3P-30, 4-2, 4P-8
%hi 5P-5
%hm 4-2, 4P-8
%i 3P-12
%i0 3P-6, 3P-8, 3P-10, 3P-13, 3P-14, 3P-15
%i0..%i5 3P-12
%i1 3P-6, 3P-8, 3P-10, 3P-13, 3P-14
%i2 3P-6, 3P-8, 3P-10, 3P-14, 3P-15
%i3 3P-6, 3P-8, 3P-10, 3P-14
%i4 3P-6, 3P-8, 3P-14, 3P-15
%i5 3P-6, 3P-8, 3P-10, 3P-14
%i6 3P-6, 3P-8, 3P-10
%i7 3P-6, 3P-8, 3P-10
%i7+8 3P-10, 3P-15
%l0 3-2, 3P-6, 3P-8, 3P-10, 3P-22, 3P-32
%l1 3-2, 3P-6, 3P-8, 3P-21, 3P-32
%l2 3P-6, 3P-8
%l3 3P-6, 3P-8
%l4 3P-6, 3P-8, 3P-15
%l44 4P-9
%l5 3P-6, 3P-8
%l6 3P-6, 3P-8, 3P-21
%l7 3P-6, 3P-8, 3P-10, 3P-21, 3P-30, 3P-31
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%npc 3P-21

%o 3P-12
%o0 3-1, 3P-6, 3P-10, 3P-11, 3P-12, 3P-13, 3P-14, 3P-15, 3P-21, 3P-22, 3P-30
%o1 3-1, 3P-6, 3P-10, 3P-11, 3P-14, 3P-21, 3P-30
%o2 3P-6, 3P-10, 3P-11, 3P-14, 3P-15, 3P-22
%o3 3P-6, 3P-10, 3P-11, 3P-14, 3P-22
%o4 3P-6, 3P-11, 3P-14, 3P-15, 3P-22
%o5 3P-6, 3P-10, 3P-11, 3P-12, 3P-14
%o6 3P-6, 3P-10
%o7 3P-6, 3P-10, 3P-15
%o7+8 3P-15
%pc 3P-21, 3P-24, 3P-32
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