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Contents

Foreword ........................................................................................................................................... vii
Introduction ....................................................................................................................................... viii

I Introductory Elements .................................................................................................................... 9

1 Scope........................................................................................................................................... 9
   1.1 General..................................................................................................................................... 9
   1.2 Module Specific Scope .......................................................................................................... 9
2 Normative References ................................................................................................................... 10
3 Requirements ............................................................................................................................... 14
   3.1 Relevant Libraries ............................................................................................................... 14
   3.2 LSB Implementation Conformance ....................................................................................... 14
   3.3 LSB Application Conformance ............................................................................................ 15
4 Definitions ................................................................................................................................... 17
5 Terminology ............................................................................................................................... 18
6 Documentation Conventions ....................................................................................................... 20
7 Relationship To ISO/IEC 9945 POSIX ....................................................................................... 21
8 Relationship To Other Free Standards Group Specifications ...................................................... 22

II Executable And Linking Format (ELF) ....................................................................................... 23

9 Introduction................................................................................................................................. 23
10 Low Level System Information ................................................................................................. 24
   10.1 Operating System Interface ............................................................................................... 24
   10.2 Machine Interface ............................................................................................................. 24
11 Object Format ............................................................................................................................ 25
   11.1 Object Files ........................................................................................................................ 25
   11.2 Sections .............................................................................................................................. 25
   11.3 Special Sections .................................................................................................................. 28
   11.4 Symbol Mapping ............................................................................................................... 34
   11.5 DWARF Extensions .......................................................................................................... 34
   11.6 Exception Frames .............................................................................................................. 37
   11.7 Symbol Versioning ............................................................................................................ 42
   11.8 ABI note tag ...................................................................................................................... 46
12 Dynamic Linking ...................................................................................................................... 47
   12.1 Program Loading and Dynamic Linking ............................................................................. 47
   12.2 Program Header ............................................................................................................... 47
   12.3 Dynamic Entries .............................................................................................................. 47

III Base Libraries ............................................................................................................................ 52

13 Base Libraries ........................................................................................................................... 52
   13.1 Introduction ....................................................................................................................... 52
   13.2 Program Interpreter .......................................................................................................... 52
   13.3 Interfaces for libc .............................................................................................................. 52
   13.4 Data Definitions for libc .................................................................................................... 65
   13.5 Interface Definitions for libc ............................................................................................. 106
   13.6 Interfaces for libm ............................................................................................................. 212
   13.7 Data Definitions for libm ................................................................................................... 215
   13.8 Interface Definitions for libm ........................................................................................... 217
   13.9 Interfaces for libpthread ................................................................................................. 217
   13.10 Data Definitions for libpthread ....................................................................................... 220
   13.11 Interface Definitions for libpthread ............................................................................... 222
   13.12 Interfaces for libgcc_s .................................................................................................... 223
   13.13 Data Definitions for libgcc_s ................................................................. 223
13.14 Interfaces for libdl ................................................................. 224
13.15 Data Definitions for libdl .......................................................... 225
13.16 Interface Definitions for libdl ....................................................... 226
13.17 Interfaces for librt ................................................................. 227
13.18 Interfaces for libcrypt ............................................................. 228
13.19 Interfaces for libpam ............................................................... 229
13.20 Data Definitions for libpam ........................................................ 230
13.21 Interface Definitions for libpam .................................................... 231
IV Utility Libraries .................................................................................. 244
14 Utility Libraries .................................................................................. 244
14.1 Introduction ................................................................................. 244
14.2 Interfaces for libz ......................................................................... 244
14.3 Data Definitions for libz ............................................................... 245
14.4 Interface Definitions for libz ....................................................... 247
14.5 Interfaces for libncurses .............................................................. 293
14.6 Data Definitions for libncurses .................................................... 296
14.7 Interfaces for libutil ................................................................. 300
14.8 Interface Definitions for libutil ..................................................... 300
V Commands and Utilities .................................................................... 306
15 Commands and Utilities ................................................................. 306
15.1 Commands and Utilities .............................................................. 306
15.2 Command Behavior ................................................................. 307
VI Execution Environment .................................................................... 368
16 File System Hierarchy ....................................................................... 368
16.1 /dev: Device Files ........................................................................ 368
16.2 /etc: Host-specific system configuration ......................................... 368
16.3 User Accounting Databases ......................................................... 370
16.4 Path For System Administration Utilities ....................................... 370
17 Additional Recommendations .......................................................... 371
17.1 Recommendations for applications on ownership and permissions 371
18 Additional Behaviors ......................................................................... 373
18.1 Mandatory Optional Behaviors .................................................... 373
19 Localization ..................................................................................... 375
19.1 Introduction ............................................................................... 375
19.2 Regular Expressions .................................................................... 375
19.3 Pattern Matching Notation ............................................................ 375
VII System Initialization .......................................................................... 377
20 System Initialization .......................................................................... 377
20.1 Cron Jobs .................................................................................... 377
20.2 Init Script Actions ........................................................................ 378
20.3 Comment Conventions for Init Scripts .......................................... 379
20.4 Installation and Removal of Init Scripts .......................................... 381
20.5 Run Levels .................................................................................. 382
20.6 Facility Names ............................................................................... 383
20.7 Script Names ............................................................................... 384
20.8 Init Script Functions ..................................................................... 384
VIII Users & Groups ............................................................................... 387
21 Users & Groups ................................................................................ 387
21.1 User and Group Database ............................................................ 387
21.2 User & Group Names .................................................................... 387
21.3 User ID Ranges ............................................................................. 388
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.4 Rationale</td>
<td>388</td>
</tr>
<tr>
<td>IX Package Format and Installation</td>
<td>389</td>
</tr>
<tr>
<td>22 Software Installation</td>
<td>389</td>
</tr>
<tr>
<td>22.1 Introduction</td>
<td>389</td>
</tr>
<tr>
<td>22.2 Package File Format</td>
<td>389</td>
</tr>
<tr>
<td>22.3 Package Script Restrictions</td>
<td>408</td>
</tr>
<tr>
<td>22.4 Package Tools</td>
<td>408</td>
</tr>
<tr>
<td>22.5 Package Naming</td>
<td>409</td>
</tr>
<tr>
<td>22.6 Package Dependencies</td>
<td>409</td>
</tr>
<tr>
<td>22.7 Package Architecture Considerations</td>
<td>410</td>
</tr>
<tr>
<td>A Alphabetical Listing of Interfaces</td>
<td>411</td>
</tr>
<tr>
<td>A.1 libc</td>
<td>411</td>
</tr>
<tr>
<td>A.2 libcrypt</td>
<td>421</td>
</tr>
<tr>
<td>A.3 libdl</td>
<td>421</td>
</tr>
<tr>
<td>A.4 libm</td>
<td>421</td>
</tr>
<tr>
<td>A.5 libncurses</td>
<td>425</td>
</tr>
<tr>
<td>A.6 libpam</td>
<td>428</td>
</tr>
<tr>
<td>A.7 libpthread</td>
<td>428</td>
</tr>
<tr>
<td>A.8 librt</td>
<td>430</td>
</tr>
<tr>
<td>A.9 libutil</td>
<td>430</td>
</tr>
<tr>
<td>A.10 libz</td>
<td>430</td>
</tr>
<tr>
<td>B Future Directions (Informative)</td>
<td>432</td>
</tr>
<tr>
<td>B.1 Introduction</td>
<td>432</td>
</tr>
<tr>
<td>B.2 Commands And Utilities</td>
<td>433</td>
</tr>
<tr>
<td>lsbinstall</td>
<td>433</td>
</tr>
<tr>
<td>C GNU Free Documentation License</td>
<td>437</td>
</tr>
<tr>
<td>C.1 PREAMBLE</td>
<td>437</td>
</tr>
<tr>
<td>C.2 APPLICABILITY AND DEFINITIONS</td>
<td>437</td>
</tr>
<tr>
<td>C.3 VERBATIM COPYING</td>
<td>438</td>
</tr>
<tr>
<td>C.4 COPYING IN QUANTITY</td>
<td>438</td>
</tr>
<tr>
<td>C.5 MODIFICATIONS</td>
<td>439</td>
</tr>
<tr>
<td>C.6 COMBINING DOCUMENTS</td>
<td>440</td>
</tr>
<tr>
<td>C.7 COLLECTIONS OF DOCUMENTS</td>
<td>441</td>
</tr>
<tr>
<td>C.8 AGGREGATION WITH INDEPENDENT WORKS</td>
<td>441</td>
</tr>
<tr>
<td>C.9 TRANSLATION</td>
<td>441</td>
</tr>
<tr>
<td>C.10 TERMINATION</td>
<td>441</td>
</tr>
<tr>
<td>C.11 FUTURE REVISIONS OF THIS LICENSE</td>
<td>441</td>
</tr>
<tr>
<td>C.12 How to use this License for your documents</td>
<td>442</td>
</tr>
</tbody>
</table>
List of Figures

11-1 Version Definition Entries ................................................................. 43
11-2 Version Definition Auxiliary Entries .................................................. 44
11-3 Version Needed Entries .................................................................... 44
11-4 Version Needed Auxiliary Entries ..................................................... 45
12-1 Dynamic Structure ........................................................................... 47
Foreword

This is version 3.0 of the Linux Standard Base Core Specification. This specification is part of a family of specifications under the general title "Linux Standard Base". Developers of applications or implementations interested in using the LSB trademark should see the Free Standards Group Certification Policy for details.
Introduction

The LSB defines a binary interface for application programs that are compiled and packaged for LSB-conforming implementations on many different hardware architectures. Since a binary specification shall include information specific to the computer processor architecture for which it is intended, it is not possible for a single document to specify the interface for all possible LSB-conforming implementations. Therefore, the LSB is a family of specifications, rather than a single one.

This document should be used in conjunction with the documents it references. This document enumerates the system components it includes, but descriptions of those components may be included entirely or partly in this document, partly in other documents, or entirely in other reference documents. For example, the section that describes system service routines includes a list of the system routines supported in this interface, formal declarations of the data structures they use that are visible to applications, and a pointer to the underlying referenced specification for information about the syntax and semantics of each call. Only those routines not described in standards referenced by this document, or extensions to those standards, are described in the detail. Information referenced in this way is as much a part of this document as is the information explicitly included here.

The specification carries a version number of either the form \(x.y\) or \(x.y.z\). This version number carries the following meaning:

- The first number \((x)\) is the major version number. All versions with the same major version number should share binary compatibility. Any addition or deletion of a new library results in a new version number. Interfaces marked as deprecated may be removed from the specification at a major version change.

- The second number \((y)\) is the minor version number. Individual interfaces may be added if all certified implementations already had that (previously undocumented) interface. Interfaces may be marked as deprecated at a minor version change. Other minor changes may be permitted at the discretion of the LSB workgroup.

- The third number \((z)\), if present, is the editorial level. Only editorial changes should be included in such versions.
1 Scope

1.1 General

The Linux Standard Base (LSB) defines a system interface for compiled applications and a minimal environment for support of installation scripts. Its purpose is to enable a uniform industry standard environment for high-volume applications conforming to the LSB.

These specifications are composed of two basic parts: A common specification ("LSB-generic") describing those parts of the interface that remain constant across all implementations of the LSB, and an architecture-specific specification ("LSB-arch") describing the parts of the interface that vary by processor architecture. Together, the LSB-generic and the architecture-specific supplement for a single hardware architecture provide a complete interface specification for compiled application programs on systems that share a common hardware architecture.

The LSB-generic document shall be used in conjunction with an architecture-specific supplement. Whenever a section of the LSB-generic specification shall be supplemented by architecture-specific information, the LSB-generic document includes a reference to the architecture supplement. Architecture supplements may also contain additional information that is not referenced in the LSB-generic document.

The LSB contains both a set of Application Program Interfaces (APIs) and Application Binary Interfaces (ABIs). APIs may appear in the source code of portable applications, while the compiled binary of that application may use the larger set of ABIs. A conforming implementation shall provide all of the ABIs listed here. The compilation system may replace (e.g. by macro definition) certain APIs with calls to one or more of the underlying binary interfaces, and may insert calls to binary interfaces as needed.

The LSB is primarily a binary interface definition. Not all of the source level APIs available to applications may be contained in this specification.

1.2 Module Specific Scope

This is the Core module of the Linux Standards Base (LSB). This module provides the fundamental system interfaces, libraries, and runtime environment upon which all conforming applications and libraries depend.

Interfaces described in this module are mandatory except where explicitly listed otherwise. Core interfaces may be supplemented by other modules; all modules are built upon the core.
2 Normative References

The specifications listed below are referenced in whole or in part by the Linux
Standard Base. In this specification, where only a particular section of one of these
references is identified, then the normative reference is to that section alone, and the
rest of the referenced document is informative.

Table 2-1 Normative References

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>DWARF Debugging Information Format,</td>
<td>DWARF Debugging Information Format, Revision 2.0.0 (July 27, 1993)</td>
<td><a href="http://refspecs.freestandards.org/dwarf/dwarf-2.0.0.pdf">http://refspecs.freestandards.org/dwarf/dwarf-2.0.0.pdf</a></td>
</tr>
<tr>
<td>Revision 2.0.0</td>
<td>DWARF Debugging Information Format, Revision 3.0.0 (Draft)</td>
<td><a href="http://refspecs.freestandards.org/dwarf/">http://refspecs.freestandards.org/dwarf/</a></td>
</tr>
<tr>
<td>Filesystem Hierarchy Standard</td>
<td>Filesystem Hierarchy Standard (FHS) 2.3</td>
<td><a href="http://www.pathname.com/fhs/">http://www.pathname.com/fhs/</a></td>
</tr>
<tr>
<td>Name</td>
<td>Title</td>
<td>URL</td>
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<td>-----------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Itanium C++ ABI</td>
<td>Itanium C++ ABI (Revision: 1.75)</td>
<td><a href="http://www.itu.int/rec/recommendation.asp?type=folders&amp;lang=e&amp;parent=T-REC-V.42">http://www.itu.int/rec/recommendation.asp?type=folders&amp;lang=e&amp;parent=T-REC-V.42</a></td>
</tr>
<tr>
<td>Linux Allocated Device Registry</td>
<td>LINUX ALLOCATED DEVICES</td>
<td><a href="http://www.lanana.org/docs/device-list/devices.txt">http://www.lanana.org/docs/device-list/devices.txt</a></td>
</tr>
<tr>
<td>PAM</td>
<td>Open Software Foundation, Request For Comments: 86.0, October 1995, V. Samar &amp; R.Schemers (SunSoft)</td>
<td><a href="http://www.opengroup.org/tech/rfc/mirror-rfc/rfc86.0.txt">http://www.opengroup.org/tech/rfc/mirror-rfc/rfc86.0.txt</a></td>
</tr>
<tr>
<td>Name</td>
<td>Title</td>
<td>URL</td>
</tr>
<tr>
<td>-------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------</td>
</tr>
<tr>
<td>SVID Issue 4</td>
<td>System V Interface Definition, Fourth Edition</td>
<td></td>
</tr>
<tr>
<td>this specification</td>
<td>Linux Standard Base</td>
<td><a href="http://www.linuxbase.org/spec/">http://www.linuxbase.org/spec/</a></td>
</tr>
</tbody>
</table>
2 Normative References

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>URL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-85912-171-3, C610), plus Corrigendum U018</td>
<td>g/un.htm</td>
<td></td>
</tr>
</tbody>
</table>
3 Requirements

3.1 Relevant Libraries

The libraries listed in Table 3-1 shall be available on a Linux Standard Base system, with the specified runtime names. The libraries listed in Table 3-2 are architecture specific, but shall be available on all LSB conforming systems. This list may be supplemented or amended by the architecture-specific specification.

Table 3-1 Standard Library Names

<table>
<thead>
<tr>
<th>Library</th>
<th>Runtime Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>libdl</td>
<td>libdl.so.2</td>
</tr>
<tr>
<td>libcrypt</td>
<td>libcrypt.so.1</td>
</tr>
<tr>
<td>libz</td>
<td>libz.so.1</td>
</tr>
<tr>
<td>libncurses</td>
<td>libncurses.so.5</td>
</tr>
<tr>
<td>libutil</td>
<td>libutil.so.1</td>
</tr>
<tr>
<td>libpthread</td>
<td>libpthread.so.0</td>
</tr>
<tr>
<td>librt</td>
<td>librt.so.1</td>
</tr>
<tr>
<td>libpam</td>
<td>libpam.so.0</td>
</tr>
<tr>
<td>libgcc_s</td>
<td>libgcc_s.so.1</td>
</tr>
</tbody>
</table>

Table 3-2 Standard Library Names defined in the Architecture Specific Supplement

<table>
<thead>
<tr>
<th>Library</th>
<th>Runtime Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>libm</td>
<td>See archLSB</td>
</tr>
<tr>
<td>libc</td>
<td>See archLSB</td>
</tr>
<tr>
<td>proginterp</td>
<td>See archLSB</td>
</tr>
</tbody>
</table>

These libraries will be in an implementation-defined directory which the dynamic linker shall search by default.

3.2 LSB Implementation Conformance

A conforming implementation shall satisfy the following requirements:

• The implementation shall implement fully the architecture described in the hardware manual for the target processor architecture.

• The implementation shall be capable of executing compiled applications having the format and using the system interfaces described in this document.

• The implementation shall provide libraries containing the interfaces specified by this document, and shall provide a dynamic linking mechanism that allows these interfaces to be attached to applications at runtime. All the interfaces shall behave as specified in this document.
3 Requirements

• The map of virtual memory provided by the implementation shall conform to the requirements of this document.

• The implementation's low-level behavior with respect to function call linkage, system traps, signals, and other such activities shall conform to the formats described in this document.

• The implementation shall provide all of the mandatory interfaces in their entirety.

• The implementation may provide one or more of the optional interfaces. Each optional interface that is provided shall be provided in its entirety. The product documentation shall state which optional interfaces are provided.

• The implementation shall provide all files and utilities specified as part of this document in the format defined here and in other referenced documents. All commands and utilities shall behave as required by this document. The implementation shall also provide all mandatory components of an application's runtime environment that are included or referenced in this document.

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

• The 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.

3.3 LSB Application Conformance

A conforming application shall satisfy the following requirements:

• Its executable files are either 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 applications.

• If it requires any optional interface defined in this document 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:

  • If such an interface or data format is supplied by another application through direct invocation of that application during execution, that application is in turn an LSB conforming application.

  • The use of that interface or data format, as well as its source, is identified in the documentation of the application.

• It shall not use any values for a named interface that are reserved for vendor extensions.
3 Requirements

A strictly conforming application does not require or use any interface, facility, or implementation-defined extension that is not defined in this document in order to be installed or to execute successfully.
4 Definitions

For the purposes of this document, the following definitions, as specified in the ISO/IEC Directives, Part 2, 2001, 4th Edition, apply:

can
be able to; there is a possibility of; it is possible to

cannot
be unable to; there is no possibility of; it is not possible to

may
is permitted; is allowed; is permissible

need not
it is not required that; no...is required

shall
is to; is required to; it is required that; has to; only...is permitted; it is necessary

shall not
is not allowed [permitted] [acceptable] [permissible]; is required to be not; is required that...be not; is not to be

should
it is recommended that; ought to

should not
it is not recommended that; ought not to
5 Terminology

For the purposes of this document, the following terms apply:

archLSB
The architectural part of the LSB Specification which describes the specific parts of the interface that are platform specific. The archLSB is complementary to the gLSB.

Binary Standard
The total set of interfaces that are available to be used in the compiled binary code of a conforming application.

gLSB
The common part of the LSB Specification that describes those parts of the interface that remain constant across all hardware implementations of the LSB.

implementation-defined
Describes a value or behavior that is not defined by this document but is selected by an implementor. The value or behavior may vary among implementations that conform to this document. An application should not rely on the existence of the value or behavior. An application that relies on such a value or behavior cannot be assured to be portable across conforming implementations. The implementor shall document such a value or behavior so that it can be used correctly by an application.

Shell Script
A file that is read by an interpreter (e.g., awk). The first line of the shell script includes a reference to its interpreter binary.

Source Standard
The set of interfaces that are available to be used in the source code of a conforming application.

undefined
Describes the nature of a value or behavior not defined by this document which results from use of an invalid program construct or invalid data input. The value or behavior may vary among implementations that conform to this document. An application should not rely on the existence or validity of the value or behavior. An application that relies on any particular value or behavior cannot be assured to be portable across conforming implementations.

unspecified
Describes the nature of a value or behavior not specified by this document which results from use of a valid program construct or valid data input. The value or behavior may vary among implementations that conform to this document. An application should not rely on the existence or validity of the value or behavior. An application that relies on any particular value or behavior cannot be assured to be portable across conforming implementations.
Other terms and definitions used in this document shall have the same meaning as defined in Chapter 3 of the Base Definitions volume of ISO POSIX (2003).
6 Documentation Conventions

Throughout this document, the following typographic conventions are used:

function()
the name of a function

command
the name of a command or utility

CONSTANT
a constant value

parameter
a parameter

variable
a variable

Throughout this specification, several tables of interfaces are presented. Each entry in these tables has the following format:

name
the name of the interface

(symver)
An optional symbol version identifier, if required.

[refno]
A reference number indexing the table of referenced specifications that follows this table.

For example,

forkpty(GLIBC_2.0) [1]

refers to the interface named forkpty() with symbol version GLIBC_2.0 that is defined in the first of the listed references below the table.
7 Relationship To ISO/IEC 9945 POSIX

This specification includes many interfaces described in ISO POSIX (2003). Unless otherwise specified, such interfaces should behave exactly as described in that specification. Any conflict between the requirements described here and the ISO POSIX (2003) standard is unintentional, except as explicitly noted otherwise.

Note: In addition to the differences noted inline in this specification, PDTR 24715 has extracted the differences between this specification and ISO POSIX (2003) into a single place. It is the long term plan of the LSB to converge with ISO/IEC 9945 POSIX.

The LSB Specification Authority is responsible for deciding the meaning of conformance to normative referenced standards in the LSB context. Problem Reports regarding underlying or referenced standards in any other context will be referred to the relevant maintenance body for that standard.
8 Relationship To Other Free Standards Group Specifications

The LSB is the base for several other specification projects under the umbrella of the Free Standards Group (FSG). This specification is the foundation, and other specifications build on the interfaces defined here. However, beyond those specifications listed as Normative References, this specification has no dependencies on other FSG projects.
9 Introduction

Executable and Linking Format (ELF) defines the object format for compiled applications. This specification supplements the information found in System V ABI Update and is intended to document additions made since the publication of that document.
10 Low Level System Information

10.1 Operating System Interface

LSB-conforming applications shall assume that stack, heap and other allocated memory regions will be non-executable. The application must take steps to make them executable if needed.

10.2 Machine Interface

10.2.1 Data Representation

LSB-conforming applications shall use the data representation as defined in the Architecture specific ELF documents.

10.2.1.1 Fundamental Types

In addition to the fundamental types specified in the Architecture specific ELF documents, a 1 byte data type is defined here.

Table 10-1 Scalar Types

<table>
<thead>
<tr>
<th>Type</th>
<th>C</th>
<th>C++</th>
<th>sizeof (bytes)</th>
<th>Alignment Representation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integral</td>
<td>_Bool</td>
<td>bool</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
11 Object Format

11.1 Object Files

LSB-conforming implementations shall support the object file Executable and Linking Format (ELF), which is defined by the following documents:

- System V ABI
- System V ABI Update
- this document
- an architecture-specific LSB specification

Conforming implementations may also support other unspecified object file formats.

11.2 Sections

11.2.1 Introduction

As described in System V ABI, an ELF object file contains a number of sections.

11.2.2 Sections Types

The section header table is an array of Elf32_Shdr or Elf64_Shdr structures as described in System V ABI. The sh_type member shall be either a value from Table 11-1, drawn from the System V ABI, or one of the additional values specified in Table 11-2.

A section header's sh_type member specifies the sections's semantics.

11.2.2.1 ELF Section Types

The following section types are defined in the System V ABI and the System V ABI Update.

Table 11-1 ELF Section Types

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHT_DYNAMIC</td>
<td>0x6</td>
<td>The section holds information for dynamic linking. Currently, an object file shall have only one dynamic section, but this restriction may be relaxed in the future. See 'Dynamic Section' in Chapter 5 for details.</td>
</tr>
<tr>
<td>SHT_DYNSYM</td>
<td>0xb</td>
<td>This section holds a minimal set of symbols adequate for dynamic linking. See also SHT_SYMTAB. Currently, an object file may have either a section of</td>
</tr>
<tr>
<td>Name</td>
<td>Value</td>
<td>Description</td>
</tr>
<tr>
<td>------------------</td>
<td>-------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SHT_SYMTAB</td>
<td></td>
<td>SHT_SYMTAB type or a section of SHT_DYNSYM type, but not both. This restriction may be relaxed in the future.</td>
</tr>
<tr>
<td>SHT_FINI_ARRAY</td>
<td>0xf</td>
<td>This section contains an array of pointers to termination functions, as described in 'Initialization and Termination Functions' in Chapter 5. Each pointer in the array is taken as a parameterless procedure with a void return.</td>
</tr>
<tr>
<td>SHT_HASH</td>
<td>0x5</td>
<td>The section holds a symbol hash table. Currently, an object file shall have only one hash table, but this restriction may be relaxed in the future. See `Hash Table' in the Chapter 5 for details.</td>
</tr>
<tr>
<td>SHT_INIT_ARRAY</td>
<td>0xe</td>
<td>This section contains an array of pointers to initialization functions, as described in 'Initialization and Termination Functions' in Chapter 5. Each pointer in the array is taken as a parameterless procedure with a void return.</td>
</tr>
<tr>
<td>SHT_NOBITS</td>
<td>0x8</td>
<td>A section of this type occupies no space in the file but otherwise resembles SHT_PROGBITS. Although this section contains no bytes, the sh_offset member contains the conceptual file offset.</td>
</tr>
<tr>
<td>SHT_NOTE</td>
<td>0x7</td>
<td>The section holds information that marks the file in some way. See `Note Section' in Chapter 5 for details.</td>
</tr>
<tr>
<td>Name</td>
<td>Value</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------</td>
<td>-------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SHT_NULL</td>
<td>0x0</td>
<td>This value marks the section header as inactive; it does not have an associated section. Other members of the section header have undefined values.</td>
</tr>
<tr>
<td>SHT_PREINIT_ARRAY</td>
<td>0x10</td>
<td>This section contains an array of pointers to functions that are invoked before all other initialization functions, as described in 'Initialization and Termination Functions' in Chapter 5. Each pointer in the array is taken as a parameterless procedure with a void return.</td>
</tr>
<tr>
<td>SHT_PROGBITS</td>
<td>0x1</td>
<td>The section holds information defined by the program, whose format and meaning are determined solely by the program.</td>
</tr>
<tr>
<td>SHT_REL</td>
<td>0x9</td>
<td>The section holds relocation entries without explicit addends, such as type Elf32_Rel for the 32-bit class of object files or type Elf64_Rel for the 64-bit class of object files. An object file may have multiple relocation sections. See &quot;Relocation&quot;</td>
</tr>
<tr>
<td>SHT_RELA</td>
<td>0x4</td>
<td>The section holds relocation entries with explicit addends, such as type Elf32_Rela for the 32-bit class of object files or type Elf64_Rela for the 64-bit class of object files. An object file may have multiple relocation sections. 'Relocation' b</td>
</tr>
<tr>
<td>SHT_STRTAB</td>
<td>0x3</td>
<td>The section holds a string table. An object file may have multiple string ta-</td>
</tr>
</tbody>
</table>
11 Object Format

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHT_SYMTAB</td>
<td>0x2</td>
<td>This section holds a symbol table. Currently, an object file may have either a section of SHT_SYMTAB type or a section of SHT_DYNSYM type, but not both. This restriction may be relaxed in the future. Typically, SHT_SYMTAB provides symbols for link editing, though it may also be used for dynamic linking. As a complete symbol table, it may contain many symbols unnecessary for dynamic linking.</td>
</tr>
</tbody>
</table>

11.2.2.2 Additional Section Types

The following additional section types are defined here.

Table 11-2 Additional Section Types

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SHT_GNU_verdef</td>
<td>0x6fffffff</td>
<td>This section contains the symbol versions that are provided.</td>
</tr>
<tr>
<td>SHT_GNU_verneed</td>
<td>0x6fffffff</td>
<td>This section contains the symbol versions that are required.</td>
</tr>
<tr>
<td>SHT_GNU_versym</td>
<td>0x6fffffff</td>
<td>This section contains the Symbol Version Table.</td>
</tr>
</tbody>
</table>

11.3 Special Sections

11.3.1 Special Sections

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

11.3.1.1 ELF Special Sections

The following sections are defined in the System V ABI and the System V ABI Update.
<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>.bss</td>
<td>SHT_NOBITS</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>.comment</td>
<td>SHT_PROGBITS</td>
<td>0</td>
</tr>
<tr>
<td>.data</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>.data1</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>.debug</td>
<td>SHT_PROGBITS</td>
<td>0</td>
</tr>
<tr>
<td>.dynamic</td>
<td>SHT_DYNSYM</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>.dynstr</td>
<td>SHT_STRTAB</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.dynsym</td>
<td>SHT_DYNSYM</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.fini</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC+SHF_EXE_CINSTR</td>
</tr>
<tr>
<td>.fini_array</td>
<td>SHT_INIT_ARRAY</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>.hash</td>
<td>SHT_HASH</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.init</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC+SHF_EXE_CINSTR</td>
</tr>
<tr>
<td>.init_array</td>
<td>SHT_FINI_ARRAY</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>.interp</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.line</td>
<td>SHT_PROGBITS</td>
<td>0</td>
</tr>
<tr>
<td>.note</td>
<td>SHT_NOTE</td>
<td>0</td>
</tr>
<tr>
<td>.preinit_array</td>
<td>SHT_PREINIT_ARRAY</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>.rodata</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.rodata1</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.shstrtab</td>
<td>SHT_STRTAB</td>
<td>0</td>
</tr>
<tr>
<td>.strtab</td>
<td>SHT_STRTAB</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.symtab</td>
<td>SHT_SYMTAB</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.tbss</td>
<td>SHT_NOBITS</td>
<td>SHF_ALLOC+SHF_WRITE+SHF_TLS</td>
</tr>
<tr>
<td>.tdata</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC+SHF_WRITE+SHF_TLS</td>
</tr>
</tbody>
</table>
11 Object Format

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>.text</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC+SHF_EXE</td>
</tr>
<tr>
<td>.bss</td>
<td></td>
<td>CINSTR</td>
</tr>
<tr>
<td>.comment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.data1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.debug</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.dynamic</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.dynstr</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.dynsym</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.fini</td>
<td></td>
<td></td>
</tr>
<tr>
<td>.fini_array</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

.bss
This section holds data that contributes to the program's memory image. The program may treat this data as uninitialized. However, the system shall initialize this data with zeroes when the program begins to run. The section occupies no file space, as indicated by the section type, SHT_NOBITS.

.comment
This section holds version control information.

.data
This section holds initialized data that contribute to the program's memory image.

.data1
This section holds initialized data that contribute to the program's memory image.

.debug
This section holds information for symbolic debugging. The contents are unspecified. All section names with the prefix .debug hold information for symbolic debugging. The contents of these sections are unspecified.

.dynamic
This section holds dynamic linking information. The section's attributes will include the SHF_ALLOC bit. Whether the SHF_WRITE bit is set is processor specific. See Chapter 5 for more information.

.dynstr
This section holds strings needed for dynamic linking, most commonly the strings that represent the names associated with symbol table entries. See Chapter 5 for more information.

.dynsym
This section holds the dynamic linking symbol table, as described in 'Symbol Table'. See Chapter 5 for more information.

.fini
This section holds executable instructions that contribute to the process termination code. That is, when a program exits normally, the system arranges to execute the code in this section.

.fini_array
This section holds an array of function pointers that contributes to a single termination array for the executable or shared object containing the section.
.hash
This section holds a symbol hash table. See `Hash Table' in Chapter 5 for more information.

.init
This section holds executable instructions that contribute to the process initialization code. When a program starts to run, the system arranges to execute the code in this section before calling the main program entry point (called main for C programs)

.init_array
This section holds an array of function pointers that contributes to a single initialization array for the executable or shared object containing the section.

.interp
This section holds the path name of a program interpreter. If the file has a loadable segment that includes relocation, the sections’ attributes will include the SHF_ALLOC bit; otherwise, that bit will be off. See Chapter 5 for more information.

.line
This section holds line number information for symbolic debugging, which describes the correspondence between the source program and the machine code. The contents are unspecified.

.note
This section holds information in the format that `Note Section' in Chapter 5 describes of the System V Application Binary Interface, Edition 4.1.

.preinit_array
This section holds an array of function pointers that contributes to a single pre-initialization array for the executable or shared object containing the section.

.rodata
This section holds read-only data that typically contribute to a non-writable segment in the process image. See `Program Header' in Chapter 5 for more information.

.rodata1
This section hold sread-only data that typically contribute to a non-writable segment in the process image. See `Program Header' in Chapter 5 for more information.

.shstrtab
This section holds section names.

.strtab
This section holds strings, most commonly the strings that represent the names associated with symbol table entries. If the file has a loadable segment that
includes the symbol string table, the section's attributes will include the SHF_ALLOC bit; otherwise, that bit will be off.

.symtab
This section holds a symbol table, as 'Symbol Table', in this chapter describes. If the file has a loadable segment that includes the symbol table, the section's attributes will include the SHF_ALLOC bit; otherwise, that bit will be off.

.tbss
This section holds uninitialized thread-local data that contribute to the program's memory image. By definition, the system initializes the data with zeros when the data is instantiated for each new execution flow. The section occupies no file space, as indicated by the section type, SHT_NOBITS. Implementations need not support thread-local storage.

t.data
This section holds initialized thread-local data that contributes to the program's memory image. A copy of its contents is instantiated by the system for each new execution flow. Implementations need not support thread-local storage.

text
This section holds the 'text,' or executable instructions, of a program.

11.3.1.2 Additional Special Sections
Object files in an LSB conforming application may also contain one or more of the additional special sections described below.

Table 11-4 Additional Special Sections

<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Attributes</th>
</tr>
</thead>
<tbody>
<tr>
<td>.ctors</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>.data.rel.ro</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>.dtors</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>.eh_frame</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.eh_frame_hdr</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.gcc_except_table</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.gnu.version</td>
<td>SHTGNU_versym</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.gnu.version_d</td>
<td>SHTGNU_verneed</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.gnu.version_r</td>
<td>SHTGNU_verneed</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.got.plt</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>.jcr</td>
<td>SHT_PROGBITS</td>
<td>SHF_ALLOC+SHF_WRITE</td>
</tr>
<tr>
<td>Name</td>
<td>Type</td>
<td>Attributes</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
<td>------------</td>
</tr>
<tr>
<td>.note.ABI-tag</td>
<td>SHT_NOTE</td>
<td>SHF_ALLOC</td>
</tr>
<tr>
<td>.stab</td>
<td>SHT_PROGBITS</td>
<td>0</td>
</tr>
<tr>
<td>.stabstr</td>
<td>SHT_STRTAB</td>
<td>0</td>
</tr>
</tbody>
</table>

.ctors

This section contains a list of global constructor function pointers.

data.rel.ro

This section holds initialized data that contribute to the program's memory image. This section may be made read-only after relocations have been applied.

dtors

This section contains a list of global destructor function pointers.
.eh_frame

This section contains information necessary for frame unwinding during exception handling.
.eh_frame_hdr

This section contains a pointer to the .eh_frame section which is accessible to the runtime support code of a C++ application. This section may also contain a binary search table which may be used by the runtime support code to more efficiently access records in the .eh_frame section.
.gcc_except_table

This section holds LSDA data.
.gnu.version

This section contains the Symbol Version Table.
.gnu.version_d

This section contains the Version Definitions.
.gnu.version_r

This section contains the Version Requirments.
.got.plt

This section holds the read-only portion of the Global Offset Table. This section may be made read-only after relocations have been applied.
.jcr

This section contains information necessary for registering compiled Java classes. The contents are compiler-specific and used by compiler initialization functions.

.note.ABI-tag

Specify ABI details.
11 Object Format

.stab
This section contains debugging information. The contents are not specified as part of the LSB.

.stabstr
This section contains strings associated with the debugging information contained in the .stab section.

11.4 Symbol Mapping

11.4.1 Introduction
Symbols in a source program are translated by the compilation system into symbols that exist in the object file.

11.4.1.1 C Language
External C symbols shall be unchanged in an object file's symbol table.

11.5 DWARF Extensions

The LSB does not specify debugging information, however, some additional sections contain information which is encoded using the the encoding as specified by DWARF Debugging Information Format, Revision 2.0.0 with extensions defined here.

Note: The extensions specified here also exist in DWARF Debugging Information Format, Revision 3.0.0 (Draft). It is expected that future versions of the LSB will reference the final version of that document, and that the definitions here will be taken from that document instead of being specified here.

11.5.1 DWARF Exception Header Encoding

The DWARF Exception Header Encoding is used to describe the type of data used in the .eh_frame and .eh_frame_hdr section. The upper 4 bits indicate how the value is to be applied. The lower 4 bits indicate the format of the data.

Table 11-5 DWARF Exception Header value format

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW_EH_PE_absptr</td>
<td>0x00</td>
<td>The Value is a literal pointer whose size is determined by the architecture.</td>
</tr>
<tr>
<td>DW_EH_PE_uleb128</td>
<td>0x01</td>
<td>Unsigned value is encoded using the Little Endian Base 128 (LEB128) as defined by DWARF Debugging Information Format, Revision 2.0.0.</td>
</tr>
<tr>
<td>DW_EH_PE_udata2</td>
<td>0x02</td>
<td>A 2 bytes unsigned value.</td>
</tr>
</tbody>
</table>
### DWARF Exception Header application

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW_EH_PE_udata4</td>
<td>0x03</td>
<td>A 4 bytes unsigned value.</td>
</tr>
<tr>
<td>DW_EH_PE_udata8</td>
<td>0x04</td>
<td>An 8 bytes unsigned value.</td>
</tr>
<tr>
<td>DW_EH_PE_sleb128</td>
<td>0x09</td>
<td>Signed value is encoded using the Little Endian Base 128 (LEB128) as defined by DWARF Debugging Information Format, Revision 2.0.0.</td>
</tr>
<tr>
<td>DW_EH_PE_sdata2</td>
<td>0x0A</td>
<td>A 2 bytes signed value.</td>
</tr>
<tr>
<td>DW_EH_PE_sdata4</td>
<td>0x0B</td>
<td>A 4 bytes signed value.</td>
</tr>
<tr>
<td>DW_EH_PE_sdata8</td>
<td>0x0C</td>
<td>An 8 bytes signed value.</td>
</tr>
</tbody>
</table>

### Table 11-6 DWARF Exception Header application

One special encoding, 0xff (DW_EH_PE_omit), shall be used to indicate that no value is present.

### 11.5.2 DWARF CFI Extensions

In addition to the Call Frame Instructions defined in section 6.4.2 of DWARF Debugging Information Format, Revision 2.0.0, the following additional Call Frame Instructions may also be used.

### Table 11-7 Additional DWARF Call Frame Instructions

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW_CFA_expression</td>
<td>0x10</td>
<td>The DW_CFA_expression</td>
</tr>
<tr>
<td>Name</td>
<td>Value</td>
<td>Meaning</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------</td>
<td>--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>DW_CFA_offset_extended_sf</td>
<td>0x11</td>
<td>The <code>DW_CFA_offset_extended_sf</code> instruction takes two operands: an unsigned LEB128 value representing a register number and a signed LEB128 factored offset. This instruction is identical to <code>DW_CFA_offset_extended</code> except that the second operand is signed.</td>
</tr>
<tr>
<td>DW_CFA_def_cfa_sf</td>
<td>0x12</td>
<td>The <code>DW_CFA_def_cfa_sf</code> instruction takes two operands: an unsigned LEB128 value representing a register number and a signed LEB128 factored offset.</td>
</tr>
</tbody>
</table>
11 Object Format

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>DW_CFA_def_cfa_offset _sf</td>
<td>0x13</td>
<td>This instruction is identical to DW_CFA_def_cfa except that the second operand is signed and factored.</td>
</tr>
<tr>
<td>DW_CFA_GNU_args_size</td>
<td>0x2e</td>
<td>The DW_CFA_GNU_args_size instruction takes an unsigned LEB128 operand representing an argument size. This instruction specifies the total of the size of the arguments which have been pushed onto the stack.</td>
</tr>
<tr>
<td>DW_CFA_GNU_negative_offset_extended</td>
<td>0x2f</td>
<td>The DW_CFA_def_cfa_sf instruction takes two operands: an unsigned LEB128 value representing a register number and an unsigned LEB128 which represents the magnitude of the offset. This instruction is identical to DW_CFA_offset_extended_sf except that the operand is subtracted to produce the offset. This instructions is obsoleted by DW_CFA_offset_extended_sf.</td>
</tr>
</tbody>
</table>

11.6 Exception Frames

When using languages that support exceptions, such as C++, additional information must be provided to the runtime environment that describes the call
frames that must be unwound during the processing of an exception. This information is contained in the special sections .eh_frame and .eh_framehdr.

Note: The format of the .eh_frame section is similar in format and purpose to the .debug_frame section which is specified in DWARF Debugging Information Format, Revision 3.0.0 (Draft). Readers are advised that there are some subtle difference, and care should be taken when comparing the two sections.

11.6.1 The .eh_frame section
The .eh_frame section shall contain 1 or more Call Frame Information (CFI) records. The number of records present shall be determined by size of the section as contained in the section header. Each CFI record contains a Common Information Entry (CIE) record followed by 1 or more Frame Description Entry (FDE) records. Both CIEs and FDEs shall be aligned to an addressing unit sized boundary.

Table 11-8 Call Frame Information Format

| Common Information Entry Record |
| Frame Description Entry Record(s) |

11.6.1.1 The Common Information Entry Format

Table 11-9 Common Information Entry Format

<table>
<thead>
<tr>
<th>Length</th>
<th>Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extended Length</td>
<td>Optional</td>
</tr>
<tr>
<td>CIE ID</td>
<td>Required</td>
</tr>
<tr>
<td>Version</td>
<td>Required</td>
</tr>
<tr>
<td>Augmentation String</td>
<td>Required</td>
</tr>
<tr>
<td>Code Alignment Factor</td>
<td>Required</td>
</tr>
<tr>
<td>Data Alignment Factor</td>
<td>Required</td>
</tr>
<tr>
<td>Return Address Register</td>
<td>Required</td>
</tr>
<tr>
<td>Augmentation Data Length</td>
<td>Optional</td>
</tr>
<tr>
<td>Augmentation Data</td>
<td>Optional</td>
</tr>
<tr>
<td>Initial Instructions</td>
<td>Required</td>
</tr>
<tr>
<td>Padding</td>
<td></td>
</tr>
</tbody>
</table>

Length
A 4 byte unsigned value indicating the length in bytes of the CIE structure, not including the Length field itself. If Length contains the value 0xffffffff, then the length is contained in the Extended Length field. If Length contains the value 0, then this CIE shall be considered a terminator and processing shall end.

Extended Length
A 8 byte unsigned value indicating the length in bytes of the CIE structure, not including the Length and Extended Length fields.
11 Object Format

CIE ID

A 4 byte unsigned value that is used to distinguish CIE records from FDE records. This value shall always be 0, which indicates this record is a CIE.

Version

A 1 byte value that identifies the version number of the frame information structure. This value shall be 1.

Augmentation String

This value is a NUL terminated string that identifies the augmentation to the CIE or to the FDEs associated with this CIE. A zero length string indicates that no augmentation data is present. The augmentation string is case sensitive and shall be interpreted as described below.

Code Alignment Factor

An unsigned LEB128 encoded value that is factored out of all advance location instructions that are associated with this CIE or its FDEs. This value shall be multiplied by the delta argument of an advance location instruction to obtain the new location value.

Data Alignment Factor

A signed LEB128 encoded value that is factored out of all offset instructions that are associated with this CIE or its FDEs. This value shall be multiplied by the register offset argument of an offset instruction to obtain the new offset value.

Augmentation Length

An unsigned LEB128 encoded value indicating the length in bytes of the Augmentation Data. This field is only present if the Augmentation String contains the character 'z'.

Augmentation Data

A block of data whose contents are defined by the contents of the Augmentation String as described below. This field is only present if the Augmentation String contains the character 'z'. The size of this data is given by the Augmentation Length.

Initial Instructions

Initial set of Call Frame Instructions. The number of instructions is determined by the remaining space in the CIE record.

Padding

Extra bytes to align the CIE structure to an addressing unit size boundary.

11.6.1.1 Augmentation String Format

The Augmentation String indicates the presence of some optional fields, and how those fields should be interpreted. This string is case sensitive. Each character in the augmentation string in the CIE can be interpreted as below:
'z'
A 'z' may be present as the first character of the string. If present, the Augmentation Data field shall be present. The contents of the Augmentation Data shall be interpreted according to other characters in the Augmentation String.

'L'
A 'L' may be present at any position after the first character of the string. This character may only be present if 'z' is the first character of the string. If present, it indicates the presence of one argument in the Augmentation Data of the CIE, and a corresponding argument in the Augmentation Data of the FDE. The argument in the Augmentation Data of the CIE is 1-byte and represents the pointer encoding used for the argument in the Augmentation Data of the FDE, which is the address of a language-specific data area (LSDA). The size of the LSDA pointer is specified by the pointer encoding used.

'P'
A 'P' may be present at any position after the first character of the string. This character may only be present if 'z' is the first character of the string. If present, it indicates the presence of two arguments in the Augmentation Data of the CIE. The first argument is 1-byte and represents the pointer encoding used for the second argument, which is the address of a personality routine handler. The personality routine is used to handle language and vendor-specific tasks. The system unwind library interface accesses the language-specific exception handling semantics via the pointer to the personality routine. The personality routine does not have an ABI-specific name. The size of the personality routine pointer is specified by the pointer encoding used.

'R'
A 'R' may be present at any position after the first character of the string. This character may only be present if 'z' is the first character of the string. If present, The Augmentation Data shall include a 1 byte argument that represents the pointer encoding for the address pointers used in the FDE.

11.6.1.2 The Frame Description Entry Format

Table 11-10 Frame Description Entry Format

<table>
<thead>
<tr>
<th>Field</th>
<th>Required/Optional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>Required</td>
</tr>
<tr>
<td>Extended Length</td>
<td>Optional</td>
</tr>
<tr>
<td>CIE Pointer</td>
<td>Required</td>
</tr>
<tr>
<td>PC Begin</td>
<td>Required</td>
</tr>
<tr>
<td>PC Range</td>
<td>Required</td>
</tr>
<tr>
<td>Augmentation Data Length</td>
<td>Optional</td>
</tr>
<tr>
<td>Augmentation Data</td>
<td>Optional</td>
</tr>
<tr>
<td>Call Frame Instructions</td>
<td>Required</td>
</tr>
<tr>
<td>Padding</td>
<td></td>
</tr>
</tbody>
</table>
Length
A 4 byte unsigned value indicating the length in bytes of the CIE structure, not including the Length field itself. If Length contains the value 0xffffffff, then the length is contained in the Extended Length field. If Length contains the value 0, then this CIE shall be considered a terminator and processing shall end.

Extended Length
A 8 byte unsigned value indicating the length in bytes of the CIE structure, not including the Length field itself.

CIE Pointer
A 4 byte unsigned value that when subtracted from the offset of the current FDE yields the offset of the start of the associated CIE. This value shall never be 0.

PC Begin
An encoded value that indicates the address of the initial location associated with this FDE. The encoding format is specified in the Augmentation Data.

PC Range
An absolute value that indicates the number of bytes of instructions associated with this FDE.

Augmentation Length
An unsigned LEB128 encoded value indicating the length in bytes of the Augmentation Data. This field is only present if the Augmentation String in the associated CIE contains the character 'z'.

Augmentation Data
A block of data whose contents are defined by the contents of the Augmentation String in the associated CIE as described above. This field is only present if the Augmentation String in the associated CIE contains the character 'z'. The size of this data is given by the Augmentation Length.

Call Frame Instructions
A set of Call Frame Instructions.

Padding
Extra bytes to align the FDE structure to an addressing unit size boundary.

11.6.2 The .eh_frame_hdr section
The .eh_frame_hdr section contains additional information about the .eh_frame section. A pointer to the start of the .eh_frame data, and optionally, a binary search table of pointers to the .eh_frame records are found in this section.

Data in this section is encoded according to Section 11.5.1.

Table 11-11 .eh_frame_hdr Section Format

<table>
<thead>
<tr>
<th>Encoding</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>unsigned byte</td>
<td>version</td>
</tr>
</tbody>
</table>
11 Object Format

<table>
<thead>
<tr>
<th>Encoding</th>
<th>Field</th>
</tr>
</thead>
<tbody>
<tr>
<td>unsigned byte</td>
<td>eh_frame_ptr_enc</td>
</tr>
<tr>
<td>unsigned byte</td>
<td>fde_count_enc</td>
</tr>
<tr>
<td>unsigned byte</td>
<td>table_enc</td>
</tr>
<tr>
<td>encoded</td>
<td>eh_frame_ptr</td>
</tr>
<tr>
<td>encoded</td>
<td>fde_count</td>
</tr>
<tr>
<td></td>
<td>binary search table</td>
</tr>
</tbody>
</table>

version

Version of the .eh_frame_hdr format. This value shall be 1.

eh_frame_ptr_enc

The encoding format of the eh_frame_ptr field.

fde_count_enc

The encoding format of the fde_count field. A value of DW_EH_PE_omit indicates the binary search table is not present.

table_enc

The encoding format of the entries in the binary search table. A value of DW_EH_PE_omit indicates the binary search table is not present.

eh_frame_ptr

The encoded value of the pointer to the start of the .eh_frame section.

fde_count

The encoded value of the count of entries in the binary search table.

binary search table

A binary search table containing fde_count entries. Each entry of the table consists of two encoded values, the initial location, and the address. The entries are sorted in an increasing order by the initial location value.

11.7 Symbol Versioning

11.7.1 Introduction

This chapter describes the Symbol Versioning mechanism. All ELF objects may provide or depend on versioned symbols. Symbol Versioning is implemented by 3 section types: SHT_GNU_versym, SHT_GNU_verdef, and SHT_GNU_verneed.

The prefix Elfxx in the following descriptions and code fragments stands for either "Elf32" or "Elf64", depending on the architecture.

Versions are described by strings. The structures that are used for symbol versions also contain a member that holds the ELF hashing values of the strings. This allows for more efficient processing.
11.7.2 Symbol Version Table

The special section `.gnu.version` which has a section type of SHT_GNU_versym shall contain the Symbol Version Table. This section shall have the same number of entries as the Dynamic Symbol Table in the .dynsym section.

The `.gnu.version` section shall contain an array of elements of type `Elfxx_Half`. Each entry specifies the version defined for or required by the corresponding symbol in the Dynamic Symbol Table.

The values in the Symbol Version Table are specific to the object in which they are located. These values are identifiers that are provided by the the `vna_other` member of the `Elfxx_Vernaux` structure or the `vd_ndx` member of the `Elfxx_Verdef` structure.

The values 0 and 1 are reserved.

0

The symbol is local, not available outside the object.

1

The symbol is defined in this object and is globally available.

All other values are used to identify version strings located in one of the other Symbol Version sections. The value itself is not the version associated with the symbol. The string identified by the value defines the version of the symbol.

11.7.3 Version Definitions

The special section `.gnu.version_d` which has a section type of SHT_GNU_verdef shall contain symbol version definitions. The number of entries in this section shall be contained in the `DT_VERDEFNUM` entry of the Dynamic Section `.dynamic`. The `sh_link` member of the section header (see figure 4-8 in the System V ABI) shall point to the section that contains the strings referenced by this section.

The section shall contain an array of `Elfxx_Verdef` structures, as described in Figure 11-1, optionally followed by an array of `Elfxx_Verdaux` structures, as defined in Figure 11-2.

```c
typedef struct {
    Elfxx_Half    vd_version;
    Elfxx_Half    vd_flags;
    Elfxx_Half    vd_ndx;
    Elfxx_Half    vd_cnt;
    Elfxx_Word    vd_hash;
    Elfxx_Word    vd_aux;
    Elfxx_Word    vd_next;
} Elfxx_Verdef;
```

**Figure 11-1 Version Definition Entries**

`vd_version`

Version revision. This field shall be set to 1.

`vd_flags`

Version information flag bitmask.
11 Object Format

vd_ndx
Version index numeric value referencing the SHT_GNU_versym section.

vd_cnt
Number of associated verdaux array entries.

vd_hash
Version name hash value (ELF hash function).

vd_aux
Offset in bytes to a corresponding entry in an array of Elfxx_Verdaux structures as defined in Figure 11-2

vd_next
Offset to the next verdef entry, in bytes.

typedef struct {
    Elfxx_Word vda_name;
    Elfxx_Word vda_next;
} Elfxx_Verdaux;

Figure 11-2 Version Definition Auxiliary Entries

vda_name
Offset to the version or dependency name string in the section header, in bytes.

vda_next
Offset to the next verdaux entry, in bytes.

11.7.4 Version Requirements
The special section .gnu.version_r which has a section type of SHT_GNU_verneed shall contain required symbol version definitions. The number of entries in this section shall be contained in the DT_VERNEEDNUM entry of the Dynamic Section .dynamic. The sh_link member of the section header (see figure 4-8 in System V ABI) shall point to the section that contains the strings referenced by this section.

The section shall contain an array of Elfxx_Verneed structures, as described in Figure 11-3, optionally followed by an array of Elfxx_Vernaux structures, as defined in Figure 11-4.

typedef struct {
    Elfxx_Half vn_version;
    Elfxx_Half vn_cnt;
    Elfxx_Word vn_file;
    Elfxx_Word vn_aux;
    Elfxx_Word vn_next;
} Elfxx_Verneed;

Figure 11-3 Version Needed Entries

vn_version
Version of structure. This value is currently set to 1, and will be reset if the versioning implementation is incompatibly altered.
vn_cnt
   Number of associated verneed array entries.

vn_file
   Offset to the file name string in the section header, in bytes.

vn_aux
   Offset to a corresponding entry in the vernaux array, in bytes.

vn_next
   Offset to the next verneed entry, in bytes.

typedef struct {
    Elfxx_Word    vna_hash;
    Elfxx_Half    vna_flags;
    Elfxx_Half    vna_other;
    Elfxx_Word    vna_name;
    Elfxx_Word    vna_next;
} Elfxx_Vernaux;

Figure 11-4 Version Needed Auxiliary Entries

vna_hash
   Dependency name hash value (ELF hash function).

vna_flags
   Dependency information flag bitmask.

vna_other
   Object file version identifier used in the .gnu.version symbol version array. Bit number 15 controls whether or not the object is hidden; if this bit is set, the object cannot be used and the static linker will ignore the symbol's presence in the object.

vna_name
   Offset to the dependency name string in the section header, in bytes.

vna_next
   Offset to the next vernaux entry, in bytes.

11.7.5 Startup Sequence

When loading a sharable object the system shall analyze version definition data from the loaded object to assure that it meets the version requirements of the calling object. This step is referred to as definition testing. The dynamic loader shall retrieve the entries in the caller's Elfxx_Verneed array and attempt to find matching definition information in the loaded Elfxx_Verdef table.

Each object and dependency shall be tested in turn. If a symbol definition is missing and the vna_flags bit for VER_FLG_WEAK is not set, the loader shall return an error and exit. If the vna_flags bit for VER_FLG_WEAK is set in the Elfxx_Vernaux entry, and the loader shall issue a warning and continue operation.
When the versions referenced by undefined symbols in the loaded object are found, version availability is certified. The test completes without error and the object shall be made available.

### 11.7.6 Symbol Resolution

When symbol versioning is used in an object, relocations extend definition testing beyond the simple match of symbol name strings: the version of the reference shall also equal the name of the definition.

The same index that is used in the symbol table can be referenced in the SHT_GNU_versym section, and the value of this index is then used to acquire name data. The corresponding requirement string is retrieved from the Elfxx_Verneed array, and likewise, the corresponding definition string from the Elfxx_Verdef table.

If the high order bit (bit number 15) of the version symbol is set, the object cannot be used and the static linker shall ignore the symbol's presence in the object.

When an object with a reference and an object with the definition are being linked, the following rules shall govern the result:

- The object with the reference and the object with the definitions both use versioning. All described matching is processed in this case. A fatal error shall be triggered when no matching definition can be found in the object whose name is the one referenced by the vn_name element in the Elfxx_Verneed entry.
- The object with the reference does not use versioning, while the object with the definitions does. In this instance, only the definitions with index numbers 1 and 2 will be used in the reference match, the same identified by the static linker as the base definition. In cases where the static linker was not used, such as in calls to dlopen(), a version that does not have the base definition index shall be acceptable if it is the only version for which the symbol is defined.
- The object with the reference uses versioning, but the object with the definitions specifies none. A matching symbol shall be accepted in this case. A fatal error shall be triggered if a corruption in the required symbols list obscures an outdated object file and causes a match on the object filename in the Elfxx_Verneed entry.
- Neither the object with the reference nor the object with the definitions use versioning. The behavior in this instance shall default to pre-existing symbol rules.

### 11.8 ABI note tag

Every executable shall contain a section named .note.ABI-tag of type SHT_NOTE. This section is structured as a note section as documented in the ELF spec. The section shall contain at least the following entry. The name field (namesz/name) contains the string "GNU". The type field shall be 1. The descsz field shall be at least 16, and the first 16 bytes of the desc field shall be as follows.

The first 32-bit word of the desc field shall be 0 (this signifies a Linux executable). The second, third, and fourth 32-bit words of the desc field contain the earliest compatible kernel version. For example, if the 3 words are 2, 2, and 5, this signifies a 2.2.5 kernel.
12 Dynamic Linking

12.1 Program Loading and Dynamic Linking

LSB-conforming implementations shall support the object file information and system actions that create running programs as specified in the System V ABI and System V ABI Update and as supplemented by this document and an architecture-specific LSB specification.

Any shared object that is loaded shall contain sufficient DT_NEEDED records to satisfy the symbols on the shared library.

12.2 Program Header

In addition to the Segment Types defined in the System V ABI and System V ABI Update the following Segment Types shall also be supported.

<table>
<thead>
<tr>
<th>Table 12-1 Linux Segment Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>PT_GNU_EH_FRAME</td>
</tr>
<tr>
<td>PT_GNU_STACK</td>
</tr>
<tr>
<td>PT_GNU_RELRO</td>
</tr>
</tbody>
</table>

PT_GNU_EH_FRAME

The array element specifies the location and size of the exception handling information as defined by the .eh_frame_hdr section.

PT_GNU_STACK

The p_flags member specifies the permissions on the segment containing the stack and is used to indicate whether the stack should be executable. The absence of this header indicates that the stack will be executable.

PT_GNU_RELRO

The array element specifies the location and size of a segment which may be made read-only after relocation phase has been processed.

12.3 Dynamic Entries

12.3.1 Introduction

As described in System V ABI, if an object file participates in dynamic linking, its program header table shall have an element of type PT_DYNAMIC. This segment contains the .dynamic section. A special symbol, _DYNAMIC, labels the section, which contains an array of the following structures.

```c
typedef struct {
    Elf32_Word     d_tag;
    union {
        Elf32_Word     d_val;
        Elf32_Addr     d_ptr;
    } d_un;
} Elf32_Dyn;
```
12 Dynamic Linking

extern Elf32_Dyn        _DYNAMIC[];

typedef struct {
    Elf64_Sxword    d_tag;
    union {
        Elf64_Xword     d_val;
        Elf64_Addr      d_ptr;
    } d_un;
} Elf64_Dyn;

extern Elf64_Dyn        _DYNAMIC[];

Figure 12-1 Dynamic Structure

For each object with this type, \texttt{d\_tag} controls the interpretation of \texttt{d\_un}.

12.3.2 Dynamic Entries

12.3.2.1 ELF Dynamic Entries

The following dynamic entries are defined in the System V ABI and System V ABI Update.

\texttt{DT\_BIND\_NOW}

Process relocations of object

\texttt{DT\_DEBUG}

For debugging; unspecified

\texttt{DT\_FINI}

Address of termination function

\texttt{DT\_HASH}

Address of symbol hash table

\texttt{DT\_HIPROC}

End of processor-specific

\texttt{DT\_INIT}

Address of init function

\texttt{DT\_JMPREL}

Address of PLT relocations

\texttt{DT\_LOPROC}

Start of processor-specific

\texttt{DT\_NEEDED}

Name of needed library

\texttt{DT\_NULL}

Marks end of dynamic section
DT_PLTREL
    Type of reloc in PLT

DT_PLTRELSZ
    Size in bytes of PLT relocations

DT_REL
    Address of Rel relocations

DT_RELA
    Address of Rela relocations

DT_RELAENT
    Size of one Rela reloc

DT_RELASZ
    Total size of Rela relocations

DT_RELENT
    Size of one Rel reloc

DT_RELSZ
    Total size of Rel relocations

DT_RPATH
    Library search path

DT_SONAME
    Name of shared object

DT_STRSZ
    Size of string table

DT_STRTAB
    Address of string table

DT_SYMBOLIC
    Start symbol search here

DT_SYMENT
    Size of one symbol table entry

DT_SYMTAB
    Address of symbol table

DT_TEXTREL
    Reloc might modify .text
12.3.2.2 Additional Dynamic Entries

An LSB conforming object may also use the following additional Dynamic Entry types.

**DT_ADDRRNGHI**
Values from DT_ADDRRNGLO through DT_ADDRRNGHI are reserved for definition by an archLSB.

**DT_ADDRRNGLO**
Values from DT_ADDRRNGLO through DT_ADDRRNGHI are reserved for definition by an archLSB.

**DT_AUXILIARY**
Shared object to load before self

**DT_FILTER**
Shared object to get values from

**DT_FINI_ARRAY**
The address of an array of pointers to termination functions.

**DT_FINI_ARRAYSZ**
Size in bytes of DT_FINI_ARRAY

**DT_HIOS**
Values from DT_LOOS through DT_HIOS are reserved for definition by specific operating systems.

**DT_INIT_ARRAY**
The address of an array of pointers to initialization functions.

**DT_INIT_ARRAYSZ**
Size in bytes of DT_INIT_ARRAY

**DT_LOOS**
Values from DT_LOOS through DT_HIOS are reserved for definition by specific operating systems.

**DT_NUM**
Number of dynamic entry tags defined (excepting reserved ranges).

**DT_POSFLAG_1**
Flags for DT_* entries, effecting the following DT_* entry

**DT_RELCOUNT**
All Elf32_Rel R_*_RELATIVE relocations have been placed into a single block and this entry specifies the number of entries in that block. This permits ld.so.1 to streamline the processing of RELATIVE relocations.
DT_RUNPATH
    null-terminated library search path string

DT_SYMINENT
    Entry size of syminfo

DT_SYMINFO
    Address of the Syminfo table.

DT_SYMINSZ
    Size of syminfo table (in bytes)

DT_VALRNGHI
    Entries which fall between DT_VALRNGHI & DT_VALRNGLO use the

DT_VALRNGLO
    Entries which fall between DT_VALRNGHI & DT_VALRNGLO use the

DT_VERDEF
    Address of version definition table

DT_VERDEFNUM
    Number of version definitions

DT_VERNEED
    Address of table with needed versions

DT_VERNEEDNUM
    Number of needed versions

DT_VERSYM
    Address of the table provided by the .gnu.version section.
13 Base Libraries

13.1 Introduction

An LSB-conforming implementation shall support the following base libraries which provide interfaces for accessing the operating system, processor and other hardware in the system.

- libc
- libm
- libgcc_s
- libdl
- librt
- libcrypt
- libpam

13.2 Program Interpreter

The Program Interpreter is specified in the appropriate architecture-specific LSB specification.

13.3 Interfaces for libc

Table 13-1 defines the library name and shared object name for the libc library

<table>
<thead>
<tr>
<th>Library:</th>
<th>libc</th>
</tr>
</thead>
<tbody>
<tr>
<td>SONAME:</td>
<td>See archLSB.</td>
</tr>
</tbody>
</table>

The behavior of the interfaces in this library is specified by the following specifications:

- Large File Support
- this specification
- SUSv2
- SVID Issue 3
- SVID Issue 4

13.3.1 RPC

13.3.1.1 Interfaces for RPC

An LSB conforming implementation shall provide the generic functions for RPC specified in Table 13-2, with the full mandatory functionality as described in the referenced underlying specification.

|---------------------|-------------------|-------------------|-------------|----------------|

52
13 Base Libraries

|-----------------|------------------|------------------------|--------------|-----------------|

Referenced Specification(s)

[1]. SVID Issue 4
[2]. SVID Issue 3
[3]. this specification

13.3.2 System Calls

13.3.2.1 Interfaces for System Calls

An LSB conforming implementation shall provide the generic functions for System Calls specified in Table 13-3, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-3 libc - System Calls Function Interfaces

## 13 Base Libraries

<table>
<thead>
<tr>
<th>Function</th>
<th>References</th>
</tr>
</thead>
</table>

*Referenced Specification(s)*

[1]. this specification
[3]. Large File Support
[4]. SUSv2
13.3.3 Standard I/O

13.3.3.1 Interfaces for Standard I/O

An LSB conforming implementation shall provide the generic functions for Standard I/O specified in Table 13-4, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-4 libc - Standard I/O Function Interfaces

<table>
<thead>
<tr>
<th>_IO_f_eof</th>
<th>fgetpos</th>
<th>fsetpos</th>
<th>putchar</th>
<th>sscanf</th>
</tr>
</thead>
<tbody>
<tr>
<td>_IO_getc</td>
<td>fgets</td>
<td>ftell</td>
<td>putchar_unlocked</td>
<td>tello</td>
</tr>
<tr>
<td>_IO_putc</td>
<td>fgetwc_unlocked</td>
<td>ftello</td>
<td>puts</td>
<td>tempnam</td>
</tr>
<tr>
<td>_IO_puts</td>
<td>fileno</td>
<td>fwrite</td>
<td>putw</td>
<td>ungetc</td>
</tr>
<tr>
<td>asprintf</td>
<td>flockfile</td>
<td>getc</td>
<td>remove</td>
<td>vasprintf</td>
</tr>
<tr>
<td>clearerr</td>
<td>fopen</td>
<td>getc_unlocked</td>
<td>rewind</td>
<td>vfprintf</td>
</tr>
<tr>
<td>ctermid</td>
<td>fprintf</td>
<td>getchar</td>
<td>rewinddir</td>
<td>vfprintf</td>
</tr>
<tr>
<td>fclose</td>
<td>fputc</td>
<td>getchar_unlocked</td>
<td>scanf</td>
<td>vprintf</td>
</tr>
<tr>
<td>fdopen</td>
<td>fputs</td>
<td>getw</td>
<td>seekdir</td>
<td>vsnprintf</td>
</tr>
<tr>
<td>feof</td>
<td>fread</td>
<td>pclose</td>
<td>setbuf</td>
<td>vsprintf</td>
</tr>
<tr>
<td>ferror</td>
<td>freopen</td>
<td>popen</td>
<td>setbuffer</td>
<td>vfprintf</td>
</tr>
<tr>
<td>fflush</td>
<td>fscanf</td>
<td>printf</td>
<td>setvbuf</td>
<td>vsprintf</td>
</tr>
<tr>
<td>fflush_unlocked</td>
<td>fseek</td>
<td>putc</td>
<td>snprintf</td>
<td>vsprintf</td>
</tr>
<tr>
<td>fgetc</td>
<td>fseeko</td>
<td>putchar_unlocked</td>
<td>sprintf</td>
<td></td>
</tr>
</tbody>
</table>

Referenced Specification(s)

[1]. this specification
[3]. SUSv2

An LSB conforming implementation shall provide the generic data interfaces for Standard I/O specified in Table 13-5, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-5 libc - Standard I/O Data Interfaces

| stderr | stdin | stdout |

Referenced Specification(s)

13.3.4 Signal Handling

13.3.4.1 Interfaces for Signal Handling
An LSB conforming implementation shall provide the generic functions for Signal Handling specified in Table 13-6, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-6 libc - Signal Handling Function Interfaces

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>__libc_current</td>
<td>sigaction [2]</td>
</tr>
<tr>
<td>__libc_current sigrtmax</td>
<td>sighold [2]</td>
</tr>
<tr>
<td>__libc_current sigrtmin</td>
<td>sigorset [1]</td>
</tr>
<tr>
<td>__libc_current sigsetjmp</td>
<td>sigset [2]</td>
</tr>
<tr>
<td>__sysv_signal</td>
<td>sigaddset [2]</td>
</tr>
<tr>
<td>__sysv_signal sigaltstack</td>
<td>sigignore [2]</td>
</tr>
<tr>
<td>__sysv_signal siginterrpt</td>
<td>sigpause [2]</td>
</tr>
<tr>
<td>__sysv_signal sigpending</td>
<td>sigsuspend [2]</td>
</tr>
<tr>
<td>__sysv_signal sigsetjmp</td>
<td>sigsetjmp [1]</td>
</tr>
<tr>
<td>bsd_signal</td>
<td>sigdelset [2]</td>
</tr>
<tr>
<td>bsd_signal sigemptyset</td>
<td>sigismember [1]</td>
</tr>
<tr>
<td>bsd_signal siginterrupt</td>
<td>sigprocmask [2]</td>
</tr>
<tr>
<td>psignal</td>
<td>sigqueue [2]</td>
</tr>
<tr>
<td>psignal siglongjmp</td>
<td>sigwait [2]</td>
</tr>
<tr>
<td>psignal siglongjmp sigrelse</td>
<td>sigwaitinfo [2]</td>
</tr>
<tr>
<td>psignal raise</td>
<td>sigfillset [2]</td>
</tr>
<tr>
<td>psignal sigreturn</td>
<td>signal [2]</td>
</tr>
<tr>
<td>psignal sigreturn sigreturn</td>
<td>sigreturn [1]</td>
</tr>
</tbody>
</table>

Referenced Specification(s)
[1]. this specification

An LSB conforming implementation shall provide the generic data interfaces for Signal Handling specified in Table 13-7, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-7 libc - Signal Handling Data Interfaces

<table>
<thead>
<tr>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>_sys_siglist</td>
</tr>
</tbody>
</table>

Referenced Specification(s)
[1]. this specification

13.3.5 Localization Functions

13.3.5.1 Interfaces for Localization Functions
An LSB conforming implementation shall provide the generic functions for Localization Functions specified in Table 13-8, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-8 libc - Localization Functions Function Interfaces

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>bind_textdomain</td>
<td>dcgettext [1]</td>
</tr>
<tr>
<td>bind_textdomain freemocale(GLI localeconv)</td>
<td>localeconv [2]</td>
</tr>
<tr>
<td>bind_textdomain textdomain</td>
<td>textdomain</td>
</tr>
</tbody>
</table>
13 Base Libraries

<table>
<thead>
<tr>
<th>aincodeset [1]</th>
<th>BC_2.3) [1]</th>
<th>[1]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>newlocale(GLIBC_2.3) [1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>uselocale(GLIBC_2.3) [1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ngettext [1]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>nl_langinfo [2]</td>
</tr>
<tr>
<td></td>
<td></td>
<td>setlocale [2]</td>
</tr>
</tbody>
</table>

Referenced Specification(s)
[1]. this specification

An LSB conforming implementation shall provide the generic data interfaces for Localization Functions specified in Table 13-9, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-9 libc - Localization Functions Data Interfaces

| __nl_msg_catcnter [1] | | |

Referenced Specification(s)
[1]. this specification

13.3.6 Socket Interface

13.3.6.1 Interfaces for Socket Interface

An LSB conforming implementation shall provide the generic functions for Socket Interface specified in Table 13-10, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-10 libc - Socket Interface Function Interfaces

|------------------------|-----------------|--------------------|---------|-----------|
13.3.7 Wide Characters

13.3.7.1 Interfaces for Wide Characters

An LSB conforming implementation shall provide the generic functions for Wide Characters specified in Table 13-11, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-11 libc - Wide Characters Function Interfaces

|-----------------------|-------------|-------------|--------------|--------------|

Referenced Specification(s)

[1], this specification
13.3.8 String Functions

13.3.8.1 Interfaces for String Functions

An LSB conforming implementation shall provide the generic functions for String Functions specified in Table 13-12, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-12 libc - String Functions Function Interfaces

<table>
<thead>
<tr>
<th>Function</th>
<th>Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>__mempcpy</td>
<td>bzero [2]</td>
</tr>
<tr>
<td>__memcpy_r</td>
<td>ffs [2]</td>
</tr>
<tr>
<td>__strncpy</td>
<td>index [2]</td>
</tr>
<tr>
<td>__strdup</td>
<td>memccpy [2]</td>
</tr>
<tr>
<td>__strtok_r</td>
<td>memcpy [2]</td>
</tr>
<tr>
<td>__memchr</td>
<td>ffs [2]</td>
</tr>
<tr>
<td>__strchr</td>
<td>index [2]</td>
</tr>
<tr>
<td>__stpcpy</td>
<td>memchr [2]</td>
</tr>
<tr>
<td>__strdup</td>
<td>memccpy [2]</td>
</tr>
<tr>
<td>__strtok_r</td>
<td>memcpy [2]</td>
</tr>
<tr>
<td>__memchr</td>
<td>ffs [2]</td>
</tr>
<tr>
<td>__strchr</td>
<td>index [2]</td>
</tr>
<tr>
<td>__stpcpy</td>
<td>memchr [2]</td>
</tr>
<tr>
<td>__strdup</td>
<td>memccpy [2]</td>
</tr>
<tr>
<td>__strtok_r</td>
<td>memcpy [2]</td>
</tr>
<tr>
<td>__memchr</td>
<td>ffs [2]</td>
</tr>
<tr>
<td>__strchr</td>
<td>index [2]</td>
</tr>
<tr>
<td>__stpcpy</td>
<td>memchr [2]</td>
</tr>
<tr>
<td>__strdup</td>
<td>memccpy [2]</td>
</tr>
<tr>
<td>__strtok_r</td>
<td>memcpy [2]</td>
</tr>
<tr>
<td>__memchr</td>
<td>ffs [2]</td>
</tr>
<tr>
<td>__strchr</td>
<td>index [2]</td>
</tr>
<tr>
<td>__stpcpy</td>
<td>memchr [2]</td>
</tr>
<tr>
<td>__strdup</td>
<td>memccpy [2]</td>
</tr>
<tr>
<td>__strtok_r</td>
<td>memcpy [2]</td>
</tr>
<tr>
<td>__memchr</td>
<td>ffs [2]</td>
</tr>
<tr>
<td>__strchr</td>
<td>index [2]</td>
</tr>
<tr>
<td>__stpcpy</td>
<td>memchr [2]</td>
</tr>
<tr>
<td>__strdup</td>
<td>memccpy [2]</td>
</tr>
<tr>
<td>__strtok_r</td>
<td>memcpy [2]</td>
</tr>
<tr>
<td>__memchr</td>
<td>ffs [2]</td>
</tr>
<tr>
<td>__strchr</td>
<td>index [2]</td>
</tr>
<tr>
<td>__stpcpy</td>
<td>memchr [2]</td>
</tr>
<tr>
<td>__strdup</td>
<td>memccpy [2]</td>
</tr>
<tr>
<td>__strtok_r</td>
<td>memcpy [2]</td>
</tr>
<tr>
<td>__memchr</td>
<td>ffs [2]</td>
</tr>
<tr>
<td>__strchr</td>
<td>index [2]</td>
</tr>
<tr>
<td>__stpcpy</td>
<td>memchr [2]</td>
</tr>
<tr>
<td>__strdup</td>
<td>memccpy [2]</td>
</tr>
<tr>
<td>__strtok_r</td>
<td>memcpy [2]</td>
</tr>
<tr>
<td>__memchr</td>
<td>ffs [2]</td>
</tr>
<tr>
<td>__strchr</td>
<td>index [2]</td>
</tr>
<tr>
<td>__stpcpy</td>
<td>memchr [2]</td>
</tr>
<tr>
<td>__strdup</td>
<td>memccpy [2]</td>
</tr>
<tr>
<td>__strtok_r</td>
<td>memcpy [2]</td>
</tr>
<tr>
<td>__memchr</td>
<td>ffs [2]</td>
</tr>
<tr>
<td>__strchr</td>
<td>index [2]</td>
</tr>
<tr>
<td>__stpcpy</td>
<td>memchr [2]</td>
</tr>
<tr>
<td>__strdup</td>
<td>memccpy [2]</td>
</tr>
<tr>
<td>__strtok_r</td>
<td>memcpy [2]</td>
</tr>
</tbody>
</table>

Referenced Specification(s)

[1]. this specification
### 13.3.9 IPC Functions

#### 13.3.9.1 Interfaces for IPC Functions

An LSB conforming implementation shall provide the generic functions for IPC Functions specified in Table 13-13, with the full mandatory functionality as described in the referenced underlying specification.

<table>
<thead>
<tr>
<th>Function Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>ftok [1]</td>
</tr>
<tr>
<td>msgrcv [1]</td>
</tr>
<tr>
<td>semget [1]</td>
</tr>
<tr>
<td>shmctl [1]</td>
</tr>
<tr>
<td>msgctl [1]</td>
</tr>
<tr>
<td>msgsnd [1]</td>
</tr>
<tr>
<td>semop [1]</td>
</tr>
<tr>
<td>shmdt [1]</td>
</tr>
<tr>
<td>msgget [1]</td>
</tr>
<tr>
<td>semctl [1]</td>
</tr>
<tr>
<td>shmat [1]</td>
</tr>
<tr>
<td>shmget [1]</td>
</tr>
</tbody>
</table>

Referenced Specification(s)


### 13.3.10 Regular Expressions

#### 13.3.10.1 Interfaces for Regular Expressions

An LSB conforming implementation shall provide the generic functions for Regular Expressions specified in Table 13-14, with the full mandatory functionality as described in the referenced underlying specification.

<table>
<thead>
<tr>
<th>Function Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>regcomp [1]</td>
</tr>
<tr>
<td>regerror [1]</td>
</tr>
<tr>
<td>regexec [2]</td>
</tr>
<tr>
<td>regfree [1]</td>
</tr>
</tbody>
</table>

Referenced Specification(s)


[2]. This specification

### 13.3.11 Character Type Functions

#### 13.3.11.1 Interfaces for Character Type Functions

An LSB conforming implementation shall provide the generic functions for Character Type Functions specified in Table 13-15, with the full mandatory functionality as described in the referenced underlying specification.

<table>
<thead>
<tr>
<th>Function Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>__ctype_b_loc (GLIBC_2.3) [1]</td>
</tr>
<tr>
<td>isalpha [2]</td>
</tr>
<tr>
<td>ispunct [2]</td>
</tr>
<tr>
<td>iswctype [2]</td>
</tr>
<tr>
<td>iswupper [2]</td>
</tr>
<tr>
<td>__ctype_get_mb_cur_max [1]</td>
</tr>
<tr>
<td>isascii [2]</td>
</tr>
<tr>
<td>isspace [2]</td>
</tr>
<tr>
<td>isxdigit [2]</td>
</tr>
<tr>
<td>iswxdigit [2]</td>
</tr>
<tr>
<td>__ctype_tolower_loc(GLIBC_2.3) [1]</td>
</tr>
<tr>
<td>iscntrl [2]</td>
</tr>
<tr>
<td>isupper [2]</td>
</tr>
<tr>
<td>iswgraph [2]</td>
</tr>
<tr>
<td>isxdigit [2]</td>
</tr>
</tbody>
</table>
13 Base Libraries

__ctype_toup
per_loc(GLIB
C_2.3) [1]


Referenced Specification(s)
[1]. this specification

13.3.12 Time Manipulation

13.3.12.1 Interfaces for Time Manipulation

An LSB conforming implementation shall provide the generic functions for Time Manipulation specified in Table 13-16, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-16 libc - Time Manipulation Function Interfaces

|------------|----------|-----------|------------------|-----------|

Referenced Specification(s)
[1]. this specification

An LSB conforming implementation shall provide the generic data interfaces for Time Manipulation specified in Table 13-17, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-17 libc - Time Manipulation Data Interfaces

|----------------|--------------|--------------|

Referenced Specification(s)
[1]. this specification
13 Base Libraries

13.3.13 Terminal Interface Functions

13.3.13.1 Interfaces for Terminal Interface Functions

An LSB conforming implementation shall provide the generic functions for Terminal Interface Functions specified in Table 13-18, with the full mandatory functionality as described in the referenced underlying specification.

<table>
<thead>
<tr>
<th>Function Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfgetispeed</td>
</tr>
<tr>
<td>cfsetispeed</td>
</tr>
<tr>
<td>tcdrain</td>
</tr>
<tr>
<td>tcgetattr</td>
</tr>
<tr>
<td>tcsendbreak</td>
</tr>
<tr>
<td>cfgetospeed</td>
</tr>
<tr>
<td>cfsetospeed</td>
</tr>
<tr>
<td>tcflow</td>
</tr>
<tr>
<td>tcgetpgrp</td>
</tr>
<tr>
<td>tcsetattr</td>
</tr>
<tr>
<td>cfmakeraw</td>
</tr>
<tr>
<td>cfsetspeed</td>
</tr>
<tr>
<td>tcflush</td>
</tr>
<tr>
<td>tcgetsid</td>
</tr>
<tr>
<td>tcsetpgrp</td>
</tr>
</tbody>
</table>

Referenced Specification(s)
[2]. this specification

13.3.14 System Database Interface

13.3.14.1 Interfaces for System Database Interface

An LSB conforming implementation shall provide the generic functions for System Database Interface specified in Table 13-19, with the full mandatory functionality as described in the referenced underlying specification.

<table>
<thead>
<tr>
<th>Function Interfaces</th>
</tr>
</thead>
<tbody>
<tr>
<td>endgrent</td>
</tr>
<tr>
<td>getgrgid_r</td>
</tr>
<tr>
<td>getprotoent</td>
</tr>
<tr>
<td>getservent</td>
</tr>
<tr>
<td>setgroups</td>
</tr>
<tr>
<td>endprotoent</td>
</tr>
<tr>
<td>getgrnam</td>
</tr>
<tr>
<td>getpwent</td>
</tr>
<tr>
<td>getutent</td>
</tr>
<tr>
<td>setprotoent</td>
</tr>
<tr>
<td>endpwent</td>
</tr>
<tr>
<td>getgrnam_r</td>
</tr>
<tr>
<td>getpwnam</td>
</tr>
<tr>
<td>getutent_r</td>
</tr>
<tr>
<td>setpwent</td>
</tr>
<tr>
<td>endservent</td>
</tr>
<tr>
<td>getgrouplist</td>
</tr>
<tr>
<td>getpwnam_r</td>
</tr>
<tr>
<td>getutxent</td>
</tr>
<tr>
<td>setservent</td>
</tr>
<tr>
<td>endutent</td>
</tr>
<tr>
<td>gethostbyaddr</td>
</tr>
<tr>
<td>getpwuid</td>
</tr>
<tr>
<td>getutxid</td>
</tr>
<tr>
<td>setutent</td>
</tr>
<tr>
<td>endutxent</td>
</tr>
<tr>
<td>gethostbyname</td>
</tr>
<tr>
<td>getpwuid_r</td>
</tr>
<tr>
<td>getutxline</td>
</tr>
<tr>
<td>setutxent</td>
</tr>
<tr>
<td>getgrent</td>
</tr>
<tr>
<td>getprotobynumber</td>
</tr>
<tr>
<td>getservbyname</td>
</tr>
<tr>
<td>pututxline</td>
</tr>
<tr>
<td>utmpname</td>
</tr>
<tr>
<td>getgrgid</td>
</tr>
<tr>
<td>getprotobynumber</td>
</tr>
<tr>
<td>getservbyport</td>
</tr>
<tr>
<td>setgrent</td>
</tr>
</tbody>
</table>

Referenced Specification(s)
13.3.15 Language Support

13.3.15.1 Interfaces for Language Support

An LSB conforming implementation shall provide the generic functions for Language Support specified in Table 13-20, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-20 libc - Language Support Function Interfaces

| __libc_start_main [1] | __register_atfork(GLIBC_2.3.2) [1] |

Referenced Specification(s)

[1]. this specification

13.3.16 Large File Support

13.3.16.1 Interfaces for Large File Support

An LSB conforming implementation shall provide the generic functions for Large File Support specified in Table 13-21, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-21 libc - Large File Support Function Interfaces


Referenced Specification(s)

[1]. this specification

[2]. Large File Support

13.3.17 Standard Library

13.3.17.1 Interfaces for Standard Library

An LSB conforming implementation shall provide the generic functions for Standard Library specified in Table 13-22, with the full mandatory functionality as described in the referenced underlying specification.
### Table 13-22 libc - Standard Library Function Interfaces

<table>
<thead>
<tr>
<th>Function</th>
<th>Allocator</th>
<th>Srand</th>
<th>Gettimeofday</th>
<th>Lrand48</th>
<th>Srand48</th>
</tr>
</thead>
<tbody>
<tr>
<td>_Exit</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>__assert_fail</td>
<td>div</td>
<td>glob</td>
<td>lsearch</td>
<td></td>
<td></td>
</tr>
<tr>
<td>__cxa_atexit</td>
<td>drand48</td>
<td>glob64</td>
<td>makecontext</td>
<td></td>
<td></td>
</tr>
<tr>
<td>__errno_location</td>
<td>ecvt</td>
<td>globfree</td>
<td>malloc</td>
<td>strtod</td>
<td></td>
</tr>
<tr>
<td>__fpending</td>
<td>erand48</td>
<td>globfree64</td>
<td>memmem</td>
<td>strtol</td>
<td></td>
</tr>
<tr>
<td>__getpagesize</td>
<td>err</td>
<td>grantpt</td>
<td>mkstemp</td>
<td>strtou</td>
<td></td>
</tr>
<tr>
<td>__isinf</td>
<td>error</td>
<td>hcreate</td>
<td>mktemp</td>
<td>swapcontext</td>
<td></td>
</tr>
<tr>
<td>__isinfif</td>
<td>errx</td>
<td>hdestroy</td>
<td>mrand48</td>
<td>syslog</td>
<td></td>
</tr>
<tr>
<td>__isnan</td>
<td>fcvt</td>
<td>hsearch</td>
<td>nftw</td>
<td>system</td>
<td></td>
</tr>
<tr>
<td>__isnanl</td>
<td>fntmsg</td>
<td>htonl</td>
<td>nrand48</td>
<td>tdelete</td>
<td></td>
</tr>
<tr>
<td>__isnaf</td>
<td>fnmatch</td>
<td>htons</td>
<td>ntohl</td>
<td>tfind</td>
<td></td>
</tr>
<tr>
<td>__isnaf1</td>
<td>fpathconf</td>
<td>imaxabs</td>
<td>ntohs</td>
<td>tmppfile</td>
<td></td>
</tr>
<tr>
<td>__sysconf</td>
<td>free</td>
<td>imaxdiv</td>
<td>openlog</td>
<td>tmppnam</td>
<td></td>
</tr>
<tr>
<td>_exit</td>
<td>freeaddrinfo</td>
<td>inet_addr</td>
<td>perror</td>
<td>tsearch</td>
<td></td>
</tr>
<tr>
<td>_longjmp</td>
<td>ftrylockfile</td>
<td>inet_ntoa</td>
<td>posix_memalign</td>
<td>ttyname</td>
<td></td>
</tr>
<tr>
<td>_setjmp</td>
<td>ftw</td>
<td>inet_ntop</td>
<td>posix_openpt</td>
<td>ttyname_r</td>
<td></td>
</tr>
<tr>
<td>abort</td>
<td>gai_strerror</td>
<td>initstate</td>
<td>putenv</td>
<td>unlockpt</td>
<td></td>
</tr>
<tr>
<td>abs</td>
<td>gcvt</td>
<td>insque</td>
<td>qsort</td>
<td>unsetenv</td>
<td></td>
</tr>
<tr>
<td>atof</td>
<td>getaddrinfo</td>
<td>isatty</td>
<td>rand</td>
<td>usleep</td>
<td></td>
</tr>
<tr>
<td>atoi</td>
<td>getcwd</td>
<td>isblank</td>
<td>rand_r</td>
<td>verrx</td>
<td></td>
</tr>
<tr>
<td>atol</td>
<td>getdate</td>
<td>jrand48</td>
<td>random</td>
<td>vfscanf</td>
<td></td>
</tr>
<tr>
<td>atoll</td>
<td>getenv</td>
<td>i64a</td>
<td>realloc</td>
<td>vscanf</td>
<td></td>
</tr>
<tr>
<td>basename</td>
<td>getlogin</td>
<td>labs</td>
<td>realpath</td>
<td>vsscanf</td>
<td></td>
</tr>
<tr>
<td>bsearch</td>
<td>getlogin_r</td>
<td>i64cong</td>
<td>remque</td>
<td>vsyslog</td>
<td></td>
</tr>
</tbody>
</table>
13 Base Libraries


Referenced Specification(s)
[2]. this specification
[3]. SUSv2

An LSB conforming implementation shall provide the generic data interfaces for
Standard Library specified in Table 13-23, with the full mandatory functionality as
described in the referenced underlying specification.

Table 13-23 libc - Standard Library Data Interfaces


Referenced Specification(s)
[1]. this specification

13.4 Data Definitions for libc

This section defines global identifiers and their values that are associated with
interfaces contained in libc. These definitions are organized into groups that
correspond to system headers. This convention is used as a convenience for the
reader, and does not imply the existence of these headers, or their content.
These definitions are intended to supplement those provided in the referenced
underlying specifications.

This specification uses ISO/IEC 9899 C Language as the reference programming
language, and data definitions are specified in ISO C format. The C language is
used here as a convenient notation. Using a C language description of these data
objects does not preclude their use by other programming languages.

13.4.1 ctype.h

enum
{
    _ISupper, _ISlower, _ISalpha, _ISdigit, _ISxdigit, _ISspace,
    _ISprint,
    _ISgraph, _ISblank, _ISCntrl, _ISPunct, _ISalnum
}
13 Base Libraries

13.4.2 dirent.h

typedef struct __dirstream DIR;

struct dirent
{
    long int d_ino;
    off_t d_off;
    unsigned short d_reclen;
    unsigned char d_type;
    char d_name[256];
};

struct dirent64
{
    uint64_t d_ino;
    int64_t d_off;
    unsigned short d_reclen;
    unsigned char d_type;
    char d_name[256];
};

13.4.3 errno.h

ISO POSIX (2003) requires that each error value shall be unique, with permission for EAGAIN and EWOULDBLOCK possibly having the same value. This specification also requires that ENOTSUP and EOPNOTSUPP have the same value.

Note: A defect report against ISO POSIX (2003) has been filed to request that specification also permit these two symbols to have the same value.

#define errno (*__errno_location())
#define EPERM   1
#define ECHILD  10
#define ENETDOWN        100
#define ENETUNREACH     101
#define ENETRESET       102
#define ECONNABORTED    103
#define ECONNRESET      104
#define ENOBUFS 105
#define EISCONN 106
#define ENOTCONN        107
#define ESHUTDOWN       108
#define ETOOMANYREFS    109
#define EAGAIN  11
#define ETIMEDOUT       110
#define ECONNREFUSED    111
#define EHOSTDOWN       112
#define EHOSTUNREACH    113
#define EALREADY        114
#define EINPROGRESS     115
#define ESTALE  116
#define EUCLEAN 117
#define ENOTNAM 118
#define ENAVAIL 119
#define ENOMEM  12
#define EISNAM  120
#define EREMOTEIO 121
#define EDQUOT 122
#define ENOMEDIUM 123
#define EMEDIUMTYPE 124
#define ECANCELED 125
#define EACCES 13
#define EFAULT 14
#define EEXIST 15
#define EBUSY 16
#define EEEXIST 17
#define EXDEV 18
#define ENODEV 19
#define EISDIR 20
#define ENAMETOOLONG 21
#define ENOTBLK 22
#define EFILE 23
#define ENOTBLK 24
#define EPERM 25
#define ETXBSY 26
#define EPERM 27
#define EPROFSC 28
#define EPROFSC 29
#define ESRCH 30
#define ENOSYS 31
#define ER.instances 32
#define EDOM 33
#define ER.instances 34
#define EEMFILE 35
#define EREMOTE 36
#define EREMOTE 37
#define ELINK 38
#define EREMOTES 39
#define EINTR 40
#define EINVAL 41
#define EISDIR 42
#define EFILE 43
#define EREMOTE 44
#define EREMOTE 45
#define EREMOTE 46
#define EREMOTE 47
#define EREMOTE 48
#define EREMOTE 49
#define EREMOTE 50
#define EREMOTE 51
#define EREMOTE 52
#define EREMOTE 53
#define EREMOTE 54
#define EREMOTE 55
#define EREMOTE 56
#define EREMOTE 57
#define EREMOTE 58
#define EREMOTE 59
#define EREMOTE 60
#define EREMOTE 61
#define EREMOTE 62
#define EREMOTE 63
#define EREMOTE 64
#define EREMOTE 65
#define EREMOTE 66
#define EREMOTE 67
#define EREMOTE 68
#define EREMOTE 69
#define EREMOTE 70
#define EREMOTE 71
#define EREMOTE 72
#define EDOTDOT 73
#define EBADMSG 74
#define EOVERFLOW 75
#define ENOTUNIQ 76
#define EBADFD 77
#define EREMCHG 78
#define ELIBACC 79
#define ENOEEXEC 80
#define ELIBBAD 80
#define ELIBSCN 81
#define ELIBMAX 82
#define ELIBEXEC 83
#define EILSEQ 84
#define ERESTART 85
#define ESTRPIPE 86
#define EUSERS 87
#define ENOTSOCK 88
#define EDESTADDRREQ 89
#define EWOULDBLOCK 90
#define EAGAIN 90
#define ENOTSUP 91
#define EPROTOTYPE 92
#define ENOPROTOOPT 93
#define EPROTONOSUPPORT 94
#define ESOCKTNOSUPPORT 95
#define EOPNOTSUPP 96
#define EAFNOSUPPORT 97
#define EADDRINUSE 98
#define EADDRNOTAVAIL 99
#define EWOULDBLOCK 99
#define EAGAIN 99
#define FD_CLOEXEC 1

struct flock
{
  short l_type;
  short l_whence;
  off_t l_start;
  off_t l_len;
  pid_t l_pid;
};

struct flock64
{
  short l_type;
  short l_whence;
  loff_t l_start;

13.4.4 fcntl.h

#define O_RDONLY 00
#define O_ACCMODE 0003
#define O_WRONLY 01
#define O_CREAT 0100
#define O_TRUNC 01000
#define O_SYNC 010000
#define O_RDWR 02
#define O_EXCL 0200
#define O_APPEND 02000
#define O_ASYNC 020000
#define O_NONBLOCK 04000
#define FD_CLOEXEC 1
loff_t l_len;
  pid_t l_pid;
}
;
#define F_DUPFD 0
#define F_RDLCK 0
#define F_GETFD 1
#define F_WRLCK 1
#define F_SETFD 2
#define F_UNLCK 2
#define F_GETFL 3
#define F_SETFL 4
#define F_GETLK 5
#define F_SETLK 6
#define F_SETLKW 7
#define F_SETOWN 8
#define F_GETOWN 9

13.4.5 fmtmsg.h

#define MM_HARD 1
#define MM_NRECOV 128
#define MM_UTIL 16
#define MM_SOFT 2
#define MM_OPSYS 32
#define MM_FIRM 4
#define MM_RECOVER 64
#define MM_APPL 8

#define MM_NOSEV 0
#define MM_HALT 1
#define MM_ERROR 2

#define MM_NULLLBL ((char *) 0)

13.4.6 fnmatch.h

#define FNM_PATHNAME (1<<0)
#define FNM_NOESCAPE (1<<1)
#define FNM_PERIOD (1<<2)
#define FNM_NOMATCH 1

13.4.7 ftw.h

#define FTW_D FTW_D
#define FTW_DNR FTW_DNR
#define FTW_DP FTW_DP
#define FTW_F FTW_F
#define FTW_NS FTW_NS
#define FTW_SL FTW_SL
#define FTW_SLN FTW_SLN

enum
{
    FTW_F, FTW_D, FTW_DNR, FTW_NS, FTW_SL, FTW_DP, FTW_SLN
}
;
enum
13 Base Libraries

{  
  FTW_PHYS, FTW_MOUNT, FTW_CHDIR, FTW_DEPTH
}
;

struct FTW
{
  int base;
  int level;
}
;

typedef int (*__ftw_func_t) (char *__filename, struct stat *__status,
                      int __flag);
typedef int (*__ftw64_func_t) (char *__filename, struct stat64 *__status,
                      int __flag);
typedef int (*__nftw_func_t) (char *__filename, struct stat *__status,
                      int __flag, struct FTW *__info);
typedef int (*__nftw64_func_t) (char *__filename, struct stat64 *__status,
                      int __flag, struct FTW *__info);

13.4.8 getopt.h

#define no_argument 0
#define required_argument 1
#define optional_argument 2

struct option
{
  char *name;
  int has_arg;
  int *flag;
  int val;
}
;

13.4.9 glob.h

#define GLOB_ERR  (1<<0)
#define GLOB_MARK (1<<1)
#define GLOB_BRACE (1<<10)
#define GLOB_NOMAGIC (1<<11)
#define GLOB_TILDE  (1<<12)
#define GLOB_ONLYDIR (1<<13)
#define GLOB_TILDE_CHECK  (1<<14)
#define GLOB_NOSORT (1<<2)
#define GLOB_NOOFFS (1<<3)
#define GLOB_NOCHECK (1<<4)
#define GLOB_APPEND (1<<5)
#define GLOB_NOESCAPE (1<<6)
#define GLOB_PERIOD (1<<7)
#define GLOB_MAGCHAR (1<<8)
#define GLOB_ALTDIRFUNC (1<<9)
#define GLOB_NOSPACE 1
#define GLOB_ABORTED 2
#define GLOB_NOMATCH 3
#define GLOB_NOSYS 4
13 Base Libraries

typedef struct
{
    size_t gl_pathc;
    char **gl_pathv;
    size_t gl_offs;
    int gl_flags;
    void (*gl_closedir) (void *);
    struct dirent (*gl_readdir) (void *);
    void *(*gl_opendir) (const char *);
    int (*gl_lstat) (const char *, struct stat *);
    int (*gl_stat) (const char *, struct stat *);
} glob_t;

typedef struct
{
    size_t gl_pathc;
    char **gl_pathv;
    size_t gl_offs;
    int gl_flags;
    void (*gl_closedir) (void *);
    struct dirent64 (*gl_readdir64) (void *);
    void *(*gl_opendir) (const char *);
    int (*gl_lstat) (const char *, struct stat *);
    int (*gl_stat) (const char *, struct stat *);
} glob64_t;

13.4.10 grp.h

struct group
{
    char *gr_name;
    char *gr_passwd;
    gid_t gr_gid;
    char **gr_mem;
};

13.4.11 iconv.h

typedef void *iconv_t;

13.4.12 inttypes.h

typedef lldiv_t imaxdiv_t;
typedef unsigned char uint8_t;
typedef unsigned short uint16_t;
typedef unsigned int uint32_t;

13.4.13 langinfo.h

#define ABDAY_1 0x20000
#define ABDAY_2 0x20001
#define ABDAY_3 0x20002
#define ABDAY_4 0x20003
#define ABDAY_5 0x20004
#define ABDAY_6 0x20005
```c
#define ABDAY_7 0x20006
#define DAY_1   0x20007
#define DAY_2   0x20008
#define DAY_3   0x20009
#define DAY_4   0x2000A
#define DAY_5   0x2000B
#define DAY_6   0x2000C
#define DAY_7   0x2000D
#define ABMON_1 0x2000E
#define ABMON_2 0x2000F
#define ABMON_3 0x20010
#define ABMON_4 0x20011
#define ABMON_5 0x20012
#define ABMON_6 0x20013
#define ABMON_7 0x20014
#define ABMON_8 0x20015
#define ABMON_9 0x20016
#define ABMON_10 0x20017
#define ABMON_11 0x20018
#define ABMON_12 0x20019
#define MON_1   0x2001A
#define MON_2   0x2001B
#define MON_3   0x2001C
#define MON_4   0x2001D
#define MON_5   0x2001E
#define MON_6   0x2001F
#define MON_7   0x20020
#define MON_8   0x20021
#define MON_9   0x20022
#define MON_10  0x20023
#define MON_11  0x20024
#define MON_12  0x20025
#define AM_STR  0x20026
#define PM_STR  0x20027
#define D_T_FMT 0x20028
#define D_FMT   0x20029
#define T_FMT   0x2002A
#define T_FMT_AMPM 0x2002B
#define ERA     0x2002C
#define ERA_D_FMT 0x2002E
#define ALT_DIGITS 0x2002F
#define ERA_D_T_FMT 0x20030
#define ERA_T_FMT 0x20031
#define CODESET 14
#define CRNCYSTR 0x4000F
#define RADIXCHAR 0x10000
#define THOUSEP 0x10001
#define YESEXPR 0x50000
#define NOEXPR 0x50001
#define YESSTR 0x50002
#define NOSTR 0x50003
```

**13.4.14 limits.h**
#define LLONG_MIN (-LLONG_MAX-1LL)
#define ULLONG_MAX 18446744073709551615ULL
#define OPEN_MAX 256
#define PATH_MAX 4096
#define LLONG_MAX 9223372036854775807LL
#define SSIZE_MAX LONG_MAX
#define MB_LEN_MAX 16
#define SCHAR_MIN (-128)
#define SCHAR_MAX 127
#define UCHAR_MAX 255
#define CHAR_BIT 8
#define SHRT_MIN (-32768)
#define SHRT_MAX 32767
#define USHRT_MAX 65535
#define INT_MIN (-INT_MAX-1)
#define INT_MAX 2147483647
#define __INT_MAX__ 2147483647
#define UINT_MAX 4294967295U
#define LONG_MIN (-LONG_MAX-1L)
#define PTHREAD_KEYS_MAX 1024
#define PTHREAD_THREADS_MAX 16384
#define PTHREAD_DESTRUCTOR_ITERATIONS 4

13.4.15 locale.h

struct lconv
{
    char *decimal_point;
    char *thousands_sep;
    char *grouping;
    char *int_curr_symbol;
    char *currency_symbol;
    char *mon_decimal_point;
    char *mon_thousands_sep;
    char *mon_grouping;
    char *positive_sign;
    char *negative_sign;
    char int_frac_digits;
    char frac_digits;
    char p_cs_precedes;
    char p_sep_by_space;
    char n_cs_precedes;
    char n_sep_by_space;
    char p_sign_posn;
    char n_sign_posn;
    char int_p_cs_precedes;
    char int_p_sep_by_space;
    char int_n_cs_precedes;
    char int_n_sep_by_space;
    char int_p_sign_posn;
    char int_n_sign_posn;
};

#define LC_GLOBAL_LOCALE ((locale_t) -1L)
#define LC_CTYPE 0
#define LC_NUMERIC 1
#define LC_TELEPHONE 10

73
#define LC_MEASUREMENT 11
#define LC_IDENTIFICATION 12
#define LC_TIME 2
#define LC_COLLATE 3
#define LC_MONETARY 4
#define LC_MESSAGES 5
#define LC_ALL 6
#define LC_PAPER 7
#define LC_NAME 8
#define LC_ADDRESS 9

typedef struct __locale_struct
{
    struct locale_data *__locales[13];
    const unsigned short *__ctype_b;
    const int *__ctype_tolower;
    const int *__ctype_toupper;
    const char *__names[13];
} __locale_t;

typedef struct __locale_struct *locale_t;
#define LC_ADDRESS_MASK (1 << LC_ADDRESS)
#define LC_COLLATE_MASK (1 << LC_COLLATE)
#define LC_IDENTIFICATION_MASK (1 << LC_IDENTIFICATION)
#define LC_MEASUREMENT_MASK (1 << LC_MEASUREMENT)
#define LC_MESSAGES_MASK (1 << LC_MESSAGES)
#define LC_MONETARY_MASK (1 << LC_MONETARY)
#define LC_NAME_MASK (1 << LC_NAME)
#define LC_NUMERIC_MASK (1 << LC_NUMERIC)
#define LC_PAPER_MASK (1 << LC_PAPER)
#define LC_TELEPHONE_MASK (1 << LC_TELEPHONE)
#define LC_TIME_MASK (1 << LC_TIME)
#define LC_CTYPE_MASK (1 << LC_CTYPE)
#define LC_ALL_MASK (LC_CTYPE_MASK | LC_NUMERIC_MASK |
    LC_TIME_MASK | LC_COLLATE_MASK | LC_MONETARY_MASK | LC_MESSAGES_MASK |
    LC_PAPER_MASK | LC_NAME_MASK | LC_ADDRESS_MASK | LC_TELEPHONE_MASK |
    LC_MEASUREMENT_MASK | LC_IDENTIFICATION_MASK)

13.4.16 net/if.h

#define IF_NAMESIZE 16
#define IFF_UP 0x01
#define IFF_BROADCAST 0x02
#define IFF_DEBUG 0x04
#define IFF_LOOPBACK 0x08
#define IFF_POINTOPOINT 0x10
#define IFF_PROMISC 0x100
#define IFF_MULTICAST 0x1000
#define IFF_NOTRAILERS 0x20
#define IFF_RUNNING 0x40
#define IFF_NOARP 0x80

struct if_nameindex
{
    unsigned int if_index;
    char *if_name;
};

struct ifaddr
{
struct sockaddr ifa_addr;
union
{
    struct sockaddr ifu_broadaddr;
    struct sockaddr ifu_dstaddr;
} ifa_ifu;
void *ifa_ifp;
void *ifa_next;
};
#define IFNAMSIZ        IF_NAMESIZE

struct ifreq
{
    union
    {
        char ifrn_name[IFNAMSIZ];
    } ifr_ifrn;
    union
    {
        struct sockaddr ifru_addr;
        struct sockaddr ifru_dstaddr;
        struct sockaddr ifru_broadaddr;
        struct sockaddr ifru_netmask;
        struct sockaddr ifru_hwaddr;
        short ifru_flags;
        int ifru_ivalue;
        int ifru_mtu;
        char ifru_slave[IFNAMSIZ];
        char ifru_newname[IFNAMSIZ];
        caddr_t ifru_data;
        struct ifmap ifru_map;
    } ifr_ifru;
};

struct ifconf
{
    int ifc_len;
    union
    {
        caddr_t ifcu_buf;
        struct ifreq *ifcu_req;
    } ifc_ifcu;
};

13.4.17 netdb.h

#define NETDB_INTERNAL -1
#define NETDB_SUCCESS 0
#define HOST_NOT_FOUND 1
#define IPPORT_RESERVED 1024
#define NI_MAXHOST 1025
#define TRY_AGAIN 2
#define NO_RECOVERY 3
#define NI_MAXSERV 32
#define NO_DATA 4
#define h_addr h_addr_list[0]
#define NO_ADDRESS  NO_DATA

struct servent {
    char *s_name;
    char **s_aliases;
    int s_port;
    char *s_proto;
}

struct hostent {
    char *h_name;
    char **h_aliases;
    int h_addrtype;
    int h_length;
    char **h_addr_list;
}

struct protoent {
    char *p_name;
    char **p_aliases;
    int p_proto;
}

struct netent {
    char *n_name;
    char **n_aliases;
    int n_addrtype;
    unsigned int n_net;
}

#define AI_PASSIVE  0x0001
#define AI_CANONNAME 0x0002
#define AI_NUMERICHOST 0x0004

struct addrinfo {
    int ai_flags;
    int ai_family;
    int ai_socktype;
    int ai_protocol;
    socklen_t ai_addrlen;
    struct sockaddr *ai_addr;
    char *ai_canonname;
    struct addrinfo *ai_next;
}

#define NI_NUMERICHOST  1
#define NI_DGRAM       16
#define NI_NUMERICSERV  2
#define NI_NOFQDN       4
#define NI_NAMEREQD     8

#define EAI_BADFLAGS    -1
#define EAI_MEMORY      -10
#define EAI_SYSTEM      -11
#define EAI_NONAME      -2
#define EAI_AGAIN       -3
#define EAI_FAIL        -4
#define EAI_NODATA      -5
#define EAI_FAMILY      -6
#define EAI_SOCKTYPE    -7
#define EAI_SERVICE     -8
#define EAI_ADDRFAMILY  -9

13.4.18 netinet/in.h

#define IPPROTO_IP      0
#define IPPROTO_ICMP    1
#define IPPROTO_UDP     17
#define IPPROTO_IGMP    2
#define IPPROTO_RAW     255
#define IPPROTO_IPV6    41
#define IPPROTO_ICMPV6  58
#define IPPROTO_TCP     6

typedef uint16_t in_port_t;

struct in_addr
{
    uint32_t s_addr;
}
;
typedef uint32_t in_addr_t;
#define INADDR_NONE     ((in_addr_t) 0xffffffff)
#define INADDR_BROADCAST        (0xffffffff)
#define INADDR_ANY      0

struct in6_addr
{
    union
    {
        uint8_t u6_addr8[16];
        uint16_t u6_addr16[8];
        uint32_t u6_addr32[4];
    } in6,u;
};

#define IN6ADDR_ANY_INIT        { { 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0 } } }
#define IN6ADDR_LOOPBACK_INIT   { { 0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,1 } } }

#define INET_ADDRSTRLEN 16

struct sockaddr_in
{
    sa_family_t sin_family;
    unsigned short sin_port;
    struct in_addr sin_addr;
    unsigned char sin_zero[8];
};

#define INET6_ADDRSTRLEN 46

struct sockaddr_in6
{
    unsigned short sin6_family;
    uint16_t sin6_port;
    uint32_t sin6_flowinfo;
    struct in6_addr sin6_addr;
    uint32_t sin6_scope_id;
}
13 Base Libraries

; #define SOL_IP    0
#define IP_TOS    1
#define IPV6_UNICAST_HOPS  16
#define IPV6_MULTICAST_IF 17
#define IPV6_MULTICAST_HOPS 18
#define IPV6_MULTICAST_LOOP 19
#define IP_TTL     2
#define IPV6_JOIN_GROUP 20
#define IPV6_LEAVE_GROUP 21
#define IPV6_V6ONLY  26
#define IP_MULTICAST_IF 32
#define IP_MULTICAST_TTL 33
#define IP_MULTICAST_LOOP 34
#define IP_ADD_MEMBERSHIP 35
#define IP_DROP_MEMBERSHIP 36
#define IP_OPTIONS  4

struct ipv6_mreq
{
    struct in6_addr ipv6mr_multiaddr;
    int ipv6mr_interface;
};

struct ip_mreq
{
    struct in_addr imr_multiaddr;
    struct in_addr imr_interface;
};

13.4.19 netinet/ip.h

#define IPTOS_LOWCOST 0x02
#define IPTOS_RELIABILITY 0x04
#define IPTOS_THROUGHPUT 0x08
#define IPTOS_LOWDELAY 0x10
#define IPTOS_TOS_MASK 0x1e
#define IPTOS_MINCOST IPTOS_LOWCOST
#define IPTOS_PREC_MASK 0xe0

13.4.20 netinet/tcp.h

#define TCP_NODELAY 1
#define SOL_TCP 6

13.4.21 netinet/udp.h

#define SOL_UDP 17

13.4.22 nl_types.h

#define NL_CAT_LOCALE 1
#define NL_SETD 1

typedef void *nl_catd;
typedef int nl_item;
13.4.23 pwd.h

struct passwd {
    char *pw_name;
    char *pw_passwd;
    uid_t pw_uid;
    gid_t pw_gid;
    char *pw_gecos;
    char *pw_dir;
    char *pw_shell;
};

13.4.24 regex.h

typedef unsigned long int reg_syntax_t;

typedef struct re_pattern_buffer {
    unsigned char *buffer;
    unsigned long int allocated;
    unsigned long int used;
    reg_syntax_t syntax;
    char *fastmap;
    char *translate;
    size_t re_nsub;
    unsigned int can_be_null:1;
    unsigned int regs_allocated:2;
    unsigned int fastmap_accurate:1;
    unsigned int no_sub:1;
    unsigned int not_bol:1;
    unsigned int not_eol:1;
    unsigned int newline_anchor:1;
} regex_t;

typedef int regoff_t;

typedef struct {
    regoff_t rm_so;
    regoff_t rm_eo;
} regmatch_t;

#define REG_ICASE  (REG_EXTENDED<<1)
#define REG_NEWLINE (REG_ICASE<<1)
#define REG_NOSUB   (REG_NEWLINE<<1)
#define REG_EXTENDED  1
#define REG_NOTEOL   (1<<1)
#define REG_NOTBOL   1

typedef enum {
    REG_ENOSYS, REG_NOERROR, REG NOMATCH, REG_BADPAT, REG_ECOLLATE,
    REG_ECTYPE,
    REG_EESCAPE, REG_ESUBREG, REG_EBRACK, REG_EPAREN, REG_EBRACE,
    REG_BADBR,
    REG_ERANGE, REG_ESPACE, REG_BADRPT, REG_EEND, REG_ESIZE,
    REG_ERPAREN
} reg_errcode_t;
13.4.25 rpc/auth.h

enum auth_stat
{
    AUTH_OK, AUTH_BADCRED = 1, AUTH_REJECTEDCRED = 2, AUTH_BADVERF = 3, AUTH_REJECTEDVERF = 4, AUTH_TOOWeak = 5, AUTH_INVALIDRESP = 6, AUTH_FAILED = 7
};

union des_block
{
    struct
    {
        u_int32_t high;
        u_int32_t low;
    }
    key;
    char c[8];
};

struct opaque_auth
{
    enum_t oa_flavor;
    caddr_t oa_base;
    u_int oa_length;
};

typedef struct AUTH
{
    struct opaque_auth ah_cred;
    struct opaque_auth ah_verf;
    union des_block ah_key;
    struct auth_ops *ah_ops;
    caddr_t ah_private;
} AUTH;

struct auth_ops
{
    void (*ah_nextverf) (struct AUTH *);
    int (*ah_marshal) (struct AUTH *, XDR *);
    int (*ah_validate) (struct AUTH *, struct opaque_auth *);
    int (*ah_refresh) (struct AUTH *);
    void (*ah_destroy) (struct AUTH *);
};

13.4.26 rpc/clnt.h

#define clnt_control(cl,rq,in)  (*((cl)->cl_ops->cl_control)(cl,rq,in))
#define clnt_abort(rh)  (*((rh)->cl_ops->cl_abort)(rh))
#define clnt_call(rh, proc, xargs, argsp, xres, resp, secs) (*((rh)->cl_ops->cl_call)(rh, proc, xargs, argsp, xres, resp, secs))
#define clnt_destroy(rh)  (*((rh)->cl_ops->cl_destroy)(rh))
#define clnt_setverf(rh,xres,resp)  (*((rh)->cl_ops->cl_setverf)(rh,xres,resp))
#define clnt_freeres(rh,xres,resp)  (*((rh)->cl_ops->cl_freeres)(rh,xres,resp))
#define clnt_geterr(rh,errp)  (*((rh)->cl_ops->cl_geterr)(rh, errp))
#define NULLPROC        ((u_long)0)
#define CLSET_TIMEOUT   1
#define CLGET_XID       10
#define CLSET_XID       11
#define CLGET_VERS      12
#define CLSET_VERS      13
#define CLGET_PROG      14
#define CLSET_PROG      15
#define CLGET_TIMEOUT   2
#define CLGET_SERVER_ADDR       3
#define CLSET_RETRY_TIMEOUT     4
#define CLGET_RETRY_TIMEOUT     5
#define CLGET_FD        6
#define CLGET_SVC_ADDR  7
#define CLSET_FD_CLOSE  8
#define CLSET_FD_NCLOSE 9

enum clnt_stat
{
    RPC_SUCCESS, RPC_CANTENCODEARGS = 1, RPC_CANTDECODERES = 2,
RPC_CANTSEND =
    3, RPC_CANTRECV = 4, RPC_TIMEOUT = 5, RPC_VERSMISMATCH =
    6, RPC_AUTHERROR = 7, RPC_PROGUNAVAIL = 8, RPC_PROGVERSISMATCH =
    9, RPC_PROCUNAVAIL = 10, RPC_CANTENCODEARGS = 11,
RPC_SYSTEMERROR =
    12, RPC_NOBROADCAST = 21, RPC_UNKNOWNHOST = 13, RPC_UNKNOWNPROTO =
    17, RPC_UNKNOWNADDR = 19, RPC_RPCBFAILURE = 14,
RPC_PROGNOTREGISTERED =
    15, RPC_N2AXLATEFAILURE = 22, RPC_FAILED = 16, RPC_INTR =
    18, RPC_TLIERROR = 20, RPC_UDERROR = 23, RPC_INPROGRESS =
    24, RPC_STALERACHANDLE = 25
};

struct rpc_err
{
    enum clnt_stat re_status;
    union
    {
        int RE_errno;
        enum auth_stat RE_why;
        struct
        {
            u_long low;
            u_long high;
        } RE_vers;
        struct
        {
            long int s1;
            long int s2;
        } RE_lb;
    } ru;
};
typedef struct CLIENT
{
    struct AUTH *cl_auth;
    struct clnt_ops *cl_ops;
    caddr_t cl_private;
}
13 Base Libraries

} CLIENT;

struct clnt_ops
{
    enum clnt_stat (*cl_call) (struct CLIENT *, u_long, xdrproc_t,
                             caddr_t,
                             xdrproc_t, caddr_t, struct timeval);
    void (*cl_abort) (void);
    void (*cl_geterr) (struct CLIENT *, struct rpc_err *);
    bool_t (*cl_freeres) (struct CLIENT *, xdrproc_t, caddr_t);
    void (*cl_destroy) (struct CLIENT *);
    bool_t (*cl_control) (struct CLIENT *, int, char *);
};

13.4.27 rpc/rpc_msg.h

enum msg_type
{
    CALL, REPLY = 1
};

enum reply_stat
{
    MSG_ACCEPTED, MSG_DENIED = 1
};

enum accept_stat
{
    SUCCESS, PROG_UNAVAIL = 1, PROG_MISMATCH = 2, PROC_UNAVAIL =
    3, GARBAGE_ARGS = 4, SYSTEM_ERR = 5
};

enum reject_stat
{
    RPC_MISMATCH, AUTH_ERROR = 1
};

struct accepted_reply
{
    struct opaque_auth ar_verf;
    enum accept_stat ar_stat;
    union
    {
        struct
        {
            unsigned long int low;
            unsigned long int high;
        }
        AR_versions;
        struct
        {
            caddr_t where;
            xdrproc_t proc;
        }
        AR_results;
    }
    ru;
};
struct rejected_reply
{
    enum reject_stat rj_stat;
    union
    {
        struct
        {
            unsigned long int low;
            unsigned long int high;
        }
        RJ_versions;
        enum auth_stat RJ_why;
    }
    ru;
};

struct reply_body
{
    enum reply_stat rp_stat;
    union
    {
        struct accepted_reply RP_ar;
        struct rejected_reply RP_dr;
    }
    ru;
};

struct call_body
{
    unsigned long int cb_rpcvers;
    unsigned long int cb_prog;
    unsigned long int cb_vers;
    unsigned long int cb_proc;
    struct opaque_auth cb_cred;
    struct opaque_auth cb_verf;
};

struct rpc_msg
{
    unsigned long int rm_xid;
    enum msg_type rm_direction;
    union
    {
        struct call_body RM_cmb;
        struct reply_body RM_rmb;
    }
    ru;
};

13.4.28 rpc/svc.h

#define svc_freeargs(xprt,xargs, argsp) (*(xprt)->xp_ops->xp_freeargs)((xprt), (xargs), (argsp))
#define svc_getargs(xprt,xargs, argsp)  (*(xprt)->xp_ops->xp_getargs)((xprt), (xargs), (argsp))
#define RPC_ANYSOCK     -1

typedef struct SVCXPRT
{
int xp_sock;
  u_short xp_port;
  struct xp_ops *xp_ops;
  int xp_addrlen;
  struct sockaddr_in xp_raddr;
  struct opaque_auth xp_verf;
  caddr_t xp_pl;
  caddr_t xp_p2;
  char xp_pad[256];
}

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;
  SVCXPRT *rq_xprt;
}

typedef void (*__dispatch_fn_t) (struct svc_req *, SVCXPRT *);

struct xp_ops
{
  bool_t (*xp_recv) (SVCXPRT * __xprt, struct rpc_msg * __msg);
  enum xprt_stat (*xp_stat) (SVCXPRT * __xprt);
  bool_t (*xp_getargs) (SVCXPRT * __xprt, xdrproc_t __xdr_args,
                        caddr_t args_ptr);
  bool_t (*xp_reply) (SVCXPRT * __xprt, struct rpc_msg * __msg);
  bool_t (*xp_freeargs) (SVCXPRT * __xprt, xdrproc_t __xdr_args,
                        caddr_t args_ptr);
  void (*xp_destroy) (SVCXPRT * __xprt);
}

13.4.29 rpc/types.h

typedef int bool_t;
typedef int enum_t;
typedef unsigned long int rpcprog_t;
typedef unsigned long int rpcvers_t;
typedef unsigned long int rpcproc_t;
typedef unsigned long int rpcprot_t;

13.4.30 rpc/xdr.h

enum xdr_op
{
  XDR_ENCODE, XDR_DECODE, XDR_FREE
};
typedef struct XDR
{
  enum xdr_op x_op;
  struct xdr_ops *x_ops;
  caddr_t x_public;
  caddr_t x_private;
  caddr_t x_base;
  int x_handy;
}
struct xdr_ops {
  bool_t (*x_getlong) (XDR *__xdrs, long int *__lp);
  bool_t (*x_putlong) (XDR *__xdrs, long int *__lp);
  bool_t (*x_getbytes) (XDR *__xdrs, caddr_t __addr, u_int __len);
  bool_t (*x_putbytes) (XDR *__xdrs, char *__addr, u_int __len);
  u_int (*x_getpostn) (XDR *__xdrs);
  bool_t (*x_setpostn) (XDR *__xdrs, u_int __pos);
  int32_t (*x_inline) (XDR *__xdrs, int __len);
  void (*x_destroy) (XDR *__xdrs);
  bool_t (*x_getint32) (XDR *__xdrs, int32_t *__ip);
  bool_t (*x_putint32) (XDR *__xdrs, int32_t *__ip);

} XDR;

typedef bool_t (*xdrproc_t) (XDR *, void *, ...);

struct xdr_discrim {
  int value;
  xdrproc_t proc;
};

13.4.31 sched.h

#define SCHED_OTHER    0
#define SCHED_FIFO     1
#define SCHED_RR       2

struct sched_param {
  int sched_priority;
};

13.4.32 search.h

typedef struct entry {
  char *key;
  void *data;
} ENTRY;
typedef enum {
  FIND, ENTER
} ACTION;
typedef enum {
  preorder, postorder, endorder, leaf
} VISIT;

typedef void (*__action_fn_t) (void *__nodep, VISIT __value, int __level);
13.4.33 setjmp.h

```c
#define setjmp(env)     _setjmp(env)
#define sigsetjmp(a,b)  __sigsetjmp(a,b)

struct __jmp_buf_tag
{
    jmp_buf __jmpbuf;
    int __mask_was_saved;
    sigset_t __saved_mask;
}

typedef struct __jmp_buf_tag jmp_buf[1];
typedef jmp_buf sigjmp_buf;
```

13.4.34 signal.h

```c
#define _SIGSET_NWORDS  (1024/(8*sizeof(unsigned long)))
#define SIGRTMAX        (__libc_current_sigrtmax ())
#define SIGRTMIN        (__libc_current_sigrtmin ())
#define SIG_BLOCK       0
#define SIG_UNBLOCK     1
#define SIG_SETMASK     2
#define NSIG     65

typedef int sig_atomic_t;

typedef void (*sighandler_t) (int);
#define SIG_HOLD          ((sighandler_t) 2)
#define SIG_ERR          ((sighandler_t)-1)
#define SIG_DFL          ((sighandler_t)0)
#define SIG_IGN          ((sighandler_t)1)
#define SIGHUP       1
#define SIGUSR1       10
#define SIGSEGV       11
#define SIGUSR2       12
#define SIGPIPE       13
#define SIGALRM       14
#define SIGTERM       15
#define SIGSTKFLT      16
#define SIGCHLD       17
#define SIGCONT       18
#define SIGSTOP       19
#define SIGINT        2
#define SIGTSTP       20
#define SIGTTIN       21
#define SIGTTOU       22
#define SIGURG        23
#define SIGXCPU       24
#define SIGXFSZ       25
#define SIGVTALRM      26
#define SIGPROF       27
#define SIGWINCH      28
#define SIGIO         29
#define SIGQUIT       3
#define SIGPWR         30
#define SIGSYS        31
#define SIGUNUSED     31
#define SIGILL        4
#define SIGTRAP       5
```
#define SIGABRT 6
#define SIGIOT 6
#define SIGBUS 7
#define SIGFPE 8
#define SIGKILL 9
#define SIGCHLD SIGCHLD
#define SIGPOLL SIGIO

#define SV_ONSTACK (1<<0)
#define SV_INTERRUPT (1<<1)
#define SV_RESETHAND (1<<2)

typedef union sigval
{
    int sival_int;
    void *sival_ptr;
}
sigval_t;
#define SIGEV_SIGNAL 0
#define SIGEV_NONE 1
#define SIGEV_THREAD 2
#define SIGEV_MAX_SIZE 64

typedef struct sigevent
{
    sigval_t sigev_value;
    int sigev_signo;
    int sigev_notify;
    union
    {
        int _pad[SIGEV_PAD_SIZE];
        struct
        {
            void (*sigev_thread_func) (sigval_t);
            void *attribute;
        }
    }
}
sigevent_t;
#define SI_MAX_SIZE 128
#define si_pid _sifields._kill._pid
#define si_uid _sifields._kill._uid
#define si_value _sifields._rt._sigval
#define si_int _sifields._rt._signal.sival_int
#define si_ptr _sifields._rt._signal.sival_ptr
#define si_status _sifields._sigchld._status
#define si_stime _sifields._sigchld._stime
#define si_utime _sifields._sigchld._utime
#define si_addr _sifields._sigfault._addr
#define si_band _sifields._sigpoll._band
#define si_fd _sifields._sigpoll._fd
#define si_timer1 _sifields._timer._timer1
#define si_timer2 _sifields._timer._timer2

typedef struct siginfo
{
    int si_signo;
    int si_errno;
    int si_code;
    union
    {
        int _pad[SI_PAD_SIZE];
    }
struct {
    pid_t _pid;
    uid_t _uid;
} _kill;

struct {
    unsigned int _timer1;
    unsigned int _timer2;
} _timer;

struct {
    pid_t _pid;
    uid_t _uid;
    sigval_t _sigval;
} _rt;

struct {
    pid_t _pid;
    uid_t _uid;
    int _status;
    clock_t _utime;
    clock_t _stime;
} _sigchld;

struct {
    void *_addr;
} _sigfault;

struct {
    int _band;
    int _fd;
} _sigpoll;

} _sifields;

siginfo_t;
#define SI_QUEUE       -1
#define SI_TIMER       -2
#define SI_MESGQ       -3
#define SI_ASYNCIO     -4
#define SI_SIGIO       -5
#define SI_TKILL       -6
#define SI_ASYNCNL     -60
#define SI_USER       0
#define SI_KERNEL     0x80
#define ILL_ILLOPC     1
#define ILL_ILLOPN     2
#define ILL_ILLADR     3
#define ILL_ILLTRP     4
#define ILL_PRVOPC     5
#define ILL_PRVREG     6
#define ILL_COPROC     7
#define ILL_BADSTK     8
#define FPE_INTDIV     1
#define FPE_INTOVF     2
#define FPE_FLTDIV  3
#define FPE_FLTOVF  4
#define FPE_FLTUND  5
#define FPE_FLTRES  6
#define FPE_FLTINV  7
#define FPE_FLTSUB  8

#define SEGV_MAPERR  1
#define SEGV_ACCERR  2

#define BUS_ADRALN  1
#define BUS_ADRERR  2
#define BUS_OBJERR  3

#define TRAP_BRKPT  1
#define TRAP_TRACE  2

#define CLD_EXITED  1
#define CLD_KILLED  2
#define CLD_DUMPED  3
#define CLD_TRAPPED 4
#define CLD_STOPPED 5
#define CLD_CONTINUED 6

#define POLL_IN   1
#define POLL_OUT  2
#define POLL_MSG  3
#define POLL_ERR  4
#define POLL_PRI  5
#define POLL_HUP  6

typedef struct
{
    unsigned long int sig[_SIGSET_NWORDS];
} sigset_t;

#define SA_NOCLDSTOP 0x00000001
#define SA_NOCLDWAIT 0x00000002
#define SA_SIGINFO  0x00000004
#define SA_ONSTACK  0x08000000
#define SA_RESTART  0x10000000
#define SA_INTERRUPT 0x20000000
#define SA_NODEFER  0x40000000
#define SA_RESETHAND 0x80000000
#define SA_NOMASK  SA_NODEFER
#define SA_ONESHOT  SA_RESETHAND

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

#define SS_ONSTACK  1
#define SS_DISABLE  2

13.4.35 stddef.h

#define offsetof(TYPE, MEMBER)   ((size_t)& ((TYPE*)0)->MEMBER)
#define NULL    (0L)

typedef int wchar_t;
13.4.36 stdio.h

```c
#define EOF     (-1)
#define P_tmpdir        "/tmp"
#define FOPEN_MAX       16
#define L_tmpnam        20
#define FILENAME_MAX    4096
#define BUFSIZ 8192
#define L_ctermid       9
#define L_cuserid       9

typedef struct
{
    off_t __pos;
    mbstate_t __state;
} fpos_t;
typedef struct
{
    off64_t __pos;
    mbstate_t __state;
} fpos64_t;
typedef struct _IO_FILE FILE;
#define _IOFBF  0
#define _IOLBF  1
#define _IONBF  2
```

13.4.37 stdlib.h

```c
#define MB_CUR_MAX (__ctype_get_mb_cur_max())
#define EXIT_SUCCESS    0
#define EXIT_FAILURE    1
#define RAND_MAX        2147483647

typedef int (*__compar_fn_t) (const void *, const void *);
struct random_data
{
    int32_t *fptr;
    int32_t *rptr;
    int32_t *state;
    int rand_type;
    int rand_deg;
    int rand_sep;
    int32_t *end_ptr;
}

typedef struct
{
    int quot;
    int rem;
} div_t;

typedef struct
{
    long int quot;
    long int rem;
} ldiv_t;
```
typedef struct {
    long long int quot;
    long long int rem;
} lldiv_t;

13.4.38 sys/file.h

#define LOCK_SH 1
#define LOCK_EX 2
#define LOCK_NB 4
#define LOCK_UN 8

13.4.39 sys/ioctl.h

struct winsize {
    unsigned short ws_row;
    unsigned short ws_col;
    unsigned short ws_xpixel;
    unsigned short ws_ypixel;
}
;

13.4.40 sys/ipc.h

#define IPC_PRIVATE     ((key_t)0)
#define IPC_RMID        0
#define IPC_CREAT       00001000
#define IPC_EXCL        00002000
#define IPC_NOWAIT      00004000
#define IPC_SET 1
#define IPC_STAT        2

13.4.41 sys/mman.h

#define MAP_FAILED      ((void*)-1)
#define PROT_NONE       0x0
#define MAP_SHARED      0x01
#define MAP_PRIVATE     0x02
#define PROT_READ       0x1
#define MAP_FIXED       0x10
#define PROT_WRITE      0x2
#define MAP_ANONYMOUS   0x20
#define PROT_EXEC       0x4
#define MS_ASYNC        1
#define MS_INVALIDATE   2
#define MS_SYNC 4
#define MAP_ANON        MAP_ANONYMOUS

13.4.42 sys/msg.h

#define MSG_NOERROR     010000
13.4.43 sys/param.h

#define NOFILE 256
#define MAXPATHLEN 4096

13.4.44 sys/poll.h

#define POLLIN 0x0001
#define POLLPRI 0x0002
#define POLLOUT 0x0004
#define POLLERR 0x0008
#define POLLHUP 0x0010
#define POLLNVAL 0x0020

struct pollfd
{
    int fd;
    short events;
    short revents;
};

typedef unsigned long int nfds_t;

13.4.45 sys/resource.h

#define RUSAGE_CHILDREN (-1)
#define RUSAGE_BOTH (-2)
#define RLIM_INFINITY (~0UL)
#define RLIM_SAVED_CUR -1
#define RLIM_SAVED_MAX -1
#define RLIMIT_CPU 0
#define RUSAGE_SELF 0
#define RLIMITFSIZE 1
#define RLIMITDATA 2
#define RLIMITSTACK 3
#define RLIMITCHILDREN 4
#define RLIMITCORE 4
#define RLIMITNOFILE 7
#define RLIMITAS 9

typedef unsigned long int rlim_t;
typedef unsigned long long int rlim64_t;
typedef int __rlimit_resource_t;

struct rlimit
{
    rlim_t rlim_cur;
    rlim_t rlim_max;
};

struct rlimit64
{
    rlim64_t rlim_cur;
    rlim64_t rlim_max;
};

struct ususage
{
    struct timeval ru_utime;
    struct timeval ru_stime;
}
long int ru_maxrss;
long int ru_ixrss;
long int ru_idrss;
long int ru_isrss;
long int ru_minflt;
long int ru_majflt;
long int ru_nswap;
long int ru_inblock;
long int ru_oublock;
long int ru_msgsnd;
long int ru_msgrcv;
long int ru_nsignals;
long int ru_nvcsrw;
long int ru_nivcsw;

enum __priority_which
{
    PRIO_PROCESS, PRIO_PGRP = 1, PRIO_USER = 2
};

#define PRIO_PGRP       PRIO_PGRP
#define PRIO_PROCESS    PRIO_PROCESS
#define PRIO_USER       PRIO_USER

typedef enum __priority_which __priority_which_t;

13.4.46 sys/sem.h

#define SEM_UNDO        0x1000
#define GETPID  11
#define GETVAL  12
#define GETALL  13
#define GETNCNT 14
#define GETZCNT 15
#define SETVAL  16
#define SETALL  17

struct sembuf
{
    short sem_num;
    short sem_op;
    short sem_flg;
};

13.4.47 sys/shm.h

#define SHM_RDONLY      010000
#define SHM_W   0200
#define SHM_RND 020000
#define SHM_R   0400
#define SHM_REMAP       040000
#define SHM_LOCK        11
#define SHM_UNLOCK      12

13.4.48 sys/socket.h
#define CMSG_NXTHDR(mhdr, cmsg)   ( ((cmsg) == NULL) ?
   CMSG_FIRSTHDR(mhdr) : (((unsigned char *)cmsg) + CMSG_ALIGN((cmsg)>
cmsg_len) + CMSG_ALIGN(sizeof(struct cmsghdr)) > (unsigned char
*)((mhdr)->msg_control) + (mhdr)->msg_controllen) ? (struct cmsghdr *
)NULL : (struct cmsghdr *)((unsigned char *)(cmsg) +
   (size_t)~(size_t)-1) &
   (size_t)-(sizeof(size_t)-1))
#define CMSG_FIRSTHDR(msg)      ((size_t) (mhdr)->msg_controllen >=
   sizeof (struct cmsghdr) ? (struct cmsghdr *) (mhdr)->msg_control :
   (struct cmsghdr *) NULL)
#define CMSG_DATA(cmsg) ((unsigned char *) (cmsg) +
   CMSG_ALIGN(sizeof(struct cmsghdr)))
#define CMSG_LEN(len)   (CMSG_ALIGN(sizeof(struct cmsghdr))+(len))
#define CMSG_SPACE(len) (CMSG_ALIGN(sizeof(struct cmsghdr))+CMSG_ALIGN(len))
#define SCM_RIGHTS      0x01
#define SOL_SOCKET      1
#define SOMAXCONN       128
#define SOL_RAW 255

struct linger
{
    int l_onoff;
    int l_linger;
}

struct cmsghdr
{
    size_t cmsg_len;
    int cmsg_level;
    int cmsg_type;
}

struct iovec
{
    void *iov_base;
    size_t iov_len;
}

typedef unsigned short sa_family_t;
typedef unsigned int socklen_t;

struct sockaddr
{
    sa_family_t sa_family;
    char sa_data[14];
}

struct sockaddr_storage
{
    sa_family_t ss_family;
    __ss_aligntype __ss_align;
    char __ss_padding[(128 - (2 * sizeof (__ss_aligntype)))];
}

struct msghdr
{
    void *msg_name;
    int msg_namelen;
    struct iovec *msg_iov;
    size_t msg_iovlen;
    void *msg_control;
}
size_t msg_controllen;
unsigned int msg_flags;
}
;
#define AF_UNSPEC 0
#define AF_UNIX 1
#define AF_INET 10
#define AF_INET6 2
#define PF_INET AF_INET
#define PF_INET6 AF_INET6
#define PF_UNIX AF_UNIX
#define PF_UNSPEC AF_UNSPEC
#define SOCK_STREAM 1
#define SOCK_PACKET 10
#define SOCK_DGRAM 2
#define SOCK_RAW 3
#define SOCK_RDM 4
#define SOCK_SEQPACKET 5
#define SO_DEBUG 1
#define SO_OOBINLINE 10
#define SO_NO_CHECK 11
#define SO_PRIORITY 12
#define SO_LINGER 13
#define SO_REUSEADDR 2
#define SO_TYPE 3
#define SO_ACCEPTCONN 30
#define SO_ERROR 4
#define SO_DONTROUTE 5
#define SO_BROADCAST 6
#define SO_SNDBUF 7
#define SO_RCVBUF 8
#define SO_KEEPALIVE 9
#define SIOCIFFLAGS 0x8913
#define SIOCIFADDR 0x8915
#define SIOCIFNETMASK 0x891b
#define SHUT_RD 0
#define SHUT_WR 1
#define SHUT_RDWR 2
#define MSG_DONTROUTE 4
#define MSG_WAITALL 0x100
#define MSG_TRUNC 0x20
#define MSG_EOR 0x80
#define MSG_OOB 1
#define MSG_PEEK 2
#define MSG_CTRUNC 8

13.4.49 sys/stat.h

#define S_ISBLK(m) (((m) & S_IFMT)==S_IFBLK)
#define S_ISCHR(m) (((m) & S_IFMT)==S_IFCHR)
#define S_ISDIR(m) (((m) & S_IFMT)==S_IFDIR)
#define S_ISFIFO(m) (((m) & S_IFMT)==S_IFIFO)
#define S_ISLNK(m) (((m) & S_IFMT)==S_IFLNK)
#define S_ISREG(m) (((m) & S_IFMT)==S_IFREG)
#define S_ISSOCK(m) (((m) & S_IFMT)==S_IFSOCK)
#define S_TYPEISMQ(buf) ((buf)->st_mode - (buf)->st_mode)
#define S_TYPEISSEM(buf) ((buf)->st_mode - (buf)->st_mode)
13 Base Libraries

#define S_TYPEISSHM(buf) ((buf)->st_mode - (buf)->st_mode)
#define S_IRWXU (S_IREAD|S_IWRITE|S_IEXEC)
#define S_IROTH (S_IRGRP>>3)
#define S_IRGRP (S_IRUSR>>3)
#define S_IRWXO (S_IWGRP>>3)
#define S_IWGRP (S_IWUSR>>3)
#define S_IWOTH (S_IWGRP>>3)
#define S_IWGRP (S_IWUSR>>3)
#define S_ISVTX 01000
#define S_IXUSR 0x0040
#define S_IWUSR 0x0080
#define S_IRUSR 0x0100
#define S_ISGID 0x0400
#define S_ISUID 0x0800
#define S_IFIFO 0x1000
#define S_IFCHR 0x2000
#define S_IFDIR 0x4000
#define S_IFBLK 0x6000
#define S_IFREG 0x8000
#define S_IFLNK 0xa000
#define S_IFSOCK 0xc000
#define S_IFMT 0xf000
#define st_atime st_atim.tv_sec
#define st_ctime st_ctim.tv_sec
#define st_mtime st_mtim.tv_sec
#define S_IEXEC S_IXUSR
#define S_IWRITE S_IWUSR
#define S_IREAD S_IRUSR

13.4.50 sys/time.h

#define ITIMER_REAL 0
#define ITIMER_VIRTUAL 1
#define ITIMER_PROF 2

struct timezone
{
    int tz_minuteswest;
    int tz_dsttime;
};

typedef int __itimer_which_t;

struct timespec
{
    time_t tv_sec;
    long int tv_nsec;
};

struct timeval
{
    time_t tv_sec;
    suseconds_t tv_usec;
};

struct itimerval
{
    struct timeval it_interval;
};
struct timeval it_value;

13.4.51 sys/timeb.h

struct timeb
{
    time_t time;
    unsigned short millitm;
    short timezone;
    short dstflag;
}

13.4.52 sys/times.h

struct tms
{
    clock_t tms_utime;
    clock_t tms_stime;
    clock_t tms_cutime;
    clock_t tms_cstime;
}

13.4.53 sys/types.h

#define FD_ISSET(d,set) ((set)->fds_bits[((d)/(8*sizeof(long)))]|=(1<<((d)%(8*sizeof(long))))
#define FD_CLR(d,set)   ((set)->fds_bits[((d)/(8*sizeof(long)))]&=~(1<<((d)%(8*sizeof(long)))))
#define FD_SET(d,set)   ((set)->fds_bits[((d)/(8*sizeof(long)))]|=(1<<((d)%(8*sizeof(long)))))
#define FALSE   0
#define TRUE    1
#define FD_SETSIZE      1024
#define FD_ZERO(fdsetp) bzero(fdsetp, sizeof(*(fdsetp)))

typedef signed char int8_t;
typedef short int16_t;
typedef int int32_t;
typedef unsigned char u_int8_t;
typedef unsigned short u_int16_t;
typedef unsigned int u_int32_t;
typedef unsigned int uid_t;
typedef int pid_t;
typedef unsigned long int off_t;
typedef int key_t;
typedef long int suseconds_t;
typedef unsigned int u_int;
typedef struct
{
    int __val[2];
} fsid_t;
typedef unsigned int useconds_t;
typedef unsigned long int blksize_t;
typedef long int fd_mask;
typedef int timer_t;
typedef int clockid_t;

typedef unsigned int id_t;

typedef unsigned long long int ino64_t;
typedef long long int loff_t;
typedef unsigned long int blkcnt_t;
typedef unsigned long int fsblkcnt_t;
typedef unsigned long int fsfilcnt_t;
typedef unsigned long long int blkcnt64_t;
typedef unsigned long long int fsblkcnt64_t;
typedef unsigned long long int fsfilcnt64_t;
typedef unsigned char u_char;
typedef unsigned short u_short;
typedef unsigned long int u_long;

typedef unsigned long int ino_t;
typedef unsigned int gid_t;
typedef unsigned long long int dev_t;
typedef unsigned int mode_t;
typedef unsigned long int nlink_t;
typedef char *caddr_t;

typedef struct
{   
    unsigned long int fds_bits[FDSET_LONGS];
}
fd_set;

typedef long int clock_t;
typedef long int time_t;

13.4.54 sys/un.h

#define UNIX_PATH_MAX 108

struct sockaddr_un
{   
    sa_family_t sun_family;
    char sun_path[UNIX_PATH_MAX];
};

13.4.55 sys/utsname.h

#define SYS_NMLN 65

struct utsname
{   
    char sysname[65];
    char nodename[65];
    char release[65];
    char version[65];
    char machine[65];
    char domainname[65];
};

13.4.56 sys/wait.h
#define WIFSIGNALED(status)     (!WIFSTOPPED(status) & &
WEXITED(status))
#define WIFSTOPPED(status)      (((status) & 0xff) == 0x7f)
#define WEXITSTATUS(status)     (((status) & 0xff00) >> 8)
#define WTERMSIG(status)        ((status) & 0x7f)
#define WCOREDUMP(status)       ((status) & 0x80)
#define WIFEXITED(status)       (WTERMSIG(status) == 0)
#define WNOHANG 0x00000001
#define WUNTRACED 0x00000002
#define WCOREFLAG 0x80
#define WSTOPSIG(status)        WEXITSTATUS(status)

typedef enum {
   P_ALL, P_PID, P_PGID
} idtype_t;

13.4.57 syslog.h

#define LOG_EMERG       0
#define LOG_PRIMASK     0x07
#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_KERN        (0<<3)
#define LOG_AUTHPRIV    (10<<3)
#define LOG_FTP (11<<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_CRON        (9<<3)
#define LOG_FACMASK     0x03f8
#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_UPTO(pri)   ((1 << ((pri)+1)) - 1)
#define LOG_MASK(pri)   (1 << (pri))
#define LOG_PID 0x01
#define LOG_CONS        0x02
#define LOG_ODELAY      0x04
#define LOG_NDELAY      0x08
#define LOG_NOWAIT      0x10
#define LOG_PERROR      0x20

99
13.4.58 termios.h

#define TCIFLUSH 0
#define TCOOFF 0
#define TCSANOW 0
#define BS0 0000000
#define CR0 0000000
#define FF0 0000000
#define NL0 0000000
#define TAB0 0000000
#define VT0 0000000
#define OPOST 000001
#define OCRNL 0000010
#define ONOCR 0000020
#define ONLRET 0000040
#define OFILL 0000100
#define OFDEL 0000200
#define NL1 0000400
#define TCOFflush 1
#define TCOON 1
#define TCSADRAIN 1
#define TCIOFF 2
#define TCOflush 2
#define TCSAflush 2
#define TCION 3

typedef unsigned int speed_t;
typedef unsigned char cc_t;
typedef unsigned int tcflag_t;
#define NCCS 32

struct termios {
    tcflag_t c_iflag;
    tcflag_t c_oflag;
    tcflag_t c_cflag;
    tcflag_t c_lflag;
    cc_t c_line;
    cc_t c_cc[NCCS];
    speed_t c_ispeed;
    speed_t c_ospeed;
};

#define VINTR 0
#define VQUIT 1
#define VLNEXT 15
#define VERASE 2
#define VKILL 3
#define VEOF 4

#define IGNBRK 0000001
#define BRKINT 0000002
#define IGNPAR 0000004
#define PARMARK 0000010
#define INPCK 0000020
#define ISTRIP 0000040
#define INLCR 0000100
#define IGNCR 0000200
#define ICRNL 0000400
#define IXANY 0004000
#define IMAXBEL 0020000

#define CS5 0000000

100
#define ECHO 0000010
#define B0 0000000
#define B50 0000001
#define B75 0000002
#define B110 0000003
#define B134 0000004
#define B150 0000005
#define B200 0000006
#define B300 0000007
#define B600 0000010
#define B1200 0000011
#define B1800 0000012
#define B2400 0000013
#define B4800 0000014
#define B9600 0000015
#define B19200 0000016
#define B38400 0000017

13.4.59 time.h

#define CLK_TCK ((clock_t)__sysconf(2))
#define CLOCK_REALTIME 0
#define TIMER_ABSTIME 1
#define CLOCKS_PER_SEC 1000000L

struct tm {
    int tm_sec;
    int tm_min;
    int tm_hour;
    int tm_mday;
    int tm_mon;
    int tm_year;
    int tm_wday;
    int tm_yday;
    int tm_isdst;
    long int tm_gmtoff;
    char *tm_zone;
};

struct itimerspec {
    struct timespec it_interval;
    struct timespec it_value;
};

13.4.60 ulimit.h

#define UL_GETFSIZE 1
#define UL_SETFSIZE 2

13.4.61 unistd.h

#define SEEK_SET 0
#define STDIN_FILENO 0
#define SEEK_CUR 1
#define STDOUT_FILENO 1
13 Base Libraries

#define SEEK_END  2
#define STDERR_FILENO  2

typedef long long int off64_t;
#define F_OK  0
#define X_OK  1
#define W_OK  2
#define R_OK  4

#define _POSIX_VDISABLE '\0'
#define _POSIX_CHOWN_RESTRICTED 1
#define _POSIX_JOB_CONTROL 1
#define _POSIX_NO_TRUNC 1
#define _POSIX_SHELL 1
#define _POSIX_FSYNC 200112
#define _POSIX_MAPPED_FILES 200112
#define _POSIX_MEMLOCK 200112
#define _POSIX_MEMLOCK_RANGE 200112
#define _POSIX_MEMORY_PROTECTION 200112
#define _POSIX_SEMAPHORES 200112
#define _POSIX_SHARED_MEMORY_OBJECTS 200112
#define _POSIX_TIMERS 200112
#define _POSIX2_C_BIND 200112L
#define _POSIX_THREADS 200112L

#define _PC_LINK_MAX 0
#define _PC_MAX_CANON 1
#define _PC_ASYNC_IO 10
#define _PC_PRIO_IO 11
#define _PC_FILESYSTEMBITS 13
#define _PC_REC_INCR_XFER_SIZE 14
#define _PC_REC_MIN_XFER_SIZE 16
#define _PC_REC_XFER_ALIGN 17
#define _PC_ALLOC_SIZE_MIN 18
#define _PC_MAX_INPUT 2
#define _PC_2_SYMLINKS 20
#define _PC_PRIORITY_SCHEDULING 10
#define _SC_ARG_MAX 0
#define _SC_CHILD_MAX 1
#define _SC_PRIORITY_SCHEDULING 10
#define _SC_TIMERS 11
#define _SCASYNCHRONOUS_IO 12
#define _SC_XBS5_ILP32_OFF32 125
#define _SC_XBS5_ILP32_OFFBIG 126
#define _SC_XBS5_LP64_OFF64 127
#define _SC_XBS5_LPBIG_OFFBIG 128
#define _SC_XOPEN_LEGACY 129
#define _SC_PRIORITIZED_IO 13
#define _SC_XOPEN_REALTIME 130
#define _SC_XOPEN_REALTIME_THREADS 131
#define _SC_ADVISORY_INFO 132
#define _SC_BARRIERS 133
#define _SC_CLOCK_SELECTION 137
#define _SC_CPUTIME 138
#define _SC_THREAD_CPUTIME 139
#define _SC_SYNCHRONIZED_IO 14
#define _SC_MONOTONIC_CLOCK 149
#define _SC_FSYNC       15
#define _SC_READER_WRITER_LOCKS 153
#define _SC_SPIN_LOCKS  154
#define _SC_REGEXP      155
#define _SC_SHELL       157
#define _SC_SPAWN       159
#define _SC_MAPPED_FILES 16
#define _SC_SPAWN       160
#define _SC_THREAD_SPORADIC_SERVER 161
#define _SC_TIMEOUTS   164
#define _SC_TYPED_MEMORY_OBJECTS 165
#define _SC_2_PBS_ACCOUNTING 169
#define _SC_MEMLOCK     17
#define _SC_2_PBS_LOCATE 170
#define _SC_2_PBS_MESSAGE 171
#define _SC_2_PBS_TRACK 172
#define _SC_SYMLOOP_MAX 173
#define _SC_2_PBS_CHECKPOINT 175
#define _SC_V6_ILP32_OFF32 176
#define _SC_V6_ILP32_OFFBIG 177
#define _SC_V6_LP64_OFF64 178
#define _SC_V6_LPBIG_OFFBIG 179
#define _SC_MEMLOCK_RANGE 18
#define _SC_HOST_NAME_MAX 180
#define _SC_TRACE       181
#define _SC_TRACE_EVENT_FILTER 182
#define _SC_TRACE_INHERIT 183
#define _SC_TRACE_LOG   184
#define _SC_MEMORY_PROTECTION 19
#define _SC_CLK_TCK     2
#define _SC_MESSAGE_PASSING 20
#define _SC_SEMAPHORES  21
#define _SC_SHARED_MEMORY_OBJECTS 22
#define _SC_AIO_LISTIO_MAX 23
#define _SC_AIO_MAX     24
#define _SC_AIO_PRIO_DELTA_MAX 25
#define _SC_DELAYTIMER_MAX 26
#define _SC_MQ_OPEN_MAX 27
#define _SC_MQ_PRIO_MAX 28
#define _SC_VERSION 29
#define _SC_NGROUPS_MAX 3
#define _SC_PAGESIZE 30
#define _SC_PAGE_SIZE 30
#define _SC_RTSIG_MAX   31
#define _SC_SEM_NSEMS_MAX 32
#define _SC_SEM_VALUE_MAX 33
#define _SC_SIGQUEUE_MAX 34
#define _SC_TIMER_MAX   35
#define _SC_BC_BASE_MAX 36
#define _SC_BC_DIM_MAX 37
#define _SC_BC_SCALE_MAX 38
#define _SC_BC_STRING_MAX 39
#define _SC_OPEN_MAX 4
#define _SC_COLL_WEIGHTS_MAX 40
#define _SC_EXPR_NEST_MAX 42
#define _SC_LINE_MAX 43
#define _SC_RE_DUP_MAX 44
#define _SC_2_VERSION 46
#define _SC_2_C_BIND 47
#define _SC_2_C_DEV 48
#define _SC_2_FORT_DEV 49
#define _SC_2_FORT_RUN 50
#define _SC_2_SW_DEV 51
#define _SC_2_LOCALEDEF 52
#define _SC_TZNAME_MAX 6
#define _SC_IOV_MAX 60
#define _SC_THREADS 67
#define _SC_THREAD_SAFE_FUNCTIONS 68
#define _SC_GETGR_R_SIZE_MAX 69
#define _SC_JOB_CONTROL 7
#define _SC_GETPW_R_SIZE_MAX 70
#define _SC_LOGIN_NAME_MAX 71
#define _SC_TTY_NAME_MAX 72
#define _SC_THREAD_DESTRUCTOR_ITERATIONS 73
#define _SC_THREAD_KEYS_MAX 74
#define _SC_THREAD_STACK_MIN 75
#define _SC_THREAD_THREADS_MAX 76
#define _SC_THREAD_ATTR_STACKADDR 77
#define _SC_THREAD_ATTR_STACKSIZE 78
#define _SC_THREAD_PRIORITY_SCHEDULING 79
#define _SC_SAVED_IDS 8
#define _SC_THREAD_PRIO_INHERIT 80
#define _SC_THREAD_PRIO_PROTECT 81
#define _SC_THREAD_PROCESS_SHARED 82
#define _SC_ATEXIT_MAX 87
#define _SC_PASS_MAX 88
#define _SC_XOPEN_VERSION 89
#define _SC_REALTIME_SIGNALS 9
#define _SC_XOPEN_UNIX 91
#define _SC_XOPEN_CRYPT 92
#define _SC_XOPEN_ENH_I18N 93
#define _SC_XOPEN_SHM 94
#define _SC_2_CHAR_TERM 95
#define _SC_2_C_VERSION 96
#define _SC_2_UPE 97

#define _CS_PATH 0
#define _POSIX_REGEXP 1
#define _CS_XBS5_ILP32_OFF32_CFLAGS 1100
#define _CS_XBS5_ILP32_OFF32_LDFLAGS 1101
#define _CS_XBS5_ILP32_OFF32_LIBS 1102
#define _CS_XBS5_ILP32_OFF32_LINTFLAGS 1103
#define _CS_XBS5_ILP32_OFFBIG_CFLAGS 1104
#define _CS_XBS5_ILP32_OFFBIG_LDFLAGS 1105
#define _CS_XBS5_ILP32_OFFBIG_LIBS 1106
#define _CS_XBS5_ILP32_OFFBIG_LINTFLAGS 1107
#define _CS_XBS5_LP64_OFF64_CFLAGS 1108
#define _CS_XBS5_LP64_OFF64_LDFLAGS 1109
#define _CS_XBS5_LP64_OFF64_LIBS 1110
#define _CS_XBS5_LP64_OFF64_LINTFLAGS 1111
#define _CS_XBS5_LPBIG_OFFBIG_CFLAGS 1112
#define _CS_XBS5_LPBIG_OFFBIG_LDFLAGS 1113
#define _CS_XBS5_LPBIG_OFFBIG_LIBS 1114
#define _CS_XBS5_LPBIG_OFFBIG_LINTFLAGS 1115

#define _XOPEN_XPG4 1
#define F_ULOCK 0
#define F_LOCK 1
#define F_TLOCK 2
#define F_TEST 3

13.4.62 utime.h

struct utimbuf
{

time_t actime;
time_t modtime;

13.4.63 utmp.h

#define UT_HOSTSIZE 256
#define UT_LINESIZE 32
#define UT_NAMESIZE 32

struct exit_status
{
    short e_termination;
    short e_exit;
}

#define EMPTY 0
#define RUN_LVL 1
#define BOOT_TIME 2
#define NEW_TIME 3
#define OLD_TIME 4
#define INIT_PROCESS 5
#define LOGIN_PROCESS 6
#define USER_PROCESS 7
#define DEAD_PROCESS 8
#define ACCOUNTING 9

13.4.64 wchar.h

#define WEOF (0xffffffffu)
#define WCHAR_MAX 0x7FFFFFFF
#define WCHAR_MIN 0x80000000

13.4.65 wctype.h

typedef unsigned long int wctype_t;
typedef unsigned int wint_t;
typedef const int32_t *wctrans_t;
typedef struct
{
    int count;
    wint_t value;
} __mbstate_t;
typedef __mbstate_t mbstate_t;

13.4.66 wordexp.h

enum
{
    WRDE_DOFFS, WRDE_APPEND, WRDE_NOCMD, WRDE_REUSE, WRDE_SHOWERR,
    WRDE_UNDEF,
    __WRDE_FLAGS
}
typedef struct
{
    int we_wordc;
    char **we_wordv;
    int we_offs;
} wordexp_t;
enum
{
    WRDE_NOSYS, WRDE_NOSPACE, WRDE_BADCHAR, WRDE_BADVAL, WRDE_CMDSUB,
    WRDE_SYNTAX
};

13.5 Interface Definitions for libc

The following interfaces are included in libc and are defined by this specification. Unless otherwise noted, these interfaces shall be included in the source standard. Other interfaces listed above for libc shall behave as described in the referenced base document.

_IO_feof

Name

_IO_feof — alias for feof

Synopsis

int _IO_feof(_IO_FILE * __fp);

Description

_IO_feof() tests the end-of-file indicator for the stream pointed to by __fp, returning a non-zero value if it is set. _IO_feof() is not in the source standard; it is only in the binary standard.

_IO_getc

Name

_IO_getc — alias for getc

Synopsis

int _IO_getc(_IO_FILE * __fp);

Description

_IO_getc() reads the next character from __fp and returns it as an unsigned char cast to an int, or EOF on end-of-file or error. _IO_getc() is not in the source standard; it is only in the binary standard.
_IO_putc

Name

_IO_putc — alias for putc

Synopsis

int _IO_putc(int __c, _IO_FILE *__fp);

Description

_IO_putc() writes the character __c, cast to an unsigned char, to __fp.
_IOC_putc() is not in the source standard; it is only in the binary standard.

_IO_puts

Name

_IOC_puts — alias for puts

Synopsis

int _IO_puts(const char *__s);

Description

_IOC_puts() writes the string __s and a trailing newline to stdout.
_IOC_puts() is not in the source standard; it is only in the binary standard.

__assert_fail

Name

__assert_fail — abort the program after false assertion

Synopsis

void __assert_fail(const char * assertion, const char * file, unsigned int line, const char * function);

Description

The __assert_fail() function is used to implement the assert() interface of ISO POSIX (2003). The __assert_fail() function shall print the given file filename, line line number, function function name and a message on the standard error stream in an unspecified format, and abort program execution via the abort() function. For example:

    a.c:10: foobar: Assertion a == b failed.

If function is NULL, __assert_fail() shall omit information about the function.
assertion, file, and line shall be non-NULL.

The __assert_fail() function is not in the source standard; it is only in the binary standard. The assert() interface is not in the binary standard; it is only in the source standard. The assert() may be implemented as a macro.
__ctype_b_loc

Name

__ctype_b_loc — accessor function for __ctype_b array for ctype functions

Synopsis

#include <ctype.h>
const unsigned short ** __ctype_b_loc(void);

Description

The __ctype_b_loc() function shall return a pointer into an array of characters in the current locale that contains characteristics for each character in the current character set. The array shall contain a total of 384 characters, and can be indexed with any signed or unsigned char (i.e. with an index value between −128 and 255). If the application is multithreaded, the array shall be local to the current thread.

This interface is not in the source standard; it is only in the binary standard.

Return Value

The __ctype_b_loc() function shall return a pointer to the array of characters to be used for the ctype() family of functions (see <ctype.h>).

__ctype_get_mb_cur_max

Name

__ctype_get_mb_cur_max — maximum length of a multibyte character in the current locale

Synopsis

size_t __ctype_get_mb_cur_max(void);

Description

__ctype_get_mb_cur_max() returns the maximum length of a multibyte character in the current locale.

__ctype_get_mb_cur_max() is not in the source standard; it is only in the binary standard.
__ctype_tolower_loc

Name
__ctype_tolower_loc — accessor function for __ctype_b_tolower array for
cctype tolower() function

Synopsis
#include <ctype.h>
int32_t * * __ctype_tolower_loc(void);

Description
The __ctype_tolower_loc() function shall return a pointer into an array of
caracters in the current locale that contains lower case equivalents for each
caracter in the current character set. The array shall contain a total of 384
caracters, and can be indexed with any signed or unsigned char (i.e. with an index
value between -128 and 255). If the application is multithreaded, the array shall be
local to the current thread.

This interface is not in the source standard; it is only in the binary standard.

Return Value
The __ctype_tolower_loc() function shall return a pointer to the array of
caracters to be used for the cctype() family of functions (see <ctype.h>).

__ctype_toupper_loc

Name
__ctype_toupper_loc — accessor function for __ctype_b_toupper() array for
cctype toupper() function

Synopsis
#include <ctype.h>
int32_t * * __ctype_toupper_loc(void);

Description
The __ctype_toupper_loc() function shall return a pointer into an array of
caracters in the current locale that contains upper case equivalents for each
caracter in the current character set. The array shall contain a total of 384
caracters, and can be indexed with any signed or unsigned char (i.e. with an index
value between -128 and 255). If the application is multithreaded, the array shall be
local to the current thread.

This interface is not in the source standard; it is only in the binary standard.

Return Value
The __ctype_toupper_loc() function shall return a pointer to the array of
caracters to be used for the cctype() family of functions (see <ctype.h>).
__cxa_atexit

Name
__cxa_atexit — register a function to be called by exit or when a shared library is unloaded

Synopsis
int __cxa_atexit(void (*func) (void *), void * arg, void * dso_handle);

Description
As described in the Itanium C++ ABI, __cxa_atexit() registers a destructor function to be called by exit() or when a shared library is unloaded. When a shared library is unloaded, any destructor function associated with that shared library, identified by dso_handle, shall be called with the single argument arg, and then that function shall be removed, or marked as complete, from the list of functions to run at exit(). On a call to exit(), any remaining functions registered shall be called with the single argument arg. Destructor functions shall always be called in the reverse order to their registration (i.e. the most recently registered function shall be called first).

The __cxa_atexit() function is used to implement atexit(), as described in ISO POSIX (2003). Calling atexit(func) from the statically linked part of an application shall be equivalent to __cxa_atexit(func, NULL, NULL).

__cxa_atexit() is not in the source standard; it is only in the binary standard.

Note: atexit() is not in the binary standard; it is only in the source standard.

__daylight

Name
__daylight — daylight savings time flag

Synopsis
int __daylight;

Description
The integer variable __daylight shall implement the daylight savings time flag daylight as specified in the ISO POSIX (2003) header file <time.h>.

__daylight is not in the source standard; it is only in the binary standard.
daylight is not in the binary standard; it is only in the source standard.
__environ

Name
__environ — alias for environ - user environment

Synopsis
extern char * *__environ;

Description
__environ is an alias for environ - user environment.
__environ has the same specification as environ.
__environ is not in the source standard; it is only in the binary standard.

__errno_location

Name
__errno_location — address of errno variable

Synopsis
int * __errno_location(void);

Description
__errno_location() is not in the source standard; it is only in the binary standard.

__fpending

Name
__fpending — returns in bytes the amount of output pending on a stream

Synopsis
#include <stdio_ext.h>
size_t __fpending(FILE * stream);

Description
__fpending() returns the amount of output in bytes pending on a stream.
__fpending() is not in the source standard; it is only in the binary standard.
__getpagesize

Name
__getpagesize — alias for getpagesize - get current page size

Synopsis
int __getpagesize(void);

Description
__getpagesize() is an alias for getpagesize() - get current page size.
__getpagesize() has the same specification as getpagesize().
__getpagesize() is not in the source standard; it is only in the binary standard.

__getpgid

Name
__getpgid — get the process group id

Synopsis
pid_t __getpgid(pid_t pid);

Description
__getpgid() has the same specification as getpgid().
__getpgid() is not in the source standard; it is only in the binary standard.

__h_errno_location

Name
__h_errno_location — address of h_errno variable

Synopsis
int * __h_errno_location(void);

Description
__h_errno_location() returns the address of the h_errno variable, where h_errno is as specified in ISO POSIX (2003).
__h_errno_location() is not in the source standard; it is only in the binary standard. Note that h_errno itself is only in the source standard; it is not in the binary standard.
__isinf

Name
__isinf – test for infinity

Synopsis
int __isinf(double arg);

Description
__isinf() has the same specification as isinf() in ISO POSIX (2003), except that the argument type for __isinf() is known to be double.
__isinf() is not in the source standard; it is only in the binary standard.

__isinff

Name
__isinff – test for infinity

Synopsis
int __isinff(float arg);

Description
__isinff() has the same specification as isinf() in ISO POSIX (2003) except that the argument type for __isinff() is known to be float.
__isinff() is not in the source standard; it is only in the binary standard.

__isinfl

Name
__isinfl – test for infinity

Synopsis
int __isinfl(long double arg);

Description
__isinfl() has the same specification as isinf() in the ISO POSIX (2003), except that the argument type for __isinfl() is known to be long double.
__isinfl() is not in the source standard; it is only in the binary standard.
__isnan

Name

__isnan — test for infinity

Synopsis

int __isnan(double arg);

Description

__isnan() has the same specification as isnan() in ISO POSIX (2003), except that the argument type for __isnan() is known to be double.

__isnan() is not in the source standard; it is only in the binary standard.

__isnanf

Name

__isnanf — test for infinity

Synopsis

int __isnanf(float arg);

Description

__isnanf() has the same specification as isnan() in ISO POSIX (2003), except that the argument type for __isnanf() is known to be float.

__isnanf() is not in the source standard; it is only in the binary standard.

__isnanl

Name

__isnanl — test for infinity

Synopsis

int __isnanl(long double arg);

Description

__isnanl() has the same specification as isnan() in ISO POSIX (2003), except that the argument type for __isnanl() is known to be long double.

__isnanl() is not in the source standard; it is only in the binary standard.
__libc_current_sigrtmax

Name

__libc_current_sigrtmax — return number of available real-time signal with
lowest priority

Synopsis

int __libc_current_sigrtmax(void);

Description

__libc_current_sigrtmax() returns the number of an available real-time signal
with the lowest priority.

__libc_current_sigrtmax() is not in the source standard; it is only in the binary
standard.

__libc_current_sigrtmin

Name

__libc_current_sigrtmin — return number of available real-time signal with
highest priority

Synopsis

int __libc_current_sigrtmin(void);

Description

__libc_current_sigrtmin() returns the number of an available real-time signal
with the highest priority.

__libc_current_sigrtmin() is not in the source standard; it is only in the binary
standard.

__libc_start_main

Name

__libc_start_main — initialization routine

Synopsis

int __libc_start_main(int *(main) (int, char **, char **), int argc,
char ** ubp_av, void (*init) (void), void (*fini) (void), void
(*rtld_fini) (void), void (* stack_end));

Description

The __libc_start_main() function shall initialize the process, call the main
function with appropriate arguments, and handle the return from main().

__libc_start_main() is not in the source standard; it is only in the binary
standard.
__lxstat

Name
__lxstat — inline wrapper around call to lxstat

Synopsis
#include <ctype.h>
int __lxstat(int version, char *__path, struct stat __statbuf);

Description
__lxstat() is an inline wrapper around call to lxstat().
__lxstat() is not in the source standard; it is only in the binary standard.

__memcpy

Name
__memcpy — copy given number of bytes of source to destination

Synopsis
#include <string.h>
ptr_t __memcpy(ptr_t restrict dest, const ptr_t restrict src, size_t n);

Description
__memcpy() copies \( n \) bytes of source to destination, returning pointer to bytes after
the last written byte.
__memcpy() is not in the source standard; it is only in the binary standard.

__rawmemchr

Name
__rawmemchr — scan memory

Synopsis
#include <string.h>
ptr_t __rawmemchr(const ptr_t s, int c);

Description
__rawmemchr() searches in \( s \) for \( c \).
__rawmemchr() is a weak alias to rawmemchr(). It is similar to memchr(), but it has
no length limit.
__rawmemchr() is not in the source standard; it is only in the binary standard.
__register_atfork

Name
__register_atfork — alias for register_atfork

Synopsis
int __register_atfork(void (*prepare) (void), void (*parent) (void),
void (*child) (void), void *__dso_handle);

Description
__register_atfork() implements pthread_atfork() as specified in ISO POSIX
(2003). The additional parameter __dso_handle allows a shared object to pass in it's
handle so that functions registered by __register_atfork() can be unregistered
by the runtime when the shared object is unloaded.

__sigsetjmp

Name
__sigsetjmp — save stack context for non-local goto

Synopsis
int __sigsetjmp(jmp_buf env, int savemask);

Description
__sigsetjmp() has the same behavior as sigsetjmp() as specified by ISO POSIX
(2003).
__sigsetjmp() is not in the source standard; it is only in the binary standard.

__stpcpy

Name
__stpcpy — copy a string returning a pointer to its end

Synopsis
#include <string.h>
char *__stpcpy(char * dest, const char * src);

Description
__stpcpy() copies the string src (including the terminating /0 character) to the
array dest. The strings may not overlap, and dest must be large enough to receive
the copy.

Return Value
__stpcpy() returns a pointer to the end of the string dest (that is, the address of
the terminating NULL character) rather than the beginning.
__stpcpy() has the same specification as stpcpy().
__stpcpy() is not in the source standard; it is only in the binary standard.
__strdup

Name
__strdup — alias for strdup

Synopsis
cchar * __strdup(const char string);

Description
__strdup() has the same specification as strdup().
__strdup() is not in the source standard; it is only in the binary standard.

__strtod_internal

Name
__strtod_internal — underlying function for strtod

Synopsis
double __strtod_internal(const char * __nptr, char * * __endptr, int __group);

Description
__group shall be 0 or the behavior of __strtod_internal() is undefined.
__strtod_internal(__nptr, __endptr, 0)() has the same specification as
strtod(__nptr, __endptr)().
__strtod_internal() is not in the source standard; it is only in the binary
standard.

__strtof_internal

Name
__strtof_internal — underlying function for strtof

Synopsis
float __strtof_internal(const char * __nptr, char * * __endptr, int __group);

Description
__group shall be 0 or the behavior of __strtof_internal() is undefined.
__strtof_internal(__nptr, __endptr, 0)() has the same specification as
strtof(__nptr, __endptr)().
__strtof_internal() is not in the source standard; it is only in the binary
standard.
__strtok_r

Name
__strtok_r — alias for strtok_r

Synopsis
char * __strtok_r(char * restrict s, const char * restrict delim, char * * restrict save_ptr);

Description
__strtok_r() has the same specification as strtok_r().
__strtok_r() is not in the source standard; it is only in the binary standard.

__strtol_internal

Name
__strtol_internal — alias for strtol

Synopsis
long int __strtol_internal(const char * __nptr, char * * __endptr, int __base, int __group);

Description
__group shall be 0 or the behavior of __strtol_internal() is undefined.
__strtol_internal(__nptr, __endptr, __base, 0) has the same specification as
strtol(__nptr, __endptr, __base).
__strtol_internal() is not in the source standard; it is only in the binary standard.

__strtold_internal

Name
__strtold_internal — underlying function for strtold

Synopsis
long double __strtold_internal(const char * __nptr, char * * __endptr, int __group);

Description
__group shall be 0 or the behavior of __strtold_internal() is undefined.
__strtold_internal(__nptr, __endptr, 0) has the same specification as
strtold(__nptr, __endptr).
__strtold_internal() is not in the source standard; it is only in the binary standard.
__strtoll_internal

Name
__strtoll_internal — underlying function for strtoll

Synopsis

long long __strtoll_internal(const char * __nptr, char * * __endptr, int __base, int __group);

Description
__group shall be 0 or the behavior of __strtoll_internal() is undefined.
__strtoll_internal(__nptr, __endptr, __base, 0) has the same specification as
cstrtol(__nptr, __endptr, __base).
__strtoll_internal() is not in the source standard; it is only in the binary
standard.

__strtoul_internal

Name
__strtoul_internal — underlying function for strtoul

Synopsis

unsigned long int __strtoul_internal(const char * __nptr, char * * __endptr, int __base, int __group);

Description
__group shall be 0 or the behavior of __strtoul_internal() is undefined.
__strtoul_internal(__nptr, __endptr, __base, 0) has the same specification as
cstrtol(__nptr, __endptr, __base).
__strtoul_internal() is not in the source standard; it is only in the binary
standard.
__strtoull_internal

Name
__strtoull_internal — underlying function for strtoull

Synopsis
unsigned long long __strtoull_internal(const char *__nptr, char **__endptr, int __base, int __group);

Description
__group shall be 0 or the behavior of __strtoull_internal() is undefined.
__strtoull_internal(__nptr, __endptr, __base, 0) has the same specification
as strtoull(__nptr, __endptr, __base).
__strtoull_internal() is not in the source standard; it is only in the binary
standard.

__sysconf

Name
__sysconf — get configuration information at runtime

Synopsis
#include <unistd.h>
long __sysconf(int name);

Description
__sysconf() gets configuration information at runtime.
__sysconf() is weak alias to sysconf().
__sysconf() has the same specification as sysconf().
__sysconf() is not in the source standard; it is only in the binary standard.

__sysv_signal

Name
__sysv_signal — signal handling

Synopsis
__sighandler_t __sysv_signal(int sig, __sighandler_t handler);

Description
__sysv_signal() has the same behavior as signal() as specified by ISO POSIX
(2003).
__sysv_signal() is not in the source standard; it is only in the binary standard.
__timezone

Name
— global variable containing timezone

Synopsis
long int __timezone;

Description
__timezone() has the same specification as timezone() in the ISO POSIX (2003)

__tzname

Name
— global variable containing the timezone

Synopsis
char * __tzname[2];

Description
__tzname has the same specification as tzname in the ISO POSIX (2003).
Note that the array size of 2 is explicit in the ISO POSIX (2003), but not in the SUSv2.

__wcstod_internal

Name
__wcstod_internal — underlying function for wcstod

Synopsis
double __wcstod_internal(const wchar_t * nptr, wchar_t * * endptr, int group);

Description
group shall be 0 or the behavior of __wcstod_internal() is undefined.
__wcstod_internal(nptr, endptr, 0) shall behave as wcstod(nptr, endptr) as
__wcstod_internal() is not in the source standard; it is only in the binary
standard.
__wcstof_internal

Name
__wcstof_internal — underlying function for wcstof

Synopsis
float __wcstof_internal(const wchar_t * nptr, wchar_t ** endptr, int group);

Description
group shall be 0 or the behavior of __wcstof_internal() is undefined.
__wcstof_internal(nptr, endptr, 0) shall behave as wcstof(nptr, endptr) as specified in ISO POSIX (2003).
__wcstof_internal() is not in the source standard; it is only in the binary standard.

__wcstol_internal

Name
__wcstol_internal — underlying function for wcstol

Synopsis
long __wcstol_internal(const wchar_t * nptr, wchar_t ** endptr, int base, int group);

Description
group shall be 0 or the behavior of __wcstol_internal() is undefined.
__wcstol_internal(nptr, endptr, base, 0) shall behave as wcstol(nptr, endptr, base) as specified by ISO POSIX (2003).
__wcstol_internal() is not in the source standard; it is only in the binary standard.
__wcstold_internal

Name
__wcstold_internal – underlying function for wcstold

Synopsis
long double __wcstold_internal(const wchar_t * nptr, wchar_t * * endptr, int group);

Description

__wcstold_internal() is not in the source standard; it is only in the binary standard.

__wcstoul_internal

Name
__wcstoul_internal – underlying function for wcstoul

Synopsis
unsigned long __wcstoul_internal(const wchar_t * restrict nptr, wchar_t * * restrict endptr, int base, int group);

Description

__wcstoul_internal() is not in the source standard; it is only in the binary standard.
__xmknod

Name
__xmknod – make block or character special file

Synopsis
int __xmknod(int ver, const char *path, mode_t mode, dev_t *dev);

Description
The __xmknod() function shall implement the mknod() interface from ISO POSIX (2003).
The value of ver shall be 1 or the behavior of __xmknod() is undefined.
__xmknod(1, path, mode, dev) shall behave as mknod(path, mode, dev) as specified by ISO POSIX (2003).
The __xmknod() function is not in the source standard; it is only in the binary standard.

Note: The mknod() function is not in the binary standard; it is only in the source standard.

__xstat

Name
__xstat – get File Status

Synopsis
#include <sys/stat.h>
#include <unistd.h>
int __xstat(int ver, const char *path, struct stat *stat_buf);
int __lxstat(int ver, const char *path, struct stat *stat_buf);
int __fxstat(int ver, int fildes, struct stat *stat_buf);

Description
The functions __xstat(), __lxstat(), and __fxstat() shall implement the ISO POSIX (2003) functions stat(), lstat(), and fstat() respectively.
ver shall be 3 or the behavior of these functions is undefined.
__xstat(3, path, stat_buf) shall implement stat(path, stat_buf) as specified by ISO POSIX (2003).
__lxstat(3, path, stat_buf) shall implement lstat(path, stat_buf) as specified by ISO POSIX (2003).
__fxstat(3, fildes, stat_buf) shall implement fstat(fildes, stat_buf) as specified by ISO POSIX (2003).
__xstat(), __lxstat(), and __fxstat() are not in the source standard; they are only in the binary standard.
stat(), lstat(), and fstat() are not in the binary standard; they are only in the source standard.
### __xstat64

**Name**

__xstat64 — get File Status

**Synopsis**

```c
#define _LARGEFILE_SOURCE 1
#include <sys/stat.h>
#include <unistd.h>
int __xstat64(int ver, const char *path, struct stat64 *stat_buf);
int __lxstat64(int ver, const char *path, struct stat64 *stat_buf);
int __fxstat64(int ver, int fildes, struct stat64 *stat_buf);
```

**Description**

The functions __xstat64(), __lxstat64(), and __fxstat64() shall implement the Large File Support functions stat64(), lstat64(), and fstat64() respectively.

`ver` shall be 3 or the behavior of these functions is undefined.

- **__xstat64(3, path, stat_buf)** shall behave as `stat(path, stat_buf)` as specified by Large File Support.
- **__lxstat64(3, path, stat_buf)** shall behave as `lstat(path, stat_buf)` as specified by Large File Support.
- **__fxstat64(3, fildes, stat_buf)** shall behave as `fstat(fildes, stat_buf)` as specified by Large File Support.

__xstat64(), __lxstat64(), and __fxstat64() are not in the source standard; they are only in the binary standard.

- `stat64()`, `lstat64()`, and `fstat64()` are not in the binary standard; they are only in the source standard.

### _environ

**Name**

_environ — alias for environ - user environment

**Synopsis**

```c
extern char * * _environ;
```

**Description**

_environ is an alias for environ - user environment.

### _nl_msg_cat_cntr

**Name**

_nl_msg_cat_cntr — new catalog load counter

**Synopsis**

```c
#include <libintl.h>
```
extern int _nl_msg_cat_cntr;

**Description**

The global variable _nl_msg_cat_cntr is incremented each time a new catalog is loaded. This variable is only in the binary standard; it is not in the source standard.

**_sys_errlist**

**Name**

_sys_errlist — array containing the "C" locale strings used by strerror()

**Synopsis**

```c
#include <stdio.h>

extern const char *const _sys_errlist[];
```

**Description**

_sys_errlist is an array containing the "C" locale strings used by strerror(). This normally should not be used directly. strerror() provides all of the needed functionality.

**_sys_siglist**

**Name**

_sys_siglist — array containing the names of the signal names

**Synopsis**

```c
#include <signal.h>

extern const char *const _sys_siglist[NSIG];
```

**Description**

_sys_siglist is an array containing the names of the signal names.

The _sys_siglist array is only in the binary standard; it is not in the source standard. Applications wishing to access the names of signals should use the strsignal() function.
acct

Name
acct — switch process accounting on or off

Synopsis
#include <dirent.h>
int acct(const char * filename);

Description
When filename is the name of an existing file, acct() turns accounting on and
appends a record to filename for each terminating process. When filename is
NULL, acct() turns accounting off.

Return Value
On success, 0 is returned. On error, -1 is returned and the global variable errno is
set appropriately.

Errors
ENOSYS
BSD process accounting has not been enabled when the operating system
kernel was compiled. The kernel configuration parameter controlling this
feature is CONFIG_BSD_PROCESS_ACCT.

ENOMEM
Out of memory.

EPERM
The calling process has no permission to enable process accounting.

EACCES
filename is not a regular file.

EIO
Error writing to the filename.

EUSERS
There are no more free file structures or we run out of memory.
adjtime

Name
adjtime — correct the time to allow synchronization of the system clock

Synopsis
#include <time.h>
int adjtime(const struct timeval * delta, struct timeval * olddelta);

Description
adjtime() makes small adjustments to the system time as returned by
gmtime(2), advancing or retarding it by the time specified by the timeval
delta. If delta is negative, the clock is slowed down by incrementing it more
slowly than normal until the correction is complete. If delta is positive, a larger
increment than normal is used. The skew used to perform the correction is
generally a fraction of one percent. Thus, the time is always a monotonically
increasing function. A time correction from an earlier call to adjtime() may not be
finished when adjtime() is called again. If olddelta is non-NULL, the structure
pointed to will contain, upon return, the number of microseconds still to be
corrected from the earlier call.

adjtime() may be used by time servers that synchronize the clocks of computers in
a local area network. Such time servers would slow down the clocks of some
machines and speed up the clocks of others to bring them to the average network
time.

Appropriate privilege is required to adjust the system time.

Return Value
On success, 0 is returned. On error, -1 is returned and the global variable errno is
set appropriately.

Errors
EFAULT

An argument points outside the process’s allocated address space.

EPERM

The process does not have appropriate privilege.
asprintf

Name
asprintf — write formatted output to a dynamically allocated string

Synopsis
#include <stdio.h>
int asprintf(char ** restrict ptr, const char * restrict format, ...);

Description
The asprintf() function shall behave as sprintf(), except that the output string shall be dynamically allocated space of sufficient length to hold the resulting string. The address of this dynamically allocated string shall be stored in the location referenced by ptr.

Return Value
Refer to fprintf().

Errors
Refer to fprintf().
bind_textdomain_codeset

Name
bind_textdomain_codeset — specify encoding for message retrieval

Synopsis
#include <libintl.h>
char * bind_textdomain_codeset (const char * domainname, const char * codeset);

Description
The bind_textdomain_codeset() function can be used to specify the output
codeset for message catalogs for domain domainname. The codeset argument shall
be a valid codeset name which can be used for the iconv_open function, or a null
pointer. If the codeset argument is the null pointer, then function returns the
currently selected codeset for the domain with the name domainname. It shall return
a null pointer if no codeset has yet been selected.

Each successive call to bind_textdomain_codeset() function overrides the
settings made by the preceding call with the same domainname.

The bind_textdomain_codeset() function shall return a pointer to a string
containing the name of the selected codeset. The string shall be allocated internally
in the function and shall not be changed or freed by the user.

The bind_textdomain_codeset() function returns a pointer to a string containing
the name of the selected codeset. The string is allocated internally in the function
and shall not be changed by the user.

Parameters
domainname

The domainname argument is applied to the currently active LC_MESSAGE
locale. It is equivalent in syntax and meaning to the domainname argument to
textdomain, except that the selection of the domain is valid only for the
duration of the call.

codeset

The name of the output codeset for the selected domain, or NULL to select the
current codeset.

If domainname is the null pointer, or is an empty string,
bind_textdomain_codeset() shall fail, but need not set errno.

Return Value
Returns the currently selected codeset name. It returns a null pointer if no codeset
has yet been selected.

Errors
ENOMEM

Insufficient memory available to allocate return value.
13 Base Libraries

See Also
gettext, dgettext, ngettext, dnngettext, dcngettext, textdomain,
bindingdomain

bindresvport

Name
bindresvport — bind socket to privileged IP port

Synopsis
#include <sys/types.h>
#include <rpc.rpc.h>
int bindresvport(int sd, struct sockaddr_in * sin);

Description
If the process has appropriate privilege, the bindresvport() function shall bind a
socket to a privileged IP port.

Return Value
On success, 0 is returned. On error, -1 is returned and the global variable errno is
set appropriately.

Errors
EPERM

The process did not have appropriate privilege.

EPFNOSUPPORT

Address of sin did not match address family of sd.
bindtextdomain

Name
bindtextdomain — specify the location of a message catalog

Synopsis
#include <libintl.h>
char * bindtextdomain(const char * domainname, const char * dirname);

Description
The bindtextdomain() shall set the the base directory of the hierarchy containing message catalogs for a given message domain.

The bindtextdomain() function specifies that the domainname message catalog can be found in the dirname directory hierarchy, rather than in the system default locale data base.

If dirname is not NULL, the base directory for message catalogs belonging to domain domainname shall be set to dirname. If dirname is NULL, the base directory for message catalogs shall not be altered.

The function shall make copies of the argument strings as needed.
dirname can be an absolute or relative pathname.

Note: Applications that wish to use chdir() should always use absolute pathnames to avoid misadventently selecting the wrong or non-existant directory.

If domainname is the null pointer, or is an empty string, bindtextdomain() shall fail, but need not set errno.

The bindtextdomain() function shall return a pointer to a string containing the name of the selected directory. The string shall be allocated internally in the function and shall not be changed or freed by the user.

Return Value
On success, bindtextdomain() shall return a pointer to a string containing the directory pathname currently bound to the domain. On failure, a NULL pointer is returned, and the global variable errno may be set to indicate the error.

Errors
ENOMEM
Insufficient memory was available.

See Also
gettext, dgettext, ngettext, dngettext, dcgettext, dcngettext, textdomain, bind_textdomain_codeset
13 Base Libraries

cfmakeraw

Name
cfmakeraw — get and set terminal attributes

Synopsis

#include <termios.h>
void cfmakeraw(struct termios * termios_p);

Description

The cfmakeraw() function shall set the attributes of the termios structure referenced by termios_p as follows:

termios_p->c_iflag &= ~(IGNBRK|BRKINT|PARMRK|ISTRIP
                      |INLCR|IGNCR|ICRNL|IXON);

termios_p->c_oflag &= ~OPOST;

termios_p->c_lflag &= ~(ECHO|ECHONL|ICANON|ISIG|IEXTEN);

termios_p->c_cflag &= ~(CSIZE|PARENB);

termios_p->c_cflag |= CS8;

termios_p shall point to a termios structure that contains the following members:

tcflag_t c_iflag;      /* input modes */
tcflag_t c_oflag;      /* output modes */
tcflag_t c_cflag;      /* control modes */
tcflag_t c_lflag;      /* local modes */
cc_t c_cc[NCCS];       /* control chars */
Name

cfsetspeed — set terminal input and output data rate

Synopsis

#include <termios.h>
int cfsetspeed(struct termios *t, speed_t speed);

Description

cfsetspeed() sets the baud rate values in the termios structure. The effects of the function on the terminal as described below do not become effective, nor are all errors detected, until the tcsetattr() function is called. Certain values for baud rates set in termios and passed to tcsetattr() have special meanings.

Getting and Setting the Baud Rate

Input and output baud rates are found in the termios structure. The unsigned integer speed_t is typedef’d in the include file termios.h. The value of the integer corresponds directly to the baud rate being represented; however, the following symbolic values are defined.

#define B0      0
#define B50     50
#define B75     75
#define B110    110
#define B134    134
#define B150    150
#define B200    200
#define B300    300
#define B600    600
#define B1200   1200
#define B1800   1800
#define B2400   2400
#define B4800   4800
#define B9600   9600
#define B19200  19200
#define B38400  38400
#ifndef _POSIX_SOURCE
#define EXTA    19200
#define EXTB    38400
#endif  /*_POSIX_SOURCE */

cfsetspeed() sets both the input and output baud rates in the termios structure referenced by t to speed.

Return Value

On success, 0 is returned. On error, -1 is returned and the global variable errno is set appropriately.

Errors

EINVAL

Invalid speed argument
daemon

Name
daemon — run in the background

Synopsis
#include <unistd.h>
int daemon(int nochdir, int noclose);

Description
The daemon() function shall create a new process, detached from the controlling
terminal. If successful, the calling process shall exit and the new process shall
continue to execute the application in the background. If nochdir evaluates to true,
the current directory shall not be changed. Otherwise, daemon() shall change the
current working directory to the root ('/'). If noclose evaluates to true the standard
input, standard output, and standard error file descriptors shall not be altered.
Otherwise, daemon() shall close the standard input, standard output and standard
error file descriptors and reopen them attached to /dev/null.

Return Value
On error, -1 is returned, and the global variable errno is set to any of the errors
specified for the library functions fork() and setsid().

dcgettext

Name
dcgettext — perform domain and category specific lookup in message catalog

Synopsis
#include <libintl.h>
#include <locale.h>
char * dcgettext(const char * domainname, const char *msgid, int category);

Description
The dcgettext() function is a domain specified version of gettext().

The dcgettext() function shall lookup the translation in the current locale of the
message identified by msgid in the domain specified by domainname and in the
locale category specified by category. If domainname is NULL, the current default
domain shall be used. The msgid argument shall be a NULL-terminated string to be
matched in the catalogue. category shall specify the locale category to be used for
retrieving message strings. The category parameter shall be one of LC_CTYPE,
LC_COLLATE, LC_MESSAGES, LC_MONETARY, LC_NUMERIC, or LC_TIME. The default
domain shall not be changed by a call to dcgettext().

Return Value
If a translation was found in one of the specified catalogs, it shall be converted to
the current locale's codeset and returned. The resulting NULL-terminated string
shall be allocated by the dcgettext function, and must not be modified or freed. If no
translation was found, or category was invalid, msgid shall be returned.

Errors
dcgettext() shall not modify the errno global variable.

See Also
ggettext, dgettext, ngettext, dngettext, dcngettext, textdomain, bindtextdomain,
bind_textdomain_codeset

dcngettext

Name
dcngettext — perform domain and category specific lookup in message catalog
with plural

Synopsis
#include <libintl.h>
#include <locale.h>
char * dcngettext(const char * domainname, const char * msgid1, const char * msgid2, unsigned long int n, int category);

Description
The dcngettext() function is a domain specific version of gettext, capable of returning either a singular or plural form of the message. The dcngettext() function shall lookup the translation in the current locale of the message identified by msgid1 in the domain specified by domainname and in the locale category specified by category. If domainname is NULL, the current default domain shall be used. The msgid1 argument shall be a NULL-terminated string to be matched in the catalogue. category shall specify the locale category to be used for retrieving message strings. The category parameter shall be one of LC_CTYPE, LC_COLLATE, LC_MESSAGES, LC_MONETARY, LC_NUMERIC, or LC_TIME. The default domain shall not be changed by a call to dcngettext(). If n is 1 then the singular version of the message is returned, otherwise one of the plural forms is returned, depending on the value of n and the current locale settings.

Return Value
If a translation corresponding to the value of n was found in one of the specified catalogs for msgid1, it shall be converted to the current locale's codeset and returned. The resulting NULL-terminated string shall be allocated by the dcngettext() function, and must not be modified or freed. If no translation was found, or category was invalid, msgid1 shall be returned if n has the value 1, otherwise msgid2 shall be returned.

Errors
dcngettext() shall not modify the errno global variable.

See Also
gettext, dgettext, ngettext, dngettext, dcgettext, textdomain, bindtextdomain, bind_textdomain_codeset
dgettext

Name
dgettext — perform lookup in message catalog for the current LC_MESSAGES locale

Synopsis
#include <libintl.h>
char * dgettext(const char * domainname, const char * msgid);

Description
dgettext() is a domain specified version of gettext().

Parameters
domainname

dgettext() applies domainname to the currently active LC_MESSAGE locale. This usage is equivalent in syntax and meaning to the textdomain() function's application of domainname, except that the selection of the domain in dgettext() is valid only for the duration of the call.

msgid

a NULL-terminated string to be matched in the catalogue with respect to a specific domain and the current locale.

Return Value
On success of a msgid query, the translated NULL-terminated string is returned. On error, the original msgid is returned. The length of the string returned is undetermined until dgettext() is called.

Errors
dgettext() shall not modify the errno global variable.

See Also
gettext, dgettext, ngettext, dngettext, dcgettext, dcngettext, textdomain, bindtextdomain, bind_textdomain_codeset
**dngettext**

**Name**
dngettext — perform lookup in message catalog for the current locale

**Synopsis**
```c
#include <libintl.h>
char * dngettext(const char * domainname, const char * msgid1, const char * msgid2, unsigned long int n);
```

**Description**
dngettext() shall be equivalent to a call to
dcngettext(domainname, msgid1, msgid2, n, LC_MESSAGES)

See dcngettext() for more information.

**See Also**
gettext, dgettext, ngettext, dcgettext, dcngettext, textdomain, bindtextdomain, bind_textdomain_codeset

**duplocale**

**Name**
duplocale — provide new handle for selection of locale

**Synopsis**
```c
#include <locale.h>
locale_t duplocale(locale_t locale);
```

**Description**
The duplocale() function shall provide a new locale object based on the locale object provided in locale, suitable for use in the newlocale() or uselocale() functions. The new object may be released by calling freelocale().

**Return Value**
On success, the duplocale() function shall return a locale object. Otherwise, it shall return NULL, and set errno to indicate the error.

**Errors**
The duplocale() function shall fail if:

ENOMEM
   Insufficient memory.

**See Also**
setlocale(), freelocale(), newlocale(), uselocale()
err

Name
err — display formatted error messages

Synopsis
#include <err.h>
void err(int eval, const char * fmt, ...);

Description
The err() function shall display a formatted error message on the standard error stream. First, err() shall write the last component of the program name, a colon character, and a space character. If fmt is non-NULL, it shall be used as a format string for the printf() family of functions, and err() shall write the formatted message, a colon character, and a space. Finally, the error message string affiliated with the current value of the global variable errno shall be written, followed by a newline character.

The err() function shall not return, the program shall terminate with the exit value of eval.

See Also
error(), errx()

Return Value
None.

Errors
None.
error

Name
error — print error message

Synopsis
void error(int exitstatus, int errnum, const char * format, ...);

Description
error() shall print a message to standard error.

error() shall build the message from the following elements in their specified order:

1. the program name. If the application has provided a function named
   error_print_progname(), error() shall call this to supply the program
   name; otherwise, error() uses the content of the global variable
   program_name.

2. the colon and space characters, then the result of using the printf-style format
   and the optional arguments.

3. if errnum is nonzero, error() shall add the colon and space characters, then
   the result of strerror(errnum).

4. a newline.

If exitstatus is nonzero, error() shall call exit(exitstatus).

See Also
err(), errx()
errx

Name
errx — display formatted error message and exit

Synopsis
#include <err.h>
void errx(int eval, const char *fmt, ...);

Description
The errx() function shall display a formatted error message on the standard error stream. The last component of the program name, a colon character, and a space shall be output. If fmt is non-NULL, it shall be used as the format string for the printf() family of functions, and the formatted error message, a colon character, and a space shall be output. The output shall be followed by a newline character.

errx() does not return, but shall exit with the value of eval.

Return Value
None.

Errors
None.

See Also
error(), err()

fcntl

Name
fcnt1 — file control

Description
fcnt1() is as specified in ISO POSIX (2003), but with differences as listed below.

Implementation may set O_LARGEFILE
According to ISO POSIX (2003), only an application sets fcntl() flags, for example O_LARGEFILE. However, this specification also allows an implementation to set the O_LARGEFILE flag in the case where the programming environment is one of _POSIX_V6_ILP32_OFFBIG, _POSIX_V6_LP64_OFF64, _POSIX_V6_LPBIG_OFFBIG. See getconf and c99 in ISO POSIX (2003) for a description of these environments. Thus, calling fcnt1() with the F_GETFL command may return O_LARGEFILE as well as flags explicitly set by the application in the case that both the implementation and the application support an off_t of at least 64 bits.
13 Base Libraries

**fflush_unlocked**

*Name*

`fflush_unlocked` — non thread safe `fflush`

*Description*

`fflush_unlocked()` is the same as `fflush()` except that it need not be thread safe. That is, it may only be invoked in the ways which are legal for `getc_unlocked()`.

**fgetwc_unlocked**

*Name*

`fgetwc_unlocked` — non thread safe `fgetwc`

*Description*

`fgetwc_unlocked()` is the same as `fgetwc()` except that it need not be thread safe. That is, it may only be invoked in the ways which are legal for `getc_unlocked()`.
flock

Name
flock — apply or remove an advisory lock on an open file

Synopsis
int flock(int fd, int operation);

Description
flock() applies or removes an advisory lock on the open file fd. Valid operation types are:

LOCK_SH
Shared lock. More than one process may hold a shared lock for a given file at a given time.

LOCK_EX
Exclusive lock. Only one process may hold an exclusive lock for a given file at a given time.

LOCK_UN
Unlock.

LOCK_NB
Don’t block when locking. May be specified (by oring) along with one of the other operations.

A single file may not simultaneously have both shared and exclusive locks.

Return Value
On success, 0 is returned. On error, -1 is returned and the global variable errno is set appropriately.

Errors
EWOULDBLOCK
The file is locked and the LOCK_NB flag was selected.
freelocale

Name
freelocale — free a locale object

Synopsis
#include <locale.h>
void freelocale(locale_t locale);

Description
The freelocale() function shall free the locale object locale, and release any resources associated with it.

Return Value
None.

Errors
None defined.

See Also
setlocale(), newlocale(), duplocale(), uselocale()

fscanf

Name
fscanf — convert formatted input

Description
The scanf() family of functions shall behave as described in ISO POSIX (2003), except as noted below.

Differences
The %s, %S and %l conversion specifiers shall accept an option length modifier a, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set errno to ENOMEM and a conversion error results.

Note: This directly conflicts with the ISO C (1999) usage of %a as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as "%aseconds" will have a different meaning on an LSB conforming system.
fwscanf

Name
fwscanf — convert formatted input

Description
The scanf() family of functions shall behave as described in ISO POSIX (2003), except as noted below.

Differences
The %s, %S and %] conversion specifiers shall accept an option length modifier a, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set errno to ENOMEM and a conversion error results.

Note: This directly conflicts with the ISO C (1999) usage of %a as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as "%aseconds" will have a different meaning on an LSB conforming system.
getgrouplist

Name
getgrouplist — get network group entry

Synopsis
#include <grp.h>
int getgrouplist(const char * user, gid_t group, gid_t * groups, int * ngroups);

Description
The getgrouplist() function shall fill in the array groups with the supplementary groups for the user specified by user. On entry, ngroups shall refer to an integer containing the maximum number of gid_t members in the groups array. The group group shall also be included. On success, the value referred to by ngroups shall be updated to contain the number of gid_t objects copied.

Return Value
On success, if there was sufficient room to copy all the supplemental group identifiers to the array identified by groups, getgrouplist() shall return the number of gid_t objects copied, and the value referenced by ngroups shall be updated. If there was not sufficient room to copy all the supplementary group identifiers, getgrouplist() shall return -1, and update the value referenced by ngroups to the number actually copied.

If user does not refer to a valid user on the system, getgrouplist() shall return 0, and set the value referenced by ngroups to 0.

Errors
None defined.

See Also
getgroups()

getloadavg

Name
getloadavg — get system load averages

Synopsis
#include <stdlib.h>
int getloadavg(double loadavg[], int nelem);

Description
getloadavg() returns the number of processes in the system run queue averaged over various periods of time. Up to nelem samples are retrieved and assigned to successive elements of loadavg[]. The system imposes a maximum of 3 samples, representing averages over the last 1, 5, and 15 minutes, respectively.
getopt

Name
getopt — parse command line options

Synopsis

#include <unistd.h>
int getopt(int argc, char * const argv[], const char * optstring);

extern char *optarg;
Description

The `getopt()` function shall parse command line arguments as described in ISO POSIX (2003), with the following exceptions, where LSB and POSIX specifications vary. LSB systems shall implement the modified behaviors described below.

Argument Ordering

The `getopt()` function can process command line arguments referenced by `argv` in one of three ways:

**PERMUTE**

the order of arguments in `argv` is altered so that all options (and their arguments) are moved in front of all of the operands. This is the default behavior.

**Note:** This behavior has undefined results if `argv` is not modifiable. This is to support historic behavior predating the use of `const` and ISO C (1999). The function prototype was aligned with ISO POSIX (2003) despite the fact that it modifies `argv`, and the library maintainers are unwilling to change this.

**REQUIRE_ORDER**

The arguments in `argv` are processed in exactly the order given, and option processing stops when the first non-option argument is reached, or when the element of `argv` is "-". This ordering can be enforced either by setting the environment variable `POSIXLY_CORRECT`, or by setting the first character of `optstring` to '+'.

**RETURN_IN_ORDER**

The order of arguments is not altered, and all arguments are processed. Non-option arguments (operands) are handled as if they were the argument to an option with the value 1 ("\001"). This ordering is selected by setting the first character of `optstring` to '-';

Option Characteristics

**LSB** specifies that:

- an element of `argv` that starts with "-" (and is not exactly "-" or "--") is an option element.
- characters of an option element, aside from the initial "-", are option characters.

**POSIX** specifies that:

- applications using `getopt()` shall obey the following syntax guidelines:
  - option name is a single alphanumeric character from the portable character set
  - option is preceded by the '-' delimiter character
  - options without option-arguments should be accepted when grouped behind one '-' delimiter
  - each option and option-argument is a separate argument
  - option-arguments are not optional
  - all options should precede operands on the command line
• the argument "--" is accepted as a delimiter indicating the end of options and
the consideration of subsequent arguments, if any, as operands
• historical implementations of getopt() support other characters as options as an
allowed extension, but applications that use extensions are not maximally
portable.
• support for multi-byte option characters is only possible when such characters
can be represented as type int.
• applications that call any utility with a first operand starting with '-' should
usually specify "--" to mark the end of the options. Standard utilities that do not
support this guideline indicate that fact in the OPTIONS section of the utility
description.

Extensions

LSB specifies that:
• if a character is followed by two colons, the option takes an optional argument; if
there is text in the current argv element, it is returned in optarg, otherwise
optarg is set to 0.
• if optstring contains W followed by a semi-colon (;), then -W foo is treated as the
long option --foo.

Note: See getopt_long() for a description of long options.

• The first character of optstring shall modify the behavior of getopt() as
follows:
  • if the first character is '+', then REQUIRE_ORDER processing shall be in effect (see
above)
  • if the first character is '+', then RETURN_IN_ORDER processing shall be in effect
(see above)
  • if the first character is ':', then getopt() shall return ':' instead of '?' to indicate a
missing option argument, and shall not print any diagnostic message to
stderr.

POSIX specifies that:
• the -W option is reserved for implementation extensions.

Return Values

LSB specifies the following additional getopt() return values:
• \001 is returned if RETURN_IN_ORDER argument ordering is in effect, and the
  next argument is an operand, not an option. The argument is available in optarg.
Any other return value has the same meaning as for POSIX.

POSIX specifies the following getopt() return values:
• the next option character is returned, if found successfully.
• ':' is returned if a parameter is missing for one of the options and the first
  character of optstring is ':'.
• '?' is returned if an unknown option character not in optstring is encountered,
  or if getopt() detects a missing argument and the first character of optstring is
  not ':'.
• -1 is returned for the end of the option list.

Environment Variables

*LSB* specifies that:

• if the variable *POSIXLY_CORRECT* is set, option processing stops as soon as a non-option argument is encountered.

• the variable *[_PID_]_GNU_nonoption_argv_flags_* (where {PID} is the process ID for the current process), contains a space separated list of arguments that should not be treated as arguments even though they appear to be so.

**Rationale:** This was used by bash 2.0 to communicate to GNU libc which arguments resulted from wildcard expansion and so should not be considered as options. This behavior was removed in bash version 2.01, but the support remains in GNU libc.

This behavior is DEPRECATED in this version of the LSB; future revisions of this specification may not include this requirement.

### getopt_long

**Name**

getopt_long — parse command line options

**Synopsis**

```c
#define _GNU_SOURCE
#include <getopt.h>
int getopt_long(int argc, char * const argv[], const char * opstring,
const struct option * longopts, int * longindex);
```

**Description**

getopt_long() works like getopt() except that it also accepts long options, started out by two dashes. Long option names may be abbreviated if the abbreviation is unique or is an exact match for some defined option. A long option may take a parameter, of the form `--arg=param` or `--arg param`.

*longopts* is a pointer to the first element of an array of struct option declared in getopt.h as:

```c
struct option {
    const char *name;
    int has_arg;
    int *flag;
    int val;
};
```

The fields in this structure have the following meaning:

- **name**

  The name of the long option.

- **has_arg**

  One of:
argument (or 0) if the option does not take an argument,
unamed_argument (or 1) if the option requires an argument, or
optional_argument (or 2) if the option takes an optional argument.

flag

specifies how results are returned for a long option. If flag is NULL, then
gopt_long() shall return val. (For example, the calling program may set val
to the equivalent short option character.) Otherwise, getopt_long() returns 0,
and flag shall point to a variable which shall be set to val if the option is
found, but left unchanged if the option is not found.

val

The value to return, or to load into the variable pointed to by flag.

Return Value

gopt_long() returns the option character if a short option was found
successfully, or ":" if there was a missing parameter for one of the options, or "?" for
an unknown option character, or -1 for the end of the option list.

For a long option, getopt_long() returns val if flag is NULL, and 0 otherwise.
Error and -1 returns are the same as for getopt(), plus "?" for an ambiguous match
or an extraneous parameter.

gopt_long_only

Name

gopt_long_only — parse command line options

Synopsis

#define _GNU_SOURCE
#include <getopt.h>

int getopt_long_only(int argc, char * const argv[],
                     const char * optstring,
                     const struct option * longopts,
                     int * longindex);

## Description

goptopt_long_only() is like getopt_long(), but "-" as well as "--" can indicate a long option. If an option that starts with "," (not "--") doesn't match a long option, but does match a short option, it is parsed as a short option instead.

Note: The getopt_long_only() function is intended only for supporting certain programs whose command line syntax was designed before the Utility Syntax Guidelines of ISO POSIX (2003) were developed. New programs should generally call getopt_long() instead, which provides the --option syntax for long options, which is preferred by GNU and consistent with ISO POSIX (2003).

## Return Value

goptopt_long_only() returns the option character if the option was found successfully, or "," if there was a missing parameter for one of the options, or "?" for an unknown option character, or -1 for the end of the option list.

getopt_long_only() also returns the option character when a short option is recognized. For a long option, they return val if flag is NULL, and 0 otherwise. Error and -1 returns are the same as for getopt(), plus "?" for an ambiguous match or an extraneous parameter.

## getsockopt

### Name

getsockopt = get socket options

### Synopsis

#include <sys/socket.h>
#include <netinet/ip.h>
int getsockopt(int socket, int level, int option_name, void * restrict option_value, socklen_t * restrict option_len);

Description

The getsockopt() function shall behave as specified in ISO POSIX (2003), with the following extensions.

IP Protocol Level Options

If the level parameter is IPPROTO_IP, the following values shall be supported for option_name (see RFC 791:Internet Protocol for further details):

IP_OPTIONS

Get the Internet Protocol options sent with every packet from this socket. The option_value shall point to a memory buffer in which the options shall be placed; on entry option_len shall point to an integer value indicating the maximum size of the memory buffer, in bytes. On successful return, the value referenced by option_len shall be updated to the size of data copied to the buffer. For IPv4, the maximum length of options is 40 bytes.

IP_TTL

Get the current unicast Internet Protocol Time To Live value used when sending packets with this socket. The option_value shall point to a buffer large enough to hold the time to live value (at least 1 byte), and option_len shall point to an integer value holding the maximum size of that buffer. On successful return, the value referenced by option_len shall be updated to contain the number of bytes copied into the buffer, which shall be no larger than the initial value, and option_value shall point to an integer containing the time to live value.

IP_TOS

Get the Internet Protocol type of service indicator used when sending packets with this socket. The option_value shall point to a buffer large enough to hold the type of service indicator (at least 1 byte), and option_len shall point to an integer value holding the maximum size of that buffer. On successful return, the value referenced by option_len shall be updated to contain the number of bytes copied into the buffer, which shall be no larger than the initial value, and option_value shall point to an integer containing the time to live value.
**gettext**

**Name**

gettext — search message catalogs for a string

**Synopsis**

```c
#include <libintl.h>
char * gettext(const char *msgid);
```

**Description**

The `gettext()` function shall search the currently selected message catalogs for a string identified by the string `msgid`. If a string is located, that string shall be returned.

The `gettext()` function is equivalent to `dcgettext(NULL, msgid, LC_MESSAGES)`.

**Return Value**

If a string is found in the currently selected message catalogs for `msgid`, then a pointer to that string shall be returned. Otherwise, a pointer to `msgid` shall be returned.

Applications shall not modify the string returned by `gettext()`.

**Errors**

None.

The `gettext()` function shall not modify `errno`.

**See Also**

dgettext, ngettext, dngettext, dcgettext, dcngettext, textdomain, bindtextdomain, bind_textdomain_codeset
getutent

Name
getutent — access user accounting database entries

Synopsis
#include <utmp.h>
struct utmp *getutent(void);

Description
The getutent() function shall read the next entry from the user accounting
database.

Return Value
Upon successful completion, getutent() shall return a pointer to a utmp structure
containing a copy of the requested entry in the user accounting database.
Otherwise, a null pointer shall be returned. The return value may point to a static
area which is overwritten by a subsequent call to getutent().

Errors
None defined.

getutent_r

Name
getutent_r — access user accounting database entries

Synopsis
int getutent_r(struct utmp * buffer, struct utmp ** result);

Description
The getutent_r() function is a reentrant version of the getutent() function. On
entry, buffer should point to a user supplied buffer to which the next entry in the
database will be copied, and result should point to a location where the result will
be stored.

Return Value
On success, getutent_r() shall return 0 and set the location referenced by result
to a pointer to buffer. Otherwise, getutent_r() shall return -1 and set the
location referenced by result to NULL.
glob64

Name

glob64 — find pathnames matching a pattern (Large File Support)

Synopsis

#include <glob.h>
int glob64(const char * pattern, int flags, int (*errfunc) (const char *, int), glob64_t * pglob);

Description

The glob64() function is a large-file version of the glob() defined in ISO POSIX (2003). It shall search for pathnames matching pattern according to the rules used by the shell, /bin/sh. No tilde expansion or parameter substitution is done; see wordexp().

The results of a glob64() call are stored in the structure pointed to by pglob, which is a glob64_t declared in glob.h with the following members:

typedef struct
{
    size_t gl_pathc;
    char **gl_pathv;
    size_t gl_offs;
    int gl_flags;
    void (*gl_closedir) (void *);
    struct dirent64 *(*gl_readdir64) (void *);
    void *(*gl_opendir) (const char *);
    int (*gl_lstat) (const char *, struct stat *);
    int (*gl_stat) (const char *, struct stat *);
}
glob64_t;

Structure members with the same name as corresponding members of a `glob_t` as defined in ISO POSIX (2003) shall have the same purpose.

Other members are defined as follows:

- `gl_flags`
  - reserved for internal use

- `gl_closedir`
  - pointer to a function capable of closing a directory opened by `gl_opendir`

- `gl.readdir64`
  - pointer to a function capable of reading entries in a large directory

- `gl_opendir`
  - pointer to a function capable of opening a large directory

- `gl_stat`
  - pointer to a function capable of returning file status for a large file

- `gl_lstat`
  - pointer to a function capable of returning file status information for a large file or symbolic link

A large file or large directory is one with a size which cannot be represented by a variable of type `off_t`.

**Return Value**

On success, 0 is returned. Other possible returns are:

- `GLOB_NOSPACE`
  - out of memory

- `GLOB_ABORTED`
  - read error

- `GLOB_NOMATCH`
  - no match found
globfree64

Name

globfree64 — free memory from glob64() (Large File Support)

Synopsis

#include <glob.h>
void globfree64(glob64_t * pglob);

Description

globfree64() frees the dynamically allocated storage from an earlier call to
glob64().

globfree64() is a 64-bit version of globfree().

initgroups

Name

initgroups — initialize the supplementary group access list

Synopsis

#include <grp.h>
#include <sys/types.h>
int initgroups(const char * user, gid_t group);

Description

If the process has appropriate privilege, the initgroups() function shall initialize
the Supplementary Group IDs for the current process by reading the group
database and using all groups of which user is a member. The additional group
group is also added to the list.

Return Value

On success, 0 is returned. On error, -1 is returned and the global variable errno is
set appropriately.

Errors

EPERM

The calling process does not have sufficient privileges.

ENOMEM

Insufficient memory to allocate group information structure.

See Also

setgroups()
ioctl

Name
ioctl — control device

Synopsis
#include <sys/ioctl.h>
int ioctl (int fildes, int request, ...);

Description
The ioctl() function shall manipulate the underlying device parameters of special files. fildes shall be an open file descriptor referring to a special file. The ioctl() function shall take three parameters; the type and value of the third parameter is dependent on the device and request.

Conforming LSB applications shall not call ioctl() except in situations explicitly stated in this specification.

Return Value
On success, 0 is returned. An ioctl() may use the return value as an output parameter and return a non-negative value on success. On error, -1 is returned and the global variable errno is set appropriately.

Errors
EBADF
     fildes is not a valid descriptor.

EFAULT
     The third parameter references an inaccessible memory area.

ENOTTY
     fildes is not associated with a character special device.

ENOTTY
     The specified request does not apply to the kind of object that fildes references.

EINVAL
     request or the third parameter is not valid.

Relationship to POSIX (Informative)
It should be noted that ISO POSIX (2003) contains an interface named ioctl(). The LSB only defines behavior when fildes refers to a socket (see sockio) or terminal device (see ttyio), while ISO POSIX (2003) only defines behavior when fildes refers to a STREAMS device. An implementation may support both behaviors; the LSB does not require any STREAMS support.
13 Base Libraries

sockio

Name
sockio – socket ioctl commands

Synopsis

#include <sys/ioctl.h>
#include <sys/socket.h>
#include <net/if.h>
#include <netinet/in.h>

```c
int ioctl(int sockfd, int request, void *argp);
```

## Description

Socket `ioctl()` commands are a subset of the `ioctl()` calls, which can perform a variety of functions on sockets. `sockfd` shall be an open file descriptor referring to a socket (see the `socket()` or `accept()` functions).

Socket `ioctl()` commands apply to the underlying network interfaces, and affect the entire system, not just the file descriptor used to issue the `ioctl()`.

The following values for `request` are accepted:

### SIOCGIFCONF (Deprecated)

Get the interface configuration list for the system.

**Note:** The `SIOCGIFCONF` interface is superceded by the `if_nameindex()` family of functions (see ISO POSIX (2003)). A future version of this specification may withdraw this value for `request`.

`argp` shall point to a `ifconf` structure, as described in `<net/if.h>`. Before calling, the caller shall set the `ifc_ifcu.ifcu_req` field to point to an array of `ifreq` structures, and set `ifc_len` to the size in bytes of this allocated array.

Upon return, `ifc_len` will contain the size in bytes of the array which was actually used. If it is the same as the length upon calling, the caller should assume that the array was too small and try again with a larger array.

On success, `SIOCGIFCONF` shall return a nonnegative value.

**Rationale:** Historical UNIX systems disagree on the meaning of the return value.

### SIOCGIFFLAGS

Get the interface flags for the indicated interface. `argp` shall point to a `ifreq` structure. Before calling, the caller should fill in the `ifr_name` field with the interface name, and upon return, the `ifr_ifru.ifru_flags` field is set with the interface flags.

### SIOCGIFADDR

Get the interface address for the given interface. `argp` shall point to a `ifreq` structure. Before calling, the caller should fill in the `ifr_name` field with the interface name, and upon return, the `ifr_ifru.ifru_addr` field is set with the interface address.

### SIOCGIFBRDADDR

Get the interface broadcast address for the given interface. `argp` shall point to a `ifreq` structure. Before calling, the caller should fill in the `ifr_name` field with the interface name, and upon return, the `ifr_ifru.ifru_broadcast` field is set with the interface broadcast address.

### SIOCGIFNETMASK

Get the network mask for the given interface. `argp` shall point to a `ifreq` structure. Before calling, the caller should fill in the `ifr_name` field with the interface name, and upon return, the `ifr_ifru.ifru_netmask` field is set with the network mask.
SIOCGIFMTU

Get the Maximum Transmission Unit (MTU) size for the given interface. `argp` shall point to a `ifreq` structure. Before calling, the caller should fill in the `ifr_name` field with the interface name, and upon return, the `ifr_ifru.ifru_mtu` field is set with the MTU.

FIONREAD

Get the amount of queued unread data in the receive buffer. `argp` shall point to an integer where the result is to be placed.

**Note:** Some implementations may also support the use of FIONREAD on other types of file descriptor. However, the LSB only specifies its behavior for a socket-related file descriptor.

**Return Value**

On success, if `request` is SIOCGIFCONF, a non-negative integer shall be returned. If `request` is not SIOCGIFCONF, on success 0 is returned. On error, -1 is returned and the global variable `errno` is set appropriately.

**Errors**

EBADF

`sockfd` is not a valid descriptor.

EFAULT

`argp` references an inaccessible memory area.

ENOTTY

The specified `request` does not apply to the kind of object that the descriptor `sockfd` references.

EINVAL

Either `request` or `argp` is invalid.

ENOTCONN

The operation is only defined on a connected socket, but the socket wasn't connected.

ttyio

**Name**

ttyio — tty ioctl commands

**Synopsis**

```
#include <sys/ioctl.h>
```
#include <fcntl.h>

int ioctl(int fd, unsigned long request, int *argp);

Description

Tty ioctl commands are a subset of the ioctl() calls, which can perform a variety of functions on tty devices. fd shall be an open file descriptor referring to a terminal device.

The following ioctl()s are provided:

TIOCGWINSZ

Get the size attributes of the terminal or pseudo-terminal identified by fd. On entry, argp shall reference a winsize structure. On return, the structure will have ws_row set to the number of rows of text (i.e. lines of text) that can be viewed on the device, and ws_col set to the number of columns (i.e. text width).

Note: The number of columns stored in ws_col assumes that the terminal device is using a mono-spaced font.

Return Value

On success, 0 is returned. On error, -1 is returned and the global variable errno is set appropriately.

Errors

EBADF

fd is not a valid descriptor.

EFAULT

argp references an inaccessible memory area.

EINVAL

request and argp are not valid.
kill

Name
kill — send a signal

Synopsis
#include <signal.h>
int kill(pid_t pid, int sig);

Description
kill() is as specified in the ISO POSIX (2003), but with differences as listed below.

Process ID -1 doesn’t affect calling process
If pid is specified as -1, sig shall not be sent to the calling process. Other than this, the rules in the ISO POSIX (2003) apply.

Rationale: This was a deliberate Linus decision after an unpopular experiment in including the calling process in the 2.5.1 kernel. See "What does it mean to signal everybody?", Linux Weekly News, 20 December 2001, http://lwn.net/2001/1220/kernel.php3

link

Name
link — create a link to a file

Synopsis
#include <unistd.h>
int link(const char *path1, const char *path2);

Description
The link() function shall behave as specified in ISO POSIX (2003), except with differences as listed below.

Need Not Follow Symlinks
ISO POSIX (2003) specifies that pathname resolution shall follow symbolic links during pathname resolution unless the function is required to act on the symbolic link itself, or certain arguments direct that the function act on the symbolic link itself. The link() function in ISO POSIX (2003) contains no such requirement to operate on a symbolic link. However, a conforming LSB implementation need not follow a symbolic link for the path1 argument.
mbsnrtowcs

Name
mbsnrtowcs — convert a multibyte string to a wide character string

Synopsis
#include <wchar.h>
size_t mbsnrtowcs(wchar_t * dest, const char * * src, size_t nms, size_t len, mbstate_t * ps);

Description
mbsnrtowcs() is like mbsrtowcs(), except that the number of bytes to be converted, starting at src, is limited to nms.

If dest is not a NULL pointer, mbsnrtowcs() converts at most nms bytes from the multibyte string src to a wide-character string starting at dest. At most, len wide characters are written to dest. The state ps is updated.

The conversion is effectively performed by repeatedly calling:
mbrtowc(dest, *src, n, ps)

where \( n \) is some positive number, as long as this call succeeds, and then incrementing dest by one and src by the number of bytes consumed.

The conversion can stop for three reasons:

- An invalid multibyte sequence has been encountered. In this case src is left pointing to the invalid multibyte sequence, (size_t)(-1) is returned, and errno is set to EILSEQ.
- The nms limit forces a stop, or len non-L'\0' wide characters have been stored at dest. In this case, src is left pointing to the next multibyte sequence to be converted, and the number of wide characters written to dest is returned.
- The multibyte string has been completely converted, including the terminating '\0' (which has the side effect of bringing back ps to the initial state). In this case, src is set to NULL, and the number of wide characters written to dest, excluding the terminating L'\0' character, is returned.

If dest is NULL, len is ignored, and the conversion proceeds as above, except that the converted wide characters are not written out to memory, and that no destination length limit exists.

In both of the above cases, if ps is a NULL pointer, a static anonymous state only known to mbsnrtowcs() is used instead.

The programmer shall ensure that there is room for at least len wide characters at dest.

Return Value

mbsnrtowcs() returns the number of wide characters that make up the converted part of the wide character string, not including the terminating null wide character. If an invalid multibyte sequence was encountered, (size_t)(-1) is returned, and the global variable errno is set to EILSEQ.

Notes

The behavior of mbsnrtowcs() depends on the LC_CTYPE category of the current locale.

Passing NULL as ps is not multi-thread safe.

cmemmem

Name

memmem — locate bytes

Synopsis

#define _GNU_SOURCE
#include <string.h>
void * memmem(const void * haystack, size_t haystacklen, const void * needle, size_t needlelen);

**Description**

`memmem()` finds the start of the first occurrence of the byte array referenced by `needle` of length `needlelen` in the memory area `haystack` of length `haystacklen`.

**Return Value**

`memmem()` returns a pointer to the beginning of the byte array, or `NULL` if the byte array is not found.

**Notes**

Earlier versions of the C library (prior to glibc 2.1) contained a `memmem()` with various problems, and application developers should treat this function with care.

---

**memrchr**

**Name**

`memrchr` — scan memory for a character

**Synopsis**

```c
#include <string.h>
void * memrchr(const void * s, int c, size_t n);
```

**Description**

The `memrchr()` function shall locate the last occurrence of `c` (converted to an unsigned char) in the initial `n` bytes (each interpreted as an unsigned char) of the object pointed to by `s`.

**Return Value**

The `memrchr()` shall return a pointer to the located byte, or a null pointer if the byte does not occur in the object.

**Errors**

No errors are defined.

**See Also**

`memchr()`
newlocale

Name
newlocale — allocate a locale object

Synopsis
#include <locale.h>
locale_t newlocale(int category_mask, const char * locale, locale_t base);

Description
The newlocale() function shall initialize a locale object. If base is NULL, then
newlocale() shall first allocate the object; otherwise it shall use the locale object
referenced by base.

The object shall be initialized for the locale named by locale, and for the categories
selected in category_mask. The category_mask value is a bitwise inclusive OR of
the required LC_name_MASK values, or the value LC_ALL_MASK.

Return Value
On success, the newlocale() function shall return the initialized locale object.
Otherwise, it shall return NULL, and set errno to indicate the error.

Errors
The newlocale() function shall fail if:

ENOMEM
Insufficient memory.

EINVAL
An invalid category_mask was provided, or the locale was NULL.

Application Usage (Informative)
The only portable way to allocate a locale object is to call newlocale() with a NULL
base. The allocated object may be reinitialized to a new locale by passing it back to
newlocale(). The new object may be released by calling freelocale().

See Also
setlocale(), freelocale(), duplocale(), uselocale()
ngettext

Name

ngettext — search message catalogs for plural string

Synopsis

#include <libintl.h>
char * ngettext(const char * msgid1, const char * msgid2, unsigned long int n);

Description

The ngettext() function shall search the currently selected message catalogs for a string matching the singular string msgid1. If a string is located, and if n is 1, that string shall be returned. If n is not 1, a pluralized version (dependent on n) of the string shall be returned.

The ngettext() function is equivalent to dcngettext(NULL, msgid1, msgid2, n, LC_MESSAGES)().

Return Value

If a string is found in the currently selected message catalogs for msgid1, then if n is 1 a pointer to the located string shall be returned. If n is not 1, a pointer to an appropriately pluralized version of the string shall be returned. If no message could be found in the currently selected message catalogs, then if n is 1, a pointer to msgid1 shall be returned, otherwise a pointer to msgid2 shall be returned.

Applications shall not modify the string returned by ngettext().

Errors

None.

The ngettext() function shall not modify errno.

See Also

gettext, dgettext, ngettext, dngettext, dcgettext, dcngettext, textdomain, bindtextdomain, bind_textdomain_codeset
pmap_getport

Name

pmap_getport — find the port number assigned to a service registered with a portmapper.

Synopsis

#include <pmap_clnt.h>

u_short * pmap_getport(struct sockaddr_in * address, const u_long program, const u_long * version, u_int protocol);

Description

The pmap_getport() function shall return the port number assigned to a service registered with a RPC Binding service running on a given target system, using the protocol described in RFC 1833: Binding Protocols for ONC RPC Version 2. The pmap_getport() function shall be called given the RPC program number program, the program version version, and transport protocol protocol. Conforming implementations shall support both IPPROTO_UDP and IPPROTO_TCP protocols. On entry, address shall specify the address of the system on which the portmapper to be contacted resides. The value of address->sin_port shall be ignored, and the standard value for the portmapper port shall always be used.

Note: Security and network restrictions may prevent a conforming application from contacting a remote RPC Binding Service.

Return Value

On success, the pmap_getport() function shall return the port number in host byte order of the RPC application registered with the remote portmapper. On failure, if either the program was not registered or the remote portmapper service could not be reached, the pmap_getport() function shall return 0. If the remote portmap service could not be reached, the status is left in the global variable rpc_createerr.

pmap_set

Name

pmap_set — establishes mapping to machine’s RPC Bind service.

Synopsis

#include <rpc/pmap_clnt.h>

bool_t pmap_set(const u_long program, const u_long version, int protocol, u_short port);

Description

pmap_set() establishes a mapping between the triple (program, version, protocol) and port on the machine’s RPC Bind service. The value of protocol is most likely IPPROTO_UDP or IPPROTO_TCP. Automatically done by svc_register().

Return Value

pmap_set() returns 1 if it succeeds, 0 otherwise.
pmap_unset

Name
pmap_unset — destroys RPC Binding

Synopsis

#include <rpc/rpc.h>

bool_t pmap_unset(u_long protnum, u_long versnum);

Description
As a user interface to the RPC Bind service, pmap_unset() destroys all mapping between the triple [protnum, versnum, *] and ports on the machine's RPC Bind service.

Return Value
pmap_unset() returns 1 if it succeeds, zero otherwise.

psignal

Name
psignal — print signal message

Synopsis

#include <signal.h>

void psignal(int sig, const char * s);

extern const char *const sys_siglist[]

Description
The psignal() function shall display a message on the stderr stream. If s is not the null pointer, and does not point to an empty string (e.g. "\0"), the message shall consist of the string s, a colon, a space, and a string describing the signal number sig; otherwise psignal() shall display only a message describing the signal number sig. If sig is invalid, the message displayed shall indicate an unknown signal.

The array sys_siglist holds the signal description strings indexed by signal number.

Return Value
psignal() returns no value.
regexec

Name
regexec — regular expression matching

Description
The regexec() function shall behave as specified in ISO POSIX (2003), except with differences as listed below.

Differences
Certain aspects of regular expression matching are optional; see Internationalization and Regular Expressions.

scanf

Name
scanf — convert formatted input

Description
The scanf() family of functions shall behave as described in ISO POSIX (2003), except as noted below.

Differences
The %s, %S and %l conversion specifiers shall accept an option length modifier a, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set errno to ENOMEM and a conversion error results.

Note: This directly conflicts with the ISO C (1999) usage of %a as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as "%aseconds" will have a different meaning on an LSB conforming system.

setbuffer

Name
setbuffer — stream buffering operation

Synopsis
#include <stdio.h>
void setbuffer(FILE *stream, char *buf, size_t size);

Description
setbuffer() is an alias for the call to setvbuf(). It works the same, except that the size of the buffer in setbuffer() is up to the caller, rather than being determined by the default BUFSIZE.
setgroups

Name

setgroups — set list of supplementary group IDs

Synopsis

#include <grp.h>
int setgroups(size_t size, const gid_t *list);

Description

If the process has appropriate privilege, the setgroups() function shall set the supplementary group IDs for the current process. list shall reference an array of size group IDs. A process may have at most NGROUPS_MAX supplementary group IDs.

Return Value

On successful completion, 0 is returned. On error, -1 is returned and the errno is set to indicate the error.

Errors

EFAULT

list has an invalid address.

EPERM

The process does not have appropriate privileges.

EINVAL

size is greater than NGROUPS_MAX.

sethostname

Name

sethostname — set host name

Synopsis

#include <unistd.h>
#include <sys/param.h>
#include <sys/utsname.h>
int sethostname(const char * name, size_t len);

**Description**

If the process has appropriate privileges, the sethostname() function shall change the host name for the current machine. The name shall point to a null-terminated string of at most len bytes that holds the new hostname.

If the symbol HOST_NAME_MAX is defined, or if sysconf(_SC_HOST_NAME_MAX)() returns a value greater than 0, this value shall represent the maximum length of the new hostname. Otherwise, if the symbol MAXHOSTLEN is defined, this value shall represent the maximum length for the new hostname. If none of these values are defined, the maximum length shall be the size of the nodename field of the utsname structure.

**Return Value**

On success, 0 is returned. On error, -1 is returned and the global variable errno is set appropriately.

**Errors**

EINVAL

len is negative or larger than the maximum allowed size.

EPERM

the process did not have appropriate privilege.

EFAULT

name is an invalid address.

**Rationale**

ISO POSIX (2003) guarantees that:

Maximum length of a host name (not including the terminating null) as returned from the gethostname() function shall be at least 255 bytes.

The glibc C library does not currently define HOST_NAME_MAX, and although it provides the name _SC_HOST_NAME_MAX a call to sysconf() returns -1 and does not alter errno in this case (indicating that there is no restriction on the hostname length). However, the glibc manual indicates that some implementations may have MAXHOSTNAMELEN as a means of detecting the maximum length, while the Linux kernel at release 2.4 and 2.6 stores this hostname in the utsname structure. While the glibc manual suggests simply shortening the name until sethostname() succeeds, the LSB requires that one of the first four mechanisms works. Future versions of glibc may provide a more reasonable result from sysconf(_SC_HOST_NAME_MAX).
setsockopt

Name

setsockopt — set socket options

Synopsis

#include <sys/socket.h>
#include <netinet/ip.h>
int setsockopt(int socket, int level, int option_name, const void *option_value, socklen_t option_len);

Description

The setsockopt() function shall behave as specified in ISO POSIX (2003), with the following extensions.

**IP Protocol Level Options**

If the level parameter is IPPROTO_IP, the following values shall be supported for option_name (see RFC 791:Internet Protocol for further details):

**IP_OPTIONS**

Set the Internet Protocol options sent with every packet from this socket. The option_value shall point to a memory buffer containing the options and option_len shall contain the size in bytes of that buffer. For IPv4, the maximum length of options is 40 bytes.

**IP_TOS**

Set the Type of Service flags to use when sending packets with this socket. The option_value shall point to a value containing the type of service value. The least significant two bits of the value shall contain the new Type of Service indicator. Use of other bits in the value is unspecified. The option_len parameter shall hold the size, in bytes, of the buffer referred to by option_value.

**IP_TTL**

Set the current unicast Internet Protocol Time To Live value used when sending packets with this socket. The option_value shall point to a value containing the time to live value, which shall be between 1 and 255. The option_len parameter shall hold the size, in bytes, of the buffer referred to by option_value.

**IP_MULTICAST_TTL**

Sets the Time To Live value of outgoing multicast packets for this socket. optval shall point to an integer which contains the new TTL value. If the new TTL value is -1, the implementation should use an unspecified default TTL value. If the new TTL value is out of the range of acceptable values (0-255), setsockopt() shall return -1 and set errno to indicate the error.

**IP_MULTICAST_LOOP**

Sets a boolean flag indicating whether multicast packets originating locally should be looped back to the local sockets. optval shall point to an integer which contains the new flag value.

**IP_ADD_MEMBERSHIP**

Join a multicast group. optval shall point to a ip_mreq structure. Before calling, the caller should fill in the imr_multiaddr field with the multicast group address and the imr_address field with the address of the local interface. If imr_address is set to INADDR_ANY, then an appropriate interface is chosen by the system.
IP_DROP_MEMBERSHIP

Leave a multicast group. optval shall point to a ip_mreq structure containing the same values as were used with IP_ADD_MEMBERSHIP.

IP_MULTICAST_IF

Set the local device for a multicast socket. optval shall point to a ip_mreq structure initialized in the same manner as with IP_ADD_MEMBERSHIP.

The ip_mreq structure contains two struct in_addr fields: imr_multiaddr and imr_address.

Return Value

On success, 0 is returned. On error, -1 is returned and the global variable errno is set appropriately.

Errors

As defined in ISO POSIX (2003).

setutent

Name

setutent — access user accounting database entries

Synopsis

#include <utmp.h>
void setutent(void);

Description

The setutent() function shall reset the user accounting database such that the next call to getutent() shall return the first record in the database. It is recommended to call it before any of the other functions that operate on the user accounting databases (e.g. getutent())

Return Value

None.
sigandset

Name

sigandset — build a new signal set by combining the two input sets using logical AND

Synopsis

```c
#include <signal.h>
int sigandset(sigset_t * set, const sigset_t * left, const sigset_t * right);
```

Description

The `sigandset()` shall combine the two signal sets referenced by `left` and `right`, using a logical AND operation, and shall place the result in the location referenced by `set`. The resulting signal set shall contain only signals that are in both the set referenced by `left` and the set referenced by `right`.

Return Value

On success, `sigandset()` shall return 0. Otherwise, `sigandset()` shall return -1 and set `errno` to indicate the error.

Errors

EINVAL

One or more of `set`, `left`, or `right` was a null pointer.

See Also

`sigorset()`
sigisemptyset

Name
sigisemptyset — check for empty signal set

Synopsis
#include <signal.h>
int sigisemptyset(const sigset_t * set);

Description
The sigisemptyset() function shall check for empty signal set referenced by set.

Return Value
The sigisemptyset() function shall return a positive non-zero value if the signal set referenced by set is empty, or zero if this set is empty. On error, sigisemptyset() shall return -1 and set errno to indicate the error.

Errors
EINVAL
set is a null pointer.
**sigorset**

**Name**
sigorset — build a new signal set by combining the two input sets using logical OR

**Synopsis**

```c
#include <signal.h>
int sigorset(sigset_t * set, const sigset_t * left, const sigset_t * right);
```

**Description**
The `sigorset()` shall combine the two signal sets referenced by `left` and `right`, using a logical OR operation, and shall place the result in the location referenced by `set`. The resulting signal set shall contain only signals that are in either the set referenced by `left` or the set referenced by `right`.

**Return Value**
On success, `sigorset()` shall return 0. Otherwise, `sigorset()` shall return -1 and set `errno` to indicate the error.

**Errors**

`EINVAL`

One or more of `set`, `left`, or `right` was a null pointer.

**See Also**
sigandset()

**sigreturn**

**Name**
sigreturn — return from signal handler and cleanup stack frame

**Synopsis**

```c
int sigreturn(struct sigcontext * scp);
```

**Description**
The `sigreturn()` function is used by the system to cleanup after a signal handler has returned. This function is not in the source standard; it is only in the binary standard.

**Return Value**
`sigreturn()` never returns.
**sscanf**

**Name**

`sscanf` — convert formatted input

**Description**

The `scanf()` family of functions shall behave as described in ISO POSIX (2003), except as noted below.

**Differences**

The `%s`, `%S` and `%[ conversion specifiers shall accept an option length modifier `a`, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set `errno` to `ENOMEM` and a conversion error results.

**Note:** This directly conflicts with the ISO C (1999) usage of `%a` as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as `"%aseconds"` will have a different meaning on an LSB conforming system.

**stime**

**Name**

`stime` — set time

**Synopsis**

```c
#define _SVID_SOURCE
#include <time.h>
int stime(const time_t * t);
```

**Description**

If the process has appropriate privilege, the `stime()` function shall set the system's idea of the time and date. Time, referenced by `t`, is measured in seconds from the epoch (defined in ISO POSIX (2003) as 00:00:00 UTC January 1, 1970).

**Return Value**

On success, `stime()` shall return 0. Otherwise, `stime()` shall return -1 and `errno` shall be set to indicate the error.

**Errors**

**EPERM**

The process does not have appropriate privilege.

**EINVAL**

- `t` is a null pointer.
**stpcpy**

**Name**

stpcpy — copy a string returning a pointer to its end

**Synopsis**

```c
#include <string.h>
char * stpcpy(char * restrict dest, const char * restrict src);
```

**Description**

The `stpcpy()` function shall copy the string pointed to by `src` (including the terminating null character) to the array pointed to by `dest`. The strings may not overlap, and the destination string `dest` shall be large enough to receive the copy.

**Return Value**

`stpcpy()` returns a pointer to the end of the string `dest` (that is, the address of the terminating null character) rather than the beginning.

**Example**

This program uses `stpcpy()` to concatenate `foo` and `bar` to produce `foobar`, which it then prints.

```c
#include <string.h>

int main (void)
{
    char buffer[256];
    char *to = buffer;
    to = stpcpy (to, "foo");
    to = stpcpy (to, "bar");
    printf ("%s\n", buffer);
}
```
stpncpy

Name
stpncpy — copy a fixed-size string, returning a pointer to its end

Synopsis
#include <string.h>
char * stpncpy(char * restrict dest, const char * restrict src, size_t n);

Description
The stpncpy() function shall copy at most n characters from the string pointed to
by src, including the terminating null character, to the array pointed to by dest.
Exactly n characters are written at dest. If the length strlen() (src) is smaller
than n, the remaining characters in dest are filled with \0 characters. If the length
strlen(src) is greater than or equal to n, dest will not be null terminated.
The strings may not overlap.
The programmer shall ensure that there is room for at least n characters at dest.

Return Value
The stpncpy() function shall return a pointer to the terminating NULL in dest, or,
if dest is not NULL-terminated, dest + n.

strcasestr

Name
strcasestr — locate a substring ignoring case

Synopsis
#include <string.h>
char * strcasestr(const char * s1, const char * s2);

Description
The strcasestr() function shall behave as strstr(), except that it shall ignore the case of
both strings. The strcasestr() function shall be locale aware; that is
strcasestr() shall behave as if both strings had been converted to lower case in
the current locale before the comparison is performed.

Return Value
Upon successful completion, strcasestr() shall return a pointer to the located
string or a null pointer if the string is not found. If s2 points to a string with zero
length, the function shall return s1.
**strerror_r**

**Name**

`strerror_r` — reentrant version of `strerror`

**Synopsis**

```c
#include <string.h>
char * strerror_r(int errnum, char * buf, size_t buflen);
```

**Description**

The `strerror_r()` function shall behave as specified in ISO POSIX (2003), except as described below.

**Returns String, not Error Value**

The `strerror_r()` function shall return a pointer to the string corresponding to `errno`. The returned pointer may point within the buffer `buf` (at most `buflen` bytes).

**Return Value**

On success, `strerror_r()` shall return a pointer to the generated message string (determined by the setting of the LC_MESSAGES category in the current locale). Otherwise, `strerror_r()` shall return the string corresponding to "Unknown error".

**strndup**

**Name**

`strndup` — return a malloc'd copy of at most the specified number of bytes of a string

**Synopsis**

```c
#include <string.h>
char * strndup(const char * string, size_t n);
```

**Description**

The `strndup()` function shall return a malloc'd copy of at most `n` bytes of `string`. The resultant string shall be terminated even if no NULL terminator appears before `string+n`.

**Return Value**

On success, `strndup()` shall return a pointer to a newly allocated block of memory containing a copy of at most `n` bytes of `string`. Otherwise, `strndup()` shall return NULL and set `errno` to indicate the error.

**Errors**

- `ENOMEM`
  
  Insufficient memory available.
strnlen

Name
strnlen — determine the length of a fixed-size string

Synopsis
#include <string.h>
size_t strnlen(const char * s, size_t maxlen);

Description
strnlen() returns the number of characters in the string s, not including the
terminating \0 character, but at most maxlen. In doing this, strnlen() looks only
at the first maxlen characters at s and never beyond s + maxlen.

Return Value
strnlen() returns strlen(s), if that is less than maxlen, or maxlen if there is no \0
character among the first maxlen characters pointed to by s.

strptime

Name
strptime — parse a time string

Description
The strftime() shall behave as specified in the ISO POSIX (2003) with differences
as listed below.

Number of leading zeroes may be limited
The ISO POSIX (2003) specifies fields for which "leading zeros are permitted but not
required"; however, applications shall not expect to be able to supply more leading
zeroes for these fields than would be implied by the range of the field.
Implementations may choose to either match an input with excess leading zeroes,
or treat this as a non-matching input. For example, %j has a range of 001 to 366, so
0, 00, 000, 001, and 045 are acceptable inputs, but inputs such as 0000, 0366 and the
like are not.

Rationale
glibc developers consider it appropriate behavior to forbid excess leading zeroes.
When trying to parse a given input against several format strings, forbidding excess
leading zeroes could be helpful. For example, if one matches 0011-12-26 against
%m-%d-%Y and then against %Y-%m-%d, it seems useful for the first match to fail, as it
would be perverse to parse that date as November 12, year 26. The second pattern
parses it as December 26, year 11.
The ISO POSIX (2003) is not explicit that an unlimited number of leading zeroes are
required, although it may imply this. The LSB explicitly allows implementations to
have either behavior. Future versions of this standard may require implementations
to forbid excess leading zeroes.

An Interpretation Request is currently pending against ISO POSIX (2003) for this
matter.
strsep

Name

strsep — extract token from string

Synopsis

#include <string.h>
char * strsep(char ** stringp, const char * delim);

Description

The strsep() function shall find the first token in the string referenced by the pointer stringp, using the characters in delim as delimiters.

If stringp is NULL, strsep() shall return NULL and do nothing else.

If stringp is non-NULL, strsep() shall find the first token in the string referenced by stringp, where tokens are delimited by characters in the string delim. This token shall be terminated with a \0 character by overwriting the delimiter, and stringp shall be updated to point past the token. In case no delimiter was found, the token is taken to be the entire string referenced by stringp, and the location referenced by stringp is made NULL.

Return Value

strsep() shall return a pointer to the beginning of the token.

Notes

The strsep() function was introduced as a replacement for strtok(), since the latter cannot handle empty fields. However, strtok() conforms to ISO C (1999) and to ISO POSIX (2003) and hence is more portable.

See Also

strtok(), strtok_r().

strsignal

Name

strsignal — return string describing signal

Synopsis

#define _GNU_SOURCE

13 Base Libraries
#include <string.h>
char * strsignal(int sig);

extern const char * const sys_siglist[];

Description

The `strsignal()` function shall return a pointer to a string describing the signal number `sig`. The string can only be used until the next call to `strsignal()`.

The array `sys_siglist` holds the signal description strings indexed by signal number. This array should not be accessed directly by applications.

Return Value

If `sig` is a valid signal number, `strsignal()` shall return a pointer to the appropriate description string. Otherwise, `strsignal()` shall return either a pointer to the string "unknown signal", or a null pointer.

Although the function is not declared as returning a pointer to a constant character string, applications shall not modify the returned string.

**strtoq**

Name

`strtoq` - convert string value to a long or quad_t integer

Synopsis

```c
#include <sys/types.h>
#include <stdlib.h>
```
#include <limits.h>
long long strtoq(const char * nptr, char ** endptr, int base);

Description
strtoq() converts the string nptr to a quad value. The conversion is done according to the given base, which shall be between 2 and 36 inclusive, or be the special value 0.
nptr may begin with an arbitrary amount of white space (as determined by isspace()), followed by a single optional + or - sign character. If base is 0 or 16, the string may then include a 0x prefix, and the number will be read in base 16; otherwise, a 0 base is taken as 10 (decimal), unless the next character is 0, in which case it is taken as 8 (octal).
The remainder of the string is converted to a long value in the obvious manner, stopping at the first character which is not a valid digit in the given base. (In bases above 10, the letter A in either upper or lower case represents 10, B represents 11, and so forth, with Z representing 35.)

Return Value
strtoq() returns the result of the conversion, unless the value would underflow or overflow. If an underflow occurs, strtoq() returns QUAD_MIN. If an overflow occurs, strtoq() returns QUAD_MAX. In both cases, the global variable errno is set to ERANGE.

Errors
ERANGE

The given string was out of range; the value converted has been clamped.

**strouq**

Name
strouq — convert a string to an unsigned long long

Synopsis

```c
#include <sys/types.h>
#include <stdlib.h>
```
#include <limits.h>
unsigned long long strtouq(const char * nptr, char ** endptr, int base);

**Description**

*strtouq()* converts the string *nptr* to an unsigned long long value. The conversion is done according to the given base, which shall be between 2 and 36 inclusive, or be the special value 0.

*nptr* may begin with an arbitrary amount of white space (as determined by *isspace()*), followed by a single optional + or - sign character. If *base* is 0 or 16, the string may then include a 0x prefix, and the number will be read in base 16; otherwise, a 0 base is taken as 10 (decimal), unless the next character is 0, in which case it is taken as 8 (octal).

The remainder of the string is converted to an unsigned long value in the obvious manner, stopping at the end of the string or at the first character that does not produce a valid digit in the given base. (In bases above 10, the letter A in either upper or lower case represents 10, B represents 11, and so forth, with Z representing 35.)

**Return Value**

On success, *strtouq()* returns either the result of the conversion or, if there was a leading minus sign, the negation of the result of the conversion, unless the original (non-negated) value would overflow. In the case of an overflow the function returns *UQUAD_MAX* and the global variable *errno* is set to ERANGE.

**Errors**

ERANGE

The given string was out of range; the value converted has been clamped.
svc_register

Name

svc_register — register Remote Procedure Call interface

Synopsis

#include <rpc/rpc.h>
bool_t svc_register(SVCXPRT *xprt, rpcprog_t progrnum, rpcvers_t versnum,
                   __dispatch_fn_t dispatch, rpcprot_t protocol);

Description

The svc_register() function shall associate the program identified by progrnum at
version versnum with the service dispatch procedure, dispatch. If protocol is
zero, the service is not registered with the portmap service. If protocol is non-zero,
then a mapping of the triple [progrnum, versnum, protocol] to xprt->xp_port is
established with the local portmap service. The procedure dispatch has the
following form:

int dispatch(struct svc_req *request, SVCXPRT *xprt);

Return Value

svc_register() returns 1 if it succeeds, and zero otherwise.

svc_run

Name

svc_run — waits for RPC requests to arrive and calls service procedure

Synopsis

#include <rpc/svc.h>
void svc_run(void);

Description

The svc_run() function shall wait for RPC requests to arrive, read and unpack each
request, and dispatch it to the appropriate registered handler. Under normal
conditions, svc_run() shall not return; it shall only return if serious errors occur
that prevent further processing.
**svc_sendreply**

**Name**

svc_sendreply — called by RPC service's dispatch routine

**Synopsis**

```c
bool_t svc_sendreply(SVCXPRT *xprt, xdrproc_t outproc, caddr_t out);
```

**Description**

Called by an RPC service's dispatch routine to send the results of a remote procedure call. The parameter `xprt` is the request's associated transport handle; `outproc` is the XDR routine which is used to encode the results; and `out` is the address of the results. This routine returns one if it succeeds, zero otherwise.

**svctcp_create**

**Name**

svctcp_create — create a TCP/IP-based RPC service transport

**Synopsis**

```c
#include <rpc/rpc.h>
SVCXPRT * svctcp_create(int sock, u_int send_buf_size, u_int recv_buf_size);
```

**Description**

svctcp_create() creates a TCP/IP-based RPC service transport, to which it returns a pointer. The transport is associated with the socket `sock`, which may be RPC_ANYSOCK, in which case a new socket is created. If the socket is not bound to a local TCP port, then this routine binds it to an arbitrary port. Upon completion, `xprt->xp_sock` is the transport's socket descriptor, and `xprt->xp_port` is the transport's port number. Since TCP-based RPC uses buffered I/O, users may specify the size of buffers; values of zero choose suitable defaults.

**Return Value**

svctcp_create() returns NULL if it fails, or a pointer to the RPC service transport otherwise.

**svcudp_create**

**Name**

svcudp_create — create a UDP-based RPC service transport

**Synopsis**

```c
SVCXPRT * svcudp_create(int sock);
```

**Description**

This call is equivalent to `svcudp_bufcreate(sock, SZ, SZ)` for some default size `SZ`. 
**swscanf**

**Name**

swscanf — convert formatted input

**Description**

The `scanf()` family of functions shall behave as described in ISO POSIX (2003), except as noted below.

**Differences**

The `%s`, `%S` and `%*` conversion specifiers shall accept an option length modifier `a`, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set `errno` to `ENOMEM` and a conversion error results.

**Note:** This directly conflicts with the ISO C (1999) usage of `a` as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as `"%aseconds"` will have a different meaning on an LSB conforming system.
system

Name
system — execute a shell command

Synopsis
#include <stdlib.h>
int system(const char * string);

Description
The system() function shall behave as described in ISO POSIX (2003).

Notes
The fact that system() ignores interrupts is often not what a program wants. ISO POSIX (2003) describes some of the consequences; an additional consequence is that a program calling system() from a loop cannot be reliably interrupted. Many programs will want to use the exec() family of functions instead.

Do not use system() from a program with suid or sgid privileges, because unexpected values for some environment variables might be used to subvert system integrity. Use the exec() family of functions instead, but not execlp() or execvp(). system() will not, in fact, work properly from programs with suid or sgid privileges on systems on which /bin/sh is bash version 2, since bash 2 drops privileges on startup. (Debian uses a modified bash which does not do this when invoked as sh.)

The check for the availability of /bin/sh is not actually performed; it is always assumed to be available. ISO C (1999) specifies the check, but ISO POSIX (2003) specifies that the return shall always be nonzero, since a system without the shell is not conforming, and it is this that is implemented.

It is possible for the shell command to return 127, so that code is not a sure indication that the execve() call failed; check the global variable errno to make sure.
textdomain

Name
textdomain — set the current default message domain

Synopsis
#include <libintl.h>
char * textdomain(const char * domainname);

Description
The textdomain() function shall set the current default message domain to
domainname. Subsequent calls to gettext() and ngettext() use the default
message domain.

If domainname is NULL, the default message domain shall not be altered.
If domainname is "", textdomain() shall reset the default domain to the system
default of "messages".

Return
On success, textdomain() shall return the currently selected domain. Otherwise, a
null pointer shall be returned, and errno is set to indicate the error.

Errors
ENOMEM
Insufficient memory available.

unlink

Name
unlink — remove a directory entry

Synopsis
int unlink(const char * path);

Description
unlink() is as specified in ISO POSIX (2003), but with differences as listed below.
See also Additional behaviors: unlink/link on directory.

May return EISDIR on directories
If path specifies a directory, the implementation may return EISDIR instead of
EPERM as specified by ISO POSIX (2003).

Rationale: The Linux kernel has deliberately chosen EISDIR for this case and does not
expect to change.
uselocale

Name
uselocale — Set locale for thread

Synopsis
#include <locale.h>
locale_t uselocale(locale_t newloc);

Description
The uselocale() function shall set the locale for the calling thread to the locale
specified by newloc.

If newloc is the value LC_GLOBAL_LOCALE, the thread’s locale shall be set to the
process current global locale, as set by setlocale(). If newloc is NULL, the thread’s
locale is not altered.

Return Value
The uselocale() function shall return the previous locale, or LC_GLOBAL_LOCALE if
the thread local locale has not been previously set.

Errors
None defined.

See Also
setlocale(), freelocale(), duplocale(), newlocale()
utmpname

Name
utmpname — set user accounting database

Synopsis
#include <utmp.h>
int utmpname(const char * dbname);

Description
The utmpname() function shall cause the user accounting database used by the getutent(), getutent_r(), getuxent(), getuxid(), getuxline(), and putuxline() functions to be that named by dbname, instead of the system default database. See Section 16.3 for further information.

Note: The LSB does not specify the format of the user accounting database, nor the names of the file or files that may contain it.

Return Value
None.

Errors
None defined.

vasprintf

Name
vasprintf — write formatted output to a dynamically allocated string

Synopsis
#include <stdarg.h>
#include <stdio.h>
int vasprintf(char * * restrict ptr, const char * restrict format, va_list arg);

Description
The vasprintf() function shall write formatted output to a dynamically allocated string, and store the address of that string in the location referenced by ptr. It shall behave as asprintf(), except that instead of being called with a variable number of arguments, it is called with an argument list as defined by <stdarg.h>.

Return Value
Refer to fprintf().

Errors
Refer to fprintf().
vdprintf

Name
vdprintf — write formatted output to a file descriptor

Synopsis
#include <stdio.h>
int vdprintf(int fd, const char * restrict format, va_list arg);

Description
The vdprintf() shall behave as vfprintf(), except that the first argument is a file descriptor rather than a stream (as defined by ISO POSIX (2003)).

Return Value
Refer to fprintf().

Errors
Refer to fprintf().

verrx

Name
verrx — display formatted error message and exit

Synopsis
#include <stdarg.h>
#include <err.h>
void verrx(int eval, const char * fmt, va_list args);

Description
The verrx() shall behave as errx() except that instead of being called with a variable number of arguments, it is called with an argument list as defined by <stdarg.h>.

verrx() does not return, but exits with the value of eval.

Return Value
None.

Errors
None.
vfscanf

Name
vfscanf — convert formatted input

Description
The scanf() family of functions shall behave as described in ISO POSIX (2003), except as noted below.

Differences
The %s, %S and %l conversion specifiers shall accept an option length modifier a, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set errno to ENOMEM and a conversion error results.

Note: This directly conflicts with the ISO C (1999) usage of %a as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as "%aseconds" will have a different meaning on an LSB conforming system.

vfwscanf

Name
vfwscanf — convert formatted input

Description
The scanf() family of functions shall behave as described in ISO POSIX (2003), except as noted below.

Differences
The %s, %S and %l conversion specifiers shall accept an option length modifier a, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set errno to ENOMEM and a conversion error results.

Note: This directly conflicts with the ISO C (1999) usage of %a as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as "%aseconds" will have a different meaning on an LSB conforming system.
vscanf

Name

vscanf — convert formatted input

Description

The `scanf()` family of functions shall behave as described in ISO POSIX (2003), except as noted below.

Differences

The `%s`, `%S` and `%l` conversion specifiers shall accept an option length modifier `a`, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set `errno` to `ENOMEM` and a conversion error results.

Note: This directly conflicts with the ISO C (1999) usage of `%a` as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as `%%aseconds` will have a different meaning on an LSB conforming system.

vsscanf

Name

vsscanf — convert formatted input

Description

The `scanf()` family of functions shall behave as described in ISO POSIX (2003), except as noted below.

Differences

The `%s`, `%S` and `%l` conversion specifiers shall accept an option length modifier `a`, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set `errno` to `ENOMEM` and a conversion error results.

Note: This directly conflicts with the ISO C (1999) usage of `%a` as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as `%%aseconds` will have a different meaning on an LSB conforming system.
**vswscanf**

**Name**

vswscanf — convert formatted input

**Description**

The `scanf()` family of functions shall behave as described in ISO POSIX (2003), except as noted below.

**Differences**

The `%s`, `%S` and `%l` conversion specifiers shall accept an option length modifier `a`, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set `errno` to `ENOMEM` and a conversion error results.

*Note:* This directly conflicts with the ISO C (1999) usage of `%a` as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as `"%aseconds"` will have a different meaning on an LSB conforming system.

**vsyslog**

**Name**

vsyslog — log to system log

**Synopsis**

```c
#include <stdarg.h>
#include <syslog.h>
void vsyslog(int priority, char * message, va_list arglist);
```

**Description**

The `vsyslog()` function is identical to `syslog()` as specified in ISO POSIX (2003), except that `arglist` (as defined by `stdarg.h`) replaces the variable number of arguments.
vwscanf

Name
vwscanf — convert formatted input

Description
The scanf() family of functions shall behave as described in ISO POSIX (2003), except as noted below.

Differences
The %s, %S and %l conversion specifiers shall accept an option length modifier a, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set errno to ENOMEM and a conversion error results.

Note: This directly conflicts with the ISO C (1999) usage of %a as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as "%aseconds" will have a different meaning on an LSB conforming system.

wait4

Name
wait4 — wait for process termination, BSD style

Synopsis
#include <sys/types.h>
#include <sys/resource.h>


#include <sys/wait.h>

```c
pid_t wait4(pid_t pid, int *status, int options, struct rusage *rusage);
```

### Description

`wait4()` suspends execution of the current process until a child (as specified by `pid`) has exited, or until a signal is delivered whose action is to terminate the current process or to call a signal handling function. If a child (as requested by `pid`) has already exited by the time of the call (a so-called "zombie" process), the function returns immediately. Any system resources used by the child are freed.

The value of `pid` can be one of:

- `< -1`
  - wait for any child process whose process group ID is equal to the absolute value of `pid`.

- `-1`
  - wait for any child process; this is equivalent to calling `wait3()`.

- `0`
  - wait for any child process whose process group ID is equal to that of the calling process.

- `> 0`
  - wait for the child whose process ID is equal to the value of `pid`.

The value of `options` is a bitwise or of zero or more of the following constants:

- `WNOHANG`
  - return immediately if no child is there to be waited for.

- `WUNTRACED`
  - return for children that are stopped, and whose status has not been reported.

If `status` is not NULL, `wait4()` stores status information in the location `status`. This status can be evaluated with the following macros:

- `WIFEXITED(status)`
  - is nonzero if the child exited normally.

- `WEXITSTATUS(status)`
  - evaluates to the least significant eight bits of the return code of the child that terminated, which may have been set as the argument to a call to `exit()` or as the argument for a return statement in the main program. This macro can only be evaluated if `WIFEXITED()` returned nonzero.

- `WIFSIGNALED(status)`
  - returns true if the child process exited because of a signal that was not caught.
WTERMSIG(status)
returns the number of the signal that caused the child process to terminate.
This macro can only be evaluated if WIFSIGNALED() returned nonzero.

WIFSTOPPED(status)
returns true if the child process that caused the return is currently stopped; this
is only possible if the call was done using WUNTRACED().

WSTOPSIG(status)
returns the number of the signal that caused the child to stop. This macro can
only be evaluated if WIFSTOPPED() returned nonzero.

If rusage is not NULL, the struct rusage (as defined in sys/resource.h) that it
points to will be filled with accounting information. See getrusage() for details.

Return Value
On success, the process ID of the child that exited is returned. On error, -1 is
returned (in particular, when no unwaited-for child processes of the specified kind
exist), or 0 if WNOHANG() was used and no child was available yet. In the latter two
cases, the global variable errno is set appropriately.

Errors
ECHILD
No unwaited-for child process as specified does exist.

ERESTARTSYS
A WNOHANG() was not set and an unblocked signal or a SIGCHILD was caught.
This error is returned by the system call. The library interface is not allowed to
return ERESTARTSYS, but will return EINTR.

waitpid

Name
waitpid — wait for child process

Description
waitpid() is as specified in ISO POSIX (2003), but with differences as listed below.

Need not support WCONTINUED or WIFCONTINUED
Implementations need not support the XSI optional functionality of WCONTINUED() or WIFCONTINUED().
warn

Name
warn — formatted error messages

Synopsis
#include <err.h>
void warn(const char * fmt, ...);

Description
The warn() function shall display a formatted error message on the standard error stream. The output shall consist of the last component of the program name, a colon character, and a space character. If fmt is non-NULL, it shall be used as a format string for the printf() family of functions, and the formatted message, a colon character, and a space are written to stderr. Finally, the error message string affiliated with the current value of the global variable errno shall be written to stderr, followed by a newline character.

Return Value
None.

Errors
None.

warnx

Name
warnx — formatted error messages

Synopsis
#include <err.h>
void warnx(const char * fmt, ...);

Description
The warnx() function shall display a formatted error message on the standard error stream. The last component of the program name, a colon character, and a space shall be output. If fmt is non-NULL, it shall be used as the format string for the printf() family of functions, and the formatted error message, a colon character, and a space shall be output. The output shall be followed by a newline character.

Return Value
None.

Errors
None.
**wcpcpy**

**Name**
wcpcpy — copy a wide character string, returning a pointer to its end

**Synopsis**
```c
#include <wchar.h>
wchar_t * wcpcpy(wchar_t * dest, const wchar_t * src);
```

**Description**
wcpcpy() is the wide-character equivalent of `strcpy()`. It copies the wide character string `src`, including the terminating null wide character code, to the array `dest`.

The strings may not overlap.

The programmer shall ensure that there is room for at least `wcslen(src)`+1 wide characters at `dest`.

**Return Value**
wpcpy() returns a pointer to the end of the wide-character string `dest`, that is, a pointer to the terminating null wide character code.

**wcpncpy**

**Name**
wcpncpy — copy a fixed-size string of wide characters, returning a pointer to its end

**Synopsis**
```c
#include <wchar.h>
wchar_t * wcpncpy(wchar_t * dest, const wchar_t * src, size_t n);
```

**Description**
wcpncpy() is the wide-character equivalent of `stpncpy()`. It copies at most `n` wide characters from the wide-character string `src`, including the terminating null wide character code, to the array `dest`. Exactly `n` wide characters are written at `dest`. If the length `wcslen(src)` is smaller than `n`, the remaining wide characters in the array `dest` are filled with null wide character codes. If the length `wcslen(src)` is greater than or equal to `n`, the string `dest` will not be terminated with a null wide character code.

The strings may not overlap.

The programmer shall ensure that there is room for at least `n` wide characters at `dest`.

**Return Value**
wcpncpy() returns a pointer to the wide character one past the last non-null wide character written.
wcscasecmp

Name
wcscasecmp — compare two wide-character strings, ignoring case

Synopsis
#include <wchar.h>
int wcscasecmp(const wchar_t * s1, const wchar_t * s2);

Description
wcscasecmp() is the wide-character equivalent of strcasecmp(). It compares the
wide-character string s1 and the wide-character string s2, ignoring case differences
(towupper, towlower).

Return Value
The wcscasecmp() function shall return 0 if the wide-character strings s1 and s2
are equal except for case distinctions. It shall return a positive integer if s1 is greater
than s2, ignoring case. It shall return a negative integer if s1 is less than s2,
ignoring case.

Notes
The behavior of wcscasecmp() depends upon the LC_CTYPE category of the current
locale.

wcsdup

Name
wcsdup — duplicate a wide-character string

Synopsis
#include <wchar.h>
wchar_t * wcsdup(const wchar_t * s);

Description
wcsdup() is the wide-character equivalent of strdup(). It allocates and returns a
new wide-character string whose initial contents is a duplicate of the wide-
character string s.

Memory for the new wide-character string is obtained with malloc(), and can be
freed with free().

Return Value
wcsdup() returns a pointer to the new wide-character string, or NULL if sufficient
memory was not available.
wcsncasecmp

**Name**
wcsncasecmp — compare two fixed-size wide-character strings, ignoring case

**Synopsis**

```c
#include <wchar.h>
int wcsncasecmp(const wchar_t * s1, const wchar_t * s2, size_t n);
```

**Description**

`wcsncasecmp()` is the wide-character equivalent of `strncasecmp()`. It compares the wide-character string `s1` and the wide-character string `s2`, but at most `n` wide characters from each string, ignoring case differences (towupper, towlower).

**Return Value**

`wcsncasecmp()` returns 0 if the wide-character strings `s1` and `s2`, truncated to at most length `n`, are equal except for case distinctions. It returns a positive integer if truncated `s1` is greater than truncated `s2`, ignoring case. It returns a negative integer if truncated `s1` is smaller than truncated `s2`, ignoring case.

**Notes**

The behavior of `wcsncasecmp()` depends upon the `LC_CTYPE` category of the current locale.

wcsnlen

**Name**
wcsnlen — determine the length of a fixed-size wide-character string

**Synopsis**

```c
#include <wchar.h>
size_t wcsnlen(const wchar_t * s, size_t maxlen);
```

**Description**

`wcsnlen()` is the wide-character equivalent of `strnlen()`. It returns the number of wide-characters in the string `s`, not including the terminating null wide character code, but at most `maxlen`. In doing this, `wcsnlen()` looks only at the first `maxlen` wide-characters at `s` and never beyond `s + maxlen`.

**Return Value**

`wcsnlen()` returns `wcslen(s)` if that is less than `maxlen`, or `maxlen` if there is no null wide character code among the first `maxlen` wide characters pointed to by `s`. 
wcsnrtombs

Name

wcsnrtombs — convert a wide character string to a multi-byte string

Synopsis

```
#include <wchar.h>
size_t wcsnrtombs(char * dest, const wchar_t * * src, size_t nwc, size_t len, mbstate_t * ps);
```

Description

wcsnrtombs() is like wcsrtombs(), except that the number of wide characters to be converted, starting at src, is limited to nwc.

If dest is not a NULL pointer, wcsnrtombs() converts at most nwc wide characters from the wide-character string src to a multibyte string starting at dest. At most len bytes are written to dest. The state ps is updated.

The conversion is effectively performed by repeatedly calling:

```
wcrtomb(dest, *src, ps)
```

as long as this call succeeds, and then incrementing dest by the number of bytes written and src by 1.

The conversion can stop for three reasons:

- A wide character has been encountered that cannot be represented as a multibyte sequence (according to the current locale). In this case src is left pointing to the invalid wide character, (size_t)(-1) is returned, and errno is set to EILSEQ.
- nws wide characters have been converted without encountering a null wide character code, or the length limit forces a stop. In this case, src is left pointing to the next wide character to be converted, and the number bytes written to dest is returned.
- The wide-character string has been completely converted, including the terminating null wide character code (which has the side effect of bringing back ps to the initial state). In this case, src is set to NULL, and the number of bytes written to dest, excluding the terminating null wide character code, is returned.

If dest is NULL, len is ignored, and the conversion proceeds as above, except that the converted bytes are not written out to memory, and that no destination length limit exists.

In both of the above cases, if ps is a NULL pointer, a static anonymous state only known to wcsnrtombs() is used instead.

The programmer shall ensure that there is room for at least len bytes at dest.

Return Value

wcsnrtombs() returns the number of bytes that make up the converted part of multibyte sequence, not including the terminating null wide character code. If a wide character was encountered which could not be converted, (size_t)(-1) is returned, and the global variable errno set to EILSEQ.

Notes
The behavior of wcsnrtombs() depends on the LC_CTYPE category of the current locale.
Passing NULL as ps is not multi-thread safe.

**wcstoq**

**Name**
wctoq – convert wide string to long long int representation

**Synopsis**

```c
#include <wchar.h>
long long int wcstoq(const wchar_t * restrict nptr, wchar_t ** restrict endptr, int base);
```

**Description**
The wcstoq() function shall convert the initial portion of the wide string nptr to long long int representation. It is identical to wcstoll().

**Return Value**
Refer to wcstoll().

**Errors**
Refer to wcstoll().

**wcstouq**

**Name**
wctouq – convert wide string to unsigned long long int representation

**Synopsis**

```c
#include <wchar.h>
unsigned long long wcstouq(const wchar_t * restrict nptr, wchar_t ** restrict endptr, int base);
```

**Description**
The wcstouq() function shall convert the initial portion of the wide string nptr to unsigned long long int representation. It is identical to wcstoull().

**Return Value**
Refer to wcstoull().

**Errors**
Refer to wcstoull().
wscanf

Name

wscanf — convert formatted input

Description

The scanf() family of functions shall behave as described in ISO POSIX (2003), except as noted below.

Differences

The %s, %S and %l conversion specifiers shall accept an option length modifier a, which shall cause a memory buffer to be allocated to hold the string converted. In such a case, the argument corresponding to the conversion specifier should be a reference to a pointer value that will receive a pointer to the allocated buffer. If there is insufficient memory to allocate a buffer, the function may set errno to ENOMEM and a conversion error results.

Note: This directly conflicts with the ISO C (1999) usage of %a as a conversion specifier for hexadecimal float values. While this conversion specifier should be supported, a format specifier such as "%aseconds" will have a different meaning on an LSB conforming system.

xdr_u_int

Name

xdr_u_int — library routines for external data representation

Synopsis

int xdr_u_int(XDR * xdrs, unsigned int * up);

Description

xdr_u_int() is a filter primitive that translates between C unsigned integers and their external representations.

Return Value

On success, 1 is returned. On error, 0 is returned.

13.6 Interfaces for libm

Table 13-24 defines the library name and shared object name for the libm library

<table>
<thead>
<tr>
<th>Library:</th>
<th>libm</th>
</tr>
</thead>
<tbody>
<tr>
<td>SONAME:</td>
<td>See archLSB.</td>
</tr>
</tbody>
</table>

The behavior of the interfaces in this library is specified by the following specifications:

ISO C (1999)

this specification
13 Base Libraries

SUSv2

13.6.1 Math

13.6.1.1 Interfaces for Math

An LSB conforming implementation shall provide the generic functions for Math specified in Table 13-25, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-25 libm - Math Function Interfaces

<table>
<thead>
<tr>
<th>Function</th>
<th>Category</th>
<th>Description</th>
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</table>
13.7 Data Definitions for libm

This section defines global identifiers and their values that are associated with interfaces contained in libm. These definitions are organized into groups that correspond to system headers. This convention is used as a convenience for the reader, and does not imply the existence of these headers, or their content.

These definitions are intended to supplement those provided in the referenced underlying specifications.

This specification uses ISO/IEC 9899 C Language as the reference programming language, and data definitions are specified in ISO C format. The C language is used here as a convenient notation. Using a C language description of these data objects does not preclude their use by other programming languages.

13.7.1 complex.h

#define complex _Complex

13.7.2 math.h

#define DOMAIN 1
#define SING    2

struct exception
{
    int type;
    char *name;
    double arg1;
    double arg2;
    double retval;
};

#define FP_NAN 0
#define FP_INFINITY 1
#define FP_ZERO 2
#define FP_NORMAL 3

#define isnormal(x)    (fpclassify (x) == FP_NORMAL)
#define isnfinite(x)    (sizeof (x) == sizeof (float) ? __finitef (x) : sizeof (x) == sizeof (double)? __finitei (x) : __finitel (x))
#define isinf(x)        (sizeof (x) == sizeof (float) ? __isinff (x): sizeof (x) == sizeof (double) ? __isinf (x) : __isinfl (x))
#define isnan(x)        (sizeof (x) == sizeof (float) ? __isnanf (x) : sizeof (x) == sizeof (double) ? __isnan (x) : __isnanl (x))

#define HUGE_VAL 0x1.0p2047
#define HUGE_VALF 0x1.0p255f
#define HUGE_VALL 0x1.0p32767L

#define M_1_PI 0.31830988618379067154
#define M_LOG10E 0.43429448190325182765
#define M_2_PI 0.63661977236758134308
#define M_LN2 0.69314718055994530942
#define M_2_SQRTPI 1.12837916709551257390
#define M_SQRT2 1.41421356237309504880
#define M_LOG2E 1.44269504088896834074
#define M_PI_2 1.57079687364744336352
#define M_LN10 2.30258509299404548623
#define M_E 2.71828182845904523536
#define M_PI 3.14159265358979323846
#define INFINITY HUGE_VAL
#define MATH_ERRNO 1
#define MATH_ERREXCEPT 2

#define isunordered(u, v)   (__extension__({ __typeof__(u) __u = (u); __typeof__(v) __v = (v);fpclassify (__u) == FP_NAN || fpclassify (__v) == FP_NAN; }))
#define islesseg greater(x, y)   (__extension__({ __typeof__(x) __x = (x); __typeof__(y) __y = (y);if(!isunordered (__x, __y) & & __x < __y || __x <= __y) ; }))
#define islesss(x, y)   (__extension__({ __typeof__(x) __x = (x); __typeof__(y) __y = (y);if(isunordered (__x, __y) & & __x < __y || __x <= __y) ; }))
#define islessequa l(x, y)   (__extension__({ __typeof__(x) __x = (x); __typeof__(y) __y = (y);if(isunordered (__x, __y) & & __x <= __y) ; }))
#define isgreater(x, y)   (__extension__({ __typeof__(x) __x = (x); __typeof__(y) __y = (y);if(isunordered (__x, __y) & & __x > __y || __x >= __y) ; }))
#define isgreaterequal(x, y)   (__extension__({ __typeof__(x) __x = (x); __typeof__(y) __y = (y);if(isunordered (__x, __y) & & __x >= __y) ; }))
13.8 Interface Definitions for libm

The following interfaces are included in libm and are defined by this specification. Unless otherwise noted, these interfaces shall be included in the source standard. Other interfaces listed above for libm shall behave as described in the referenced base document.

__fpclassify

Name

__fpclassify — Classify real floating type

Synopsis

int __fpclassify(double arg);

Description

__fpclassify() has the same specification as fpclassify() in ISO POSIX (2003), except that the argument type for __fpclassify() is known to be double.

__fpclassify() is not in the source standard; it is only in the binary standard.

__fpclassifyf

Name

__fpclassifyf — Classify real floating type

Synopsis

int __fpclassifyf(float arg);

Description

__fpclassifyf() has the same specification as fpclassifyf() in ISO POSIX (2003), except that the argument type for __fpclassifyf() is known to be float.

__fpclassifyf() is not in the source standard; it is only in the binary standard.

13.9 Interfaces for libpthread

Table 13-27 defines the library name and shared object name for the libpthread library

Table 13-27 libpthread Definition

<table>
<thead>
<tr>
<th>Library:</th>
<th>libpthread</th>
</tr>
</thead>
<tbody>
<tr>
<td>SONAME:</td>
<td>libpthread.so.0</td>
</tr>
</tbody>
</table>

The behavior of the interfaces in this library is specified by the following specifications:

- Large File Support
- this specification
13.9.1 Realtime Threads

13.9.1.1 Interfaces for Realtime Threads

An LSB conforming implementation shall provide the generic functions for Realtime Threads specified in Table 13-28, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-28 libpthread - Realtime Threads Function Interfaces

<table>
<thead>
<tr>
<th>Function</th>
<th>Function</th>
<th>Function</th>
<th>Function</th>
<th>Function</th>
</tr>
</thead>
</table>

Referenced Specification(s)

13.9.2 Advanced Realtime Threads

13.9.2.1 Interfaces for Advanced Realtime Threads

No external functions are defined for libpthread - Advanced Realtime Threads

13.9.3 Posix Threads

13.9.3.1 Interfaces for Posix Threads

An LSB conforming implementation shall provide the generic functions for Posix Threads specified in Table 13-29, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-29 libpthread - Posix Threads Function Interfaces

<table>
<thead>
<tr>
<th>Function</th>
<th>Function</th>
<th>Function</th>
<th>Function</th>
</tr>
</thead>
</table>
13 Base Libraries

|--------------------------|-----------------------|------------------------|----------------------------|-----------------|

Referenced Specification(s)
[1]. this specification

13.9.4 Thread aware versions of libc interfaces

13.9.4.1 Interfaces for Thread aware versions of libc interfaces

An LSB conforming implementation shall provide the generic functions for Thread aware versions of libc interfaces specified in Table 13-30, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-30 libpthread - Thread aware versions of libc interfaces Function Interfaces

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>open64 [1]</td>
<td>pread64 [1]</td>
<td>pwrite64 [1]</td>
</tr>
</tbody>
</table>
13 Base Libraries

Referenced Specification(s)
[1]. Large File Support

13.10 Data Definitions for libpthread

This section defines global identifiers and their values that are associated with interfaces contained in libpthread. These definitions are organized into groups that correspond to system headers. This convention is used as a convenience for the reader, and does not imply the existence of these headers, or their content.

These definitions are intended to supplement those provided in the referenced underlying specifications.

This specification uses ISO/IEC 9899 C Language as the reference programming language, and data definitions are specified in ISO C format. The C language is used here as a convenient notation. Using a C language description of these data objects does not preclude their use by other programming languages.

13.10.1 pthread.h

```c
#define PTHREAD_SCOPE_SYSTEM    0
#define PTHREAD_MUTEX_DEFAULT   1
#define PTHREAD_MUTEX_NORMAL    1
#define PTHREAD_SCOPE_PROCESS   1
#define PTHREAD_MUTEX_RECURSIVE 2
#define PTHREAD_RWLOCK_DEFAULT_NP       2
#define PTHREAD_MUTEX_ERRORCHECK        3
#define pthread_cleanup_pop(execute)    _pthread_cleanup_pop(& _buffer,(execute));
#define __LOCK_INITIALIZER      { 0, 0 }
#define PTHREAD_RWLOCK_INITIALIZER      { __LOCK_INITIALIZER, 0,
NULL, NULL, NULL,PTHREAD_RWLOCK_DEFAULT_NP, PTHREAD_PROCESS_PRIVATE
} }
#define PTHREAD_MUTEX_INITIALIZER
{0,0,0,PTHREAD_MUTEX_NORMAL,__LOCK_INITIALIZER}
#define pthread_cleanup_push(routine,arg)       {struct _pthread_cleanup_buffer _buffer;_pthread_cleanup_push(& _buffer,(routine),(arg));
#define PTHREAD_COND_INITIALIZER        {__LOCK_INITIALIZER,0}
struct _pthread_cleanup_buffer
{ void (*__routine) (void *);
void *__arg;
int __canceltype;
struct _pthread_cleanup_buffer *__prev;
};
typedef unsigned int pthread_key_t;
typedef int pthread_once_t;
typedef long long int __pthread_cond_align_t;
typedef unsigned long int pthread_t;
struct _pthread_fastlock
{ long int __status;
int __spinlock;
};
```
typedef struct _pthread_descr_struct *pthread_descr;

typedef struct
{
    int __m_reserved;
    int __m_count;
    pthread_descr __m_owner;
    int __m_kind;
    struct _pthread_fastlock __m_lock;
}
pthread_mutex_t;
typedef struct
{
    int __mutexkind;
}
pthread_mutexattr_t;

typedef struct
{
    int __detachstate;
    int __schedpolicy;
    struct sched_param __schedparam;
    int __inheritsched;
    int __scope;
    size_t __guardsize;
    int __stackaddr_set;
    void *__stackaddr;
    unsigned long int __stacksize;
}
pthread_attr_t;

typedef struct
{
    struct _pthread_fastlock __c_lock;
    pthread_descr __c_waiting;
    char __padding[48 - sizeof (struct _pthread_fastlock) - sizeof
    _pthread_descr) - sizeof
    (_pthread_cond_align_t)];
    __pthread_cond_align_t __align;
}
pthread_cond_t;
typedef struct
{
    int __dummy;
}
pthread_condattr_t;

typedef struct _pthread_rwlock_t
{
    struct _pthread_fastlock __rw_lock;
    int __rw_readers;
    pthread_descr __rw_writer;
    pthread_descr __rw_read_waiting;
    pthread_descr __rw_write_waiting;
    int __rw_kind;
    int __rw_pshared;
}
pthread_rwlock_t;
typedef struct
{
    int __lockkind;
    int __pshared;
}
13 Base Libraries

```c
pthread_rwlockattr_t;
#define PTHREAD_CREATE_JOINABLE 0
#define PTHREAD_INHERIT_SCHED 0
#define PTHREAD_ONCE_INIT 0
#define PTHREAD_PROCESS_PRIVATE 0
#define PTHREAD_CREATE_DETACHED 1
#define PTHREAD_EXPLICIT_SCHED 1
#define PTHREAD_PROCESS_SHARED 1

#define PTHREAD_CANCELED ((void*)-1)
#define PTHREAD_CANCEL_DEFERRED 0
#define PTHREAD_CANCEL_ENABLE 0
#define PTHREAD_CANCEL_ASYNCHRONOUS 1
#define PTHREAD_CANCEL_DISABLE 1
```

13.10.2 semaphore.h

```c
typedef struct
{
       struct __pthread_fastlock __sem_lock;
       int __sem_value;
       __pthread_descr __sem_waiting;
} sem_t;
#define SEM_FAILED ((sem_t*)0)
#define SEM_VALUE_MAX ((int)((~0u)>>1))
```

13.11 Interface Definitions for libpthread

The following interfaces are included in libpthread and are defined by this specification. Unless otherwise noted, these interfaces shall be included in the source standard.

Other interfaces listed above for libpthread shall behave as described in the referenced base document.

`_pthread_cleanup_pop`

**Name**

`_pthread_cleanup_pop` — establish cancellation handlers

**Synopsis**

```c
#include <pthread.h>
void _pthread_cleanup_pop(struct __pthread_cleanup_buffer *, int);
```

**Description**

The `_pthread_cleanup_pop()` function provides an implementation of the `pthread_cleanup_pop()` macro described in ISO POSIX (2003).

The `_pthread_cleanup_pop()` function is not in the source standard; it is only in the binary standard.
_pthread_cleanup_push

Name
_pthread_cleanup_push — establish cancellation handlers

Synopsis
#include <pthread.h>
void _pthread_cleanup_push(struct _pthread_cleanup_buffer *, void (*) (void *), void *);

Description
The _pthread_cleanup_push() function provides an implementation of the
pthread_cleanup_push() macro described in ISO POSIX (2003).
The _pthread_cleanup_push() function is not in the source standard; it is only in
the binary standard.

13.12 Interfaces for libgcc_s
Table 13-31 defines the library name and shared object name for the libgcc_s library

<table>
<thead>
<tr>
<th>Library:</th>
<th>libgcc_s</th>
</tr>
</thead>
<tbody>
<tr>
<td>SONAME:</td>
<td>libgcc_s.so.1</td>
</tr>
</tbody>
</table>

13.12.1 Unwind Library

13.12.1.1 Interfaces for Unwind Library
No external functions are defined for libgcc_s - Unwind Library

13.13 Data Definitions for libgcc_s
This section defines global identifiers and their values that are associated with
interfaces contained in libgcc_s. These definitions are organized into groups that
correspond to system headers. This convention is used as a convenience for the
reader, and does not imply the existence of these headers, or their content.
These definitions are intended to supplement those provided in the referenced
underlying specifications.
This specification uses ISO/IEC 9899 C Language as the reference programming
language, and data definitions are specified in ISO C format. The C language is
used here as a convenient notation. Using a C language description of these data
objects does not preclude their use by other programming languages.

13.13.1 unwind.h

struct _Unwind_Context;
typedef void * _Unwind_Ptr;
typedef unsigned int _Unwind_Word;
typedef enum
13.14 Interfaces for libdl

Table 13-32 defines the library name and shared object name for the libdl library.

Table 13-32 libdl Definition

<table>
<thead>
<tr>
<th>Library:</th>
<th>libdl</th>
</tr>
</thead>
<tbody>
<tr>
<td>SONAME:</td>
<td>libdl.so.2</td>
</tr>
</tbody>
</table>

The behavior of the interfaces in this library is specified by the following specifications:

this specification

13.14.1 Dynamic Loader

13.14.1.1 Interfaces for Dynamic Loader

An LSB conforming implementation shall provide the generic functions for Dynamic Loader specified in Table 13-33, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-33 libdl - Dynamic Loader Function Interfaces


Referenced Specification(s)

[1]. this specification
13.15 Data Definitions for libdl

This section defines global identifiers and their values that are associated with interfaces contained in libdl. These definitions are organized into groups that correspond to system headers. This convention is used as a convenience for the reader, and does not imply the existence of these headers, or their content.

These definitions are intended to supplement those provided in the referenced underlying specifications.

This specification uses ISO/IEC 9899 C Language as the reference programming language, and data definitions are specified in ISO C format. The C language is used here as a convenient notation. Using a C language description of these data objects does not preclude their use by other programming languages.

13.15.1 dlfcn.h

```c
#define RTLD_NEXT       ((void *) -11)
#define RTLD_LOCAL      0
#define RTLD_LAZY       0x00001
#define RTLD_NOW        0x00002
#define RTLD_GLOBAL     0x00100

typedef struct {
    char *dli_fname;
    void *dli_fbase;
    char *dli_sname;
    void *dli_saddr;
} Dl_info;
```

13.16 Interface Definitions for libdl

The following interfaces are included in libdl and are defined by this specification. Unless otherwise noted, these interfaces shall be included in the source standard.

Other interfaces listed above for libdl shall behave as described in the referenced base document.

dladdr

Name

dladdr – find the shared object containing a given address

Synopsis

```c
#include <dlfcn.h>

typedef struct { 
    const char  *dli_fname;
    void        *dli_fbase;
    const char  *dli_sname;
    void        *dli_saddr;
} Dl_info;
```
The `dladdr()` function shall query the dynamic linker for information about the shared object containing the address `addr`. The information shall be returned in the user supplied data structure referenced by `dlip`.

The structure shall contain at least the following members:

- **dli_fname**
  The pathname of the shared object containing the address

- **dli_fbase**
  The base address at which the shared object is mapped into the address space of the calling process.

- **dli_sname**
  The name of the nearest runtime symbol with value less than or equal to `addr`. Where possible, the symbol name shall be returned as it would appear in C source code.

  If no symbol with a suitable value is found, both this field and `dli_saddr` shall be set to `NULL`.

- **dli_saddr**
  The address of the symbol returned in `dli_sname`. This address has type "pointer to type", where type is the type of the symbol `dli_sname`.

  **Example:** If the symbol in `dli_sname` is a function, then the type of `dli_saddr` is of type "pointer to function".

The behavior of `dladdr()` is only specified in dynamically linked programs.

**Return Value**

On success, `dladdr()` shall return non-zero, and the structure referenced by `dlip` shall be filled in as described. Otherwise, `dladdr()` shall return zero, and the cause of the error can be fetched with `dlerror()`.

**Errors**

See `dlerror()`.

**Environment**

- **LD_LIBRARY_PATH**
  directory search-path for object files
**dlopen**

**Name**

dlopen — open dynamic object

**Synopsis**

```c
#include <dlfcn.h>

void * dlopen(const char * filename, int flag);
```

**Description**

The `dlopen()` function shall behave as specified in ISO POSIX (2003), but with additional behaviors listed below.

If the file argument does not contain a slash character, then the system shall look for a library of that name in at least the following directories, and use the first one which is found:

- The directories specified by the `DT_RPATH` dynamic entry.
- The directories specified in the `LD_LIBRARY_PATH` environment variable (which is a colon separated list of pathnames). This step shall be skipped for setuid and setgid executables.
- A set of directories sufficient to contain the libraries specified in this standard.

**Note:** Traditionally, `/lib` and `/usr/lib`. This case would also cover cases in which the system used the mechanism of `/etc/ld.so.conf` and `/etc/ld.so.cache` to provide access.

Example: An application which is not linked against libm may choose to dlopen libm.

**dlsym**

**Name**

dlsym — obtain the address of a symbol from a dlopen object

**Description**

dlsym() is as specified in the ISO POSIX (2003), but with differences as listed below.

**The special purpose value for handle RTLD_NEXT**

The value RTLD_NEXT, which is reserved for future use shall be available, with the behavior as described in ISO POSIX (2003).

### 13.17 Interfaces for librt

Table 13-34 defines the library name and shared object name for the librt library

**Table 13-34 librt Definition**

<table>
<thead>
<tr>
<th>Library:</th>
<th>librt</th>
</tr>
</thead>
<tbody>
<tr>
<td>SONAME:</td>
<td>librt.so.1</td>
</tr>
</tbody>
</table>
The behavior of the interfaces in this library is specified by the following specifications:


### 13.17.1 Shared Memory Objects

#### 13.17.1.1 Interfaces for Shared Memory Objects

An LSB conforming implementation shall provide the generic functions for Shared Memory Objects specified in Table 13-35, with the full mandatory functionality as described in the referenced underlying specification.

<table>
<thead>
<tr>
<th>Function</th>
<th>Interface Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>shm_open</td>
<td>[1]</td>
</tr>
<tr>
<td>shm_unlink</td>
<td>[1]</td>
</tr>
</tbody>
</table>

Referenced Specification(s)


### 13.17.2 Clock

#### 13.17.2.1 Interfaces for Clock

An LSB conforming implementation shall provide the generic functions for Clock specified in Table 13-36, with the full mandatory functionality as described in the referenced underlying specification.

<table>
<thead>
<tr>
<th>Function</th>
<th>Interface Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>clock_gettime</td>
<td>[1]</td>
</tr>
<tr>
<td>clock_getres</td>
<td>[1]</td>
</tr>
<tr>
<td>clock_getcpuclockid</td>
<td>[1]</td>
</tr>
</tbody>
</table>

Referenced Specification(s)


### 13.17.3 Timers

#### 13.17.3.1 Interfaces for Timers

An LSB conforming implementation shall provide the generic functions for Timers specified in Table 13-37, with the full mandatory functionality as described in the referenced underlying specification.

<table>
<thead>
<tr>
<th>Function</th>
<th>Interface Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>timer_create</td>
<td>[1]</td>
</tr>
<tr>
<td>timer_delete</td>
<td>[1]</td>
</tr>
<tr>
<td>timer_getoverrun</td>
<td>[1]</td>
</tr>
<tr>
<td>timer_gettime</td>
<td>[1]</td>
</tr>
<tr>
<td>timer_settime</td>
<td>[1]</td>
</tr>
</tbody>
</table>

Referenced Specification(s)


### 13.18 Interfaces for libcrypt

Table 13-38 defines the library name and shared object name for the libcrypt library
Table 13-38 libcrypt Definition

| Library:  | libcrypt |
| SONAME:   | libcrypt.so.1 |

The behavior of the interfaces in this library is specified by the following specifications:

13.18.1 Encryption

13.18.1.1 Interfaces for Encryption

An LSB conforming implementation shall provide the generic functions for Encryption specified in Table 13-39, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-39 libcrypt - Encryption Function Interfaces


Referenced Specification(s)

13.19 Interfaces for libpam

Table 13-40 defines the library name and shared object name for the libpam library

Table 13-40 libpam Definition

| Library:  | libpam |
| SONAME:   | libpam.so.0 |

A single service name, other, shall always be present. The behavior of this service shall be determined by the system administrator. Additional service names may also exist. ¹

¹ Future versions of this specification might define additional service names.

The behavior of the interfaces in this library is specified by the following specifications:
this specification

13.19.1 Pluggable Authentication API

13.19.1.1 Interfaces for Pluggable Authentication API

An LSB conforming implementation shall provide the generic functions for Pluggable Authentication API specified in Table 13-41, with the full mandatory functionality as described in the referenced underlying specification.

Table 13-41 libpam - Pluggable Authentication API Function Interfaces


229
13.20 Data Definitions for libpam

This section defines global identifiers and their values that are associated with interfaces contained in libpam. These definitions are organized into groups that correspond to system headers. This convention is used as a convenience for the reader, and does not imply the existence of these headers, or their content.

These definitions are intended to supplement those provided in the referenced underlying specifications.

This specification uses ISO/IEC 9899 C Language as the reference programming language, and data definitions are specified in ISO C format. The C language is used here as a convenient notation. Using a C language description of these data objects does not preclude their use by other programming languages.

13.20.1 security/pam_appl.h

typedef struct pam_handle pam_handle_t;
struct pam_message
{
    int msg_style;
    const char *msg;
};
struct pam_response
{
    char *resp;
    int resp_retcode;
};

struct pam_conv
{
    int (*conv) (int num_msg, const struct pam_message * *msg,
                  struct pam_response * *resp, void *appdata_ptr);
    void *appdata_ptr;
};

#define PAM_PROMPT_ECHO_OFF     1
#define PAM_PROMPT_ECHO_ON      2
#define PAM_ERROR_MSG   3
#define PAM_TEXT_INFO   4
#define PAM_SERVICE     1
#define PAM_USER        2
#define PAM_TTY 3
#define PAM_RHOST       4
#define PAM_CONV        5
#define PAM_RUSER       8
#define PAM_USER_PROMPT 9
#define PAM_SUCCESS 0
#define PAM_OPEN_ERR 1
#define PAM_USER_UNKNOWN 10
#define PAM_MAXTRIES 11
#define PAM_NEW_AUTHTOK_REQD 12
#define PAM_ACCT_EXPIRED 13
#define PAM_SESSION_ERR 14
#define PAM_CRED_UNAVAIL 15
#define PAM_CRED_EXPIRED 16
#define PAM_CRED_ERR 17
#define PAM_CONV_ERR 19
#define PAM_SYMBOL_ERR 2
#define PAM_AUTHTOK_ERR 20
#define PAM_AUTHTOK_RECOVER_ERR 21
#define PAM_AUTHTOK_LOCK_BUSY 22
#define PAM_AUTHTOK_DISABLE_AGING 23
#define PAM_TRY_AGAIN 24
#define PAM_ABORT 26
#define PAM_AUTHTOK_EXPIRED 27
#define PAM_BAD_ITEM 29
#define PAM_SERVICE_ERR 3
#define PAM_SYSTEM_ERR 4
#define PAM_BUF_ERR 5
#define PAM_PERM_DENIED 6
#define PAM_AUTH_ERR 7
#define PAM_CRED_INSUFFICIENT 8
#define PAM_AUTHINFO_UNAVAIL 9
#define PAM_DISALLOW_NULL_AUTHTOK 0x0001U
#define PAM_ESTABLISH_CRED 0x0002U
#define PAM_DELETE_CRED 0x0004U
#define PAM_REINITIALIZE_CRED 0x0008U
#define PAM_REFRESH_CRED 0x0010U
#define PAM_CHANGE_EXPIRED_AUTHTOK 0x0020U
#define PAM_SILENT 0x8000U

## 13.21 Interface Definitions for libpam

The following interfaces are included in libpam and are defined by this specification. Unless otherwise noted, these interfaces shall be included in the source standard.

Other interfaces listed above for libpam shall behave as described in the referenced base document.
**pam_acct_mgmt**

**Name**

pam_acct_mgmt — establish the status of a user’s account

**Synopsis**

```c
#include <security/pam_appl.h>
int pam_acct_mgmt(pam_handle_t * pamh, int flags);
```

**Description**

pam_acct_mgmt() establishes the account's usability and the user's accessibility to the system. It is typically called after the user has been authenticated.

*flags* may be specified as any valid flag (namely, one of those applicable to the *flags* argument of *pam_authenticate()*) Additionally, the value of *flags* may be logically or'd with **PAM_SILENT**.

**Return Value**

**PAM_SUCCESS**

Success.

**PAM_NEW_AUTHTOK_REQD**

User is valid, but user's authentication token has expired. The correct response to this return-value is to require that the user satisfy the *pam_chauthtok()* function before obtaining service. It may not be possible for an application to do this. In such a case, the user should be denied access until the account password is updated.

**PAM_ACCT_EXPIRED**

User is no longer permitted access to the system.

**PAM_AUTH_ERR**

Authentication error.

**PAM_PERM_DENIED**

User is not permitted to gain access at this time.

**PAM_USER_UNKNOWN**

User is not known to a module's account management component.

**Note:** Errors may be translated to text with *pam_strerror()*. 
pam_authenticate

Name

pam_authenticate — authenticate the user

Synopsis

#include <security/pam_appl.h>
int pam_authenticate(pam_handle_t * pamh, int flags);

Description

pam_authenticate() serves as an interface to the authentication mechanisms of the loaded modules.

flags is an optional parameter that may be specified by the following value:

PAM_DISALLOW_NULL_AUTHTOK
   Instruct the authentication modules to return PAM_AUTH_ERR if the user does not have a registered authorization token.

Additionally, the value of flags may be logically or'd with PAM_SILENT.

The process may need to be privileged in order to successfully call this function.

Return Value

PAM_SUCCESS
   Success.

PAM_AUTH_ERR
   User was not authenticated or process did not have sufficient privileges to perform authentication.

PAM_CRED_INSUFFICIENT
   Application does not have sufficient credentials to authenticate the user.

PAM_AUTHINFO_UNAVAIL
   Modules were not able to access the authentication information. This might be due to a network or hardware failure, etc.

PAM_USER_UNKNOWN
   Supplied username is not known to the authentication service.

PAM_MAXTRIES
   One or more authentication modules has reached its limit of tries authenticating the user. Do not try again.

PAM_ABORT
   One or more authentication modules failed to load.

Note: Errors may be translated to text with pam_strerror().
pam_chauthtok

Name
pam_chauthtok — change the authentication token for a given user

Synopsis
#include <security/pam_appl.h>
int pam_chauthtok(pam_handle_t * pamh, const int flags);

Description
pam_chauthtok() is used to change the authentication token for a given user as indicated by the state associated with the handle pamh.

flags is an optional parameter that may be specified by the following value:

PAM_CHANGE_EXPIRED_AUTHTOK
User's authentication token should only be changed if it has expired.

Additionally, the value of flags may be logically or'd with PAM_SILENT.

RETURN VALUE
PAM_SUCCESS
Success.

PAM_AUTHTOK_ERR
A module was unable to obtain the new authentication token.

PAM_AUTHTOK_RECOVER_ERR
A module was unable to obtain the old authentication token.

PAM_AUTHTOK_LOCK_BUSY
One or more modules were unable to change the authentication token since it is currently locked.

PAM_AUTHTOK_DISABLE_AGING
Authentication token aging has been disabled for at least one of the modules.

PAM_PERM_DENIED
Permission denied.

PAM_TRY_AGAIN
Not all modules were in a position to update the authentication token(s). In such a case, none of the user's authentication tokens are updated.

PAM_USER_UNKNOWN
User is not known to the authentication token changing service.

Note: Errors may be translated to text with pam_strerror().
pam_close_session

**Name**
pam_close_session — indicate that an authenticated session has ended

**Synopsis**
```c
#include <security/pam_appl.h>
int pam_close_session(pam_handle_t *pamh, int flags);
```

**Description**
pam_close_session() is used to indicate that an authenticated session has ended. It is used to inform the module that the user is exiting a session. It should be possible for the PAM library to open a session and close the same session from different applications.

*flags* may have the value PAM_SILENT to indicate that no output should be generated as a result of this function call.

**Return Value**
PAM_SUCCESS
Success.
PAM_SESSION_ERR
One of the required loaded modules was unable to close a session for the user.

*Note:* Errors may be translated to text with pam_strerror().

pam_end

**Name**
pam_end — terminate the use of the PAM library

**Synopsis**
```c
#include <security/pam_appl.h>
int pam_end(pam_handle_t *pamh, int pam_status);
```

**Description**
pam_end() terminates use of the PAM library. On success, the contents of *pamh* are no longer valid, and all memory associated with it is invalid.
Normally, *pam_status* is passed the value PAM_SUCCESS, but in the event of an unsuccessful service application, the appropriate PAM error return value should be used.

**Return Value**
PAM_SUCCESS
Success.

*Note:* Errors may be translated to text with pam_strerror().
**pam_fail_delay**

**Name**

`pam_fail_delay` — specify delay time to use on authentication error

**Synopsis**

```c
#include <security/pam_appl.h>
int pam_fail_delay(pam_handle_t * pamh, unsigned int micro_sec);
```

**Description**

`pam_fail_delay()` specifies the minimum delay for the PAM library to use when an authentication error occurs. The actual delay can vary by as much at 25%. If this function is called multiple times, the longest time specified by any of the call will be used.

The delay is invoked if an authentication error occurs during the `pam_authenticate()` or `pam_chauthtok()` function calls.

Independent of the success of `pam_authenticate()` or `pam_chauthtok()`, the delay time is reset to its default value of 0 when the PAM library returns control to the application from these two functions.

**Return Value**

PAM_SUCCESS

Success.

**Note:** Errors may be translated to text with `pam_strerror()`.
pam_get_item

Name
pam_get_item — obtain the value of the indicated item.

Synopsis
#include <security/pam_appl.h>
int pam_get_item(const pam_handle_t * pamh, int item_type, const void ** item);

Description
pam_get_item() obtains the value of the indicated item_type. The possible values of item_type are the same as listed for pam_set_item().

On success, item contains a pointer to the value of the corresponding item. Note that this is a pointer to the actual data and should not be free()’d or over-written.

Return Value
PAM_SUCCESS
Success.
PAM_PERM_DENIED
Application passed a NULL pointer for item.
PAM_BAD_ITEM
Application attempted to get an undefined item.

Note: Errors may be translated to text with pam_strerror().

pam_getenvlist

Name
pam_getenvlist — returns a pointer to the complete PAM environment.

Synopsis
#include <security/pam_appl.h>
char * const * pam_getenvlist(pam_handle_t * pamh);

Description
pam_getenvlist() returns a pointer to the complete PAM environment. This pointer points to an array of pointers to NULL-terminated strings and must be terminated by a NULL pointer. Each string has the form "name=value".

The PAM library module allocates memory for the returned value and the associated strings. The calling application is responsible for freeing this memory.

Return Value
pam_getenvlist() returns an array of string pointers containing the PAM environment. On error, NULL is returned.
**pam_open_session**

**Name**

pam_open_session — indicate session has started

**Synopsis**

```c
#include <security/pam_appl.h>
int pam_open_session(pam_handle_t * pamh, int flags);
```

**Description**

The `pam_open_session()` function is used to indicate that an authenticated session has begun, after the user has been identified (see `pam_authenticate()` and, if necessary, granted credentials (see `pam_setcred()`). It is used to inform the module that the user is currently in a session. It should be possible for the PAM library to open a session and close the same session from different applications.

`flags` may have the value `PAM_SILENT` to indicate that no output be generated as a result of this function call.

**Return Value**

- `PAM_SUCCESS`
  - Success.

- `PAM_SESSION_ERR`
  - One of the loaded modules was unable to open a session for the user.

**ERRORS**

May be translated to text with `pam_strerror()`. 
pam_set_item

Name
pam_set_item — (re)set the value of an item.

Synopsis
#include <security/pam_appl.h>
int pam_set_item(pam_handle_t * pamh, int item_type, const void * item);

Description
pam_set_item() (re)sets the value of one of the following item_types:

PAM_SERVICE
service name

PAM_USER
user name

PAM_TTY
terminal name
The value for a device file should include the /dev/ prefix. The value for graphical, X-based, applications should be the $DISPLAY variable.

PAM_RHOST
remote host name

PAM_CONV
conversation structure

PAM_RUSER
remote user name

PAM_USER_PROMPT
string to be used when prompting for a user's name
The default value for this string is Please enter username: .

For all item_types other than PAM_CONV, item is a pointer to a NULL-terminated character string. In the case of PAM_CONV, item points to an initialized pam_conv structure.

Return Value
PAM_SUCCESS
Success.

PAM_PERM_DENIED
An attempt was made to replace the conversation structure with a NULL value.

PAM_BUF_ERR
Function ran out of memory making a copy of the item.

PAM_BAD_ITEM

Application attempted to set an undefined item.

**Note:** Errors may be translated to text with `pam_strerror()`. 
pam_setcred

**Name**
pam_setcred — set the module-specific credentials of the user

**Synopsis**
```c
#include <security/pam_appl.h>
extern int pam_setcred(pam_handle_t * pamh, int flags);
```

**Description**
pam_setcred() sets the module-specific credentials of the user. It is usually called after the user has been authenticated, after the account management function has been called and after a session has been opened for the user.

*flags* maybe specified from among the following values:

- PAM_ESTABLISH_CRED
  - set credentials for the authentication service
- PAM_DELETE_CRED
  - delete credentials associated with the authentication service
- PAM_REINITIALIZE_CRED
  - reinitialize the user credentials
- PAM_REFRESH_CRED
  - extend lifetime of the user credentials

Additionally, the value of *flags* may be logically or'd with PAM_SILENT.

**Return Value**

- PAM_SUCCESS
  - Success.
- PAM_CRED_UNAVAIL
  - Module cannot retrieve the user's credentials.
- PAM_CRED_EXPIRED
  - User's credentials have expired.
- PAM_USER_UNKNOWN
  - User is not known to an authentication module.
- PAM_CRED_ERR
  - Module was unable to set the credentials of the user.

**Note:** Errors may be translated to text with pam_strerror().
pam_start

Name
pam_start — initialize the PAM library

Synopsis
#include <security/pam_appl.h>
int pam_start(const char *service_name, const char *user, const struct
pam_conv *pam_conversation, pam_handle_t **pamh);

Description
pam_start() is used to initialize the PAM library. It must be called prior to any
other usage of the PAM library. On success, *pamh becomes a handle that provides
continuity for successive calls to the PAM library. pam_start() expects arguments
as follows: the service_name of the program, the username of the individual to be
authenticated, a pointer to an application-supplied pam_conv structure, and a
pointer to a pam_handle_t pointer.

An application must provide the conversation function used for direct
communication between a loaded module and the application. The application also
typically provides a means for the module to prompt the user for a password, etc.

The structure, pam_conv, is defined to be,

```
struct pam_conv {
    int (*conv) (int num_msg,
                const struct pam_message **msg,
                struct pam_response **resp,
                void *appdata_ptr);
    void *appdata_ptr;
```

It is initialized by the application before it is passed to the library. The contents of this structure are attached to the \*pamh handle. The point of this argument is to provide a mechanism for any loaded module to interact directly with the application program; this is why it is called a conversation structure.

When a module calls the referenced \texttt{conv()} function, \texttt{appdata_ptr} is set to the second element of this structure.

The other arguments of a call to \texttt{conv()} concern the information exchanged by module and application. \texttt{num_msg} holds the length of the array of pointers passed via \texttt{msg}. On success, the pointer \texttt{resp} points to an array of \texttt{num_msg} \texttt{pam_response} structures, holding the application-supplied text. Note that \texttt{resp} is a struct \texttt{pam_response} array and not an array of pointers.

**Return Value**

- \texttt{PAM_SUCCESS}  
  Success.
- \texttt{PAM_BUF_ERR}  
  Memory allocation error.
- \texttt{PAM_ABORT}  
  Internal failure.

**ERRORS**

May be translated to text with \texttt{pam_strerror()}.  

**pam_strerror**

**Name**

\texttt{pam_strerror} – returns a string describing the PAM error

**Synopsis**

\texttt{#include <security/pam_appl.h>}
\texttt{const char * pam_strerror(pam_handle_t * pamh, int errnum);}  

**Description**

\texttt{pam_strerror()} returns a string describing the PAM error associated with \texttt{errnum}.

**Return Value**

On success, this function returns a description of the indicated error. The application should not free or modify this string. Otherwise, a string indicating that the error is unknown shall be returned. It is unspecified whether or not the string returned is translated according to the setting of LC_MESSAGES.
14 Utility Libraries

14.1 Introduction

An LSB-conforming implementation shall also support the following utility libraries which are built on top of the interfaces provided by the base libraries. These libraries implement common functionality, and hide additional system dependent information such as file formats and device names.

- libz
- libcurses
- libutil

14.2 Interfaces for libz

Table 14-1 defines the library name and shared object name for the libz library

<table>
<thead>
<tr>
<th>Library:</th>
<th>libz</th>
</tr>
</thead>
<tbody>
<tr>
<td>SONAME:</td>
<td>libz.so.1</td>
</tr>
</tbody>
</table>

The behavior of the interfaces in this library is specified by the following specifications:

- this specification

14.2.1 Compression Library

14.2.1.1 Interfaces for Compression Library

An LSB conforming implementation shall provide the generic functions for Compression Library specified in Table 14-2, with the full mandatory functionality as described in the referenced underlying specification.

|-------------|-------------------|------------|--------------|------------------|
14.3 Data Definitions for libz

This section defines global identifiers and their values that are associated with interfaces contained in libz. These definitions are organized into groups that correspond to system headers. This convention is used as a convenience for the reader, and does not imply the existence of these headers, or their content.

These definitions are intended to supplement those provided in the referenced underlying specifications.

This specification uses ISO/IEC 9899 C Language as the reference programming language, and data definitions are specified in ISO C format. The C language is used here as a convenient notation. Using a C language description of these data objects does not preclude their use by other programming languages.

14.3.1 zlib.h

In addition to the values below, the zlib.h header shall define the ZLIB_VERSION macro. This macro may be used to check that the version of the library at run time matches that at compile time.

See also the zlibVersion() function, which returns the library version at run time. The first character of the version at compile time should always match the first character at run time.

```c
#define Z_NULL 0
#define MAX_WBITS 15
#define MAX_MEM_LEVEL 9
#define deflateInit2(strm,level,method,windowBits,memLevel,strategy)
deflateInit2_((strm),(level),(method),(windowBits),(memLevel),(strategy),ZLIB_VERSION,sizeof(z_stream))
#define deflateInit(strm,level) deflateInit_((strm), (level), ZLIB_VERSION, sizeof(z_stream))
#define inflateInit2(strm,windowBits) inflateInit2_((strm), (windowBits), ZLIB_VERSION, sizeof(z_stream))
#define inflateInit(strm) inflateInit_((strm), ZLIB_VERSION, sizeof(z_stream))

typedef char charf;
typedef int intf;

typedef void *voidpf;
typedef unsigned int uInt;
typedef unsigned long int uLong;
typedef uLong uLongf;
typedef void *voidp;
typedef unsigned char Byte;
typedef off_t z_off_t;
typedef void *const voidpc;
```
typedef voidp (*alloc_func) (voidp opaque, uInt items, uInt size);
typedef void (*free_func) (voidp opaque, voidp address);
struct internal_state
{  
    int dummy;
    
};
typedef Byte Bytef;
typedef uInt uIntf;

typedef struct z_stream_s
{  
    Bytef *next_in;
    uInt avail_in;
    uLong total_in;
    Bytef *next_out;
    uInt avail_out;
    uLong total_out;
    char *msg;
    struct internal_state *state;
    alloc_func zalloc;
    free_func zfree;
    voidp opaque;
    int data_type;
    uLong adler;
    uLong reserved;
}
z_stream;

typedef z_stream *z_streamp;
typedef voidp gzFile;
#define Z_NO_FLUSH 0
#define Z_PARTIAL_FLUSH 1
#define Z_SYNC_FLUSH 2
#define Z_FULL_FLUSH 3
#define Z_FINISH 4
#define Z_ERRNO (-1)
#define Z_STREAM_ERROR (-2)
#define Z_DATA_ERROR (-3)
#define Z_MEM_ERROR (-4)
#define Z_BUF_ERROR (-5)
#define Z_VERSION_ERROR (-6)
#define Z_OK 0
#define Z_STREAM_END 1
#define Z_NEED_DICT 2
#define Z_DEFAULT_COMPRESSION (-1)
#define Z_NO_COMPRESSION 0
#define Z_BEST_SPEED 1
#define Z_BEST_COMPRESSION 9
#define Z_DEFAULT_STRATEGY 0
#define Z_FILTERED 1
#define Z_HUFFMAN_ONLY 2
#define Z_BINARY 0
#define Z_ASCII 1
#define Z_UNKNOWN 2
#define Z_DEFLATED 8
14.4 Interface Definitions for libz

The following interfaces are included in libz and are defined by this specification. Unless otherwise noted, these interfaces shall be included in the source standard. Other interfaces listed above for libz shall behave as described in the referenced base document.

adler32

Name
adler32 — compute Adler 32 Checksum

Synopsis
#include <zlib.h>
uLong adler32(uLong adler, const Bytef * buf, uInt len);

Description
The adler32() function shall compute a running Adler-32 checksum (as described in RFC 1950: ZLIB Compressed Data Format Specication). On entry, adler is the previous value for the checksum, and buf shall point to an array of len bytes of data to be added to this checksum. The adler32() function shall return the new checksum.

If buf is NULL (or Z_NULL), adler32() shall return the initial checksum.

Return Value
The adler32() function shall return the new checksum value.

Errors
None defined.

Application Usage (informative)
The following code fragment demonstrates typical usage of the adler32() function:

    uLong adler = adler32(0L, Z_NULL, 0);

    while (read_buffer(buffer, length) != EOF) {
        adler = adler32(adler, buffer, length);
    }
    if (adler != original_adler) error();
compress

Name
compress — compress data

Synopsis
#include <zlib.h>
int compress(Bytef * dest, uLongf * destLen, const Bytef * source, uLong sourceLen);

Description
The compress() function shall attempt to compress sourceLen bytes of data in the buffer source, placing the result in the buffer dest.

On entry, destLen should point to a value describing the size of the dest buffer. The application should ensure that this value be at least (sourceLen × 1.001) + 12. On successful exit, the variable referenced by destLen shall be updated to hold the length of compressed data in dest.

The compress() function is equivalent to compress2() with a level of Z_DEFAULT_LEVEL.

Return Value
On success, compress() shall return Z_OK. Otherwise, compress() shall return a value to indicate the error.

Errors
On error, compress() shall return a value as described below:

Z_BUF_ERROR
   The buffer dest was not large enough to hold the compressed data.

Z_MEM_ERROR
   Insufficient memory.
compress2

Name
compress2 — compress data at a specified level

Synopsis
#include <zlib.h>
int compress2(Bytef * dest, uLongf * destLen, const Bytef * source, uLong sourceLen, int level);

Description
The compress2() function shall attempt to compress sourceLen bytes of data in the buffer source, placing the result in the buffer dest, at the level described by level. The level supplied shall be a value between 0 and 9, or the value Z_DEFAULT_COMPRESSION. A level of 1 requests the highest speed, while a level of 9 requests the highest compression. A level of 0 indicates that no compression should be used, and the output shall be the same as the input.

On entry, destLen should point to a value describing the size of the dest buffer. The application should ensure that this value be at least (sourceLen × 1.001) + 12. On successful exit, the variable referenced by destLen shall be updated to hold the length of compressed data in dest.

The compress() function is equivalent to compress2() with a level of Z_DEFAULT_LEVEL.

Return Value
On success, compress2() shall return Z_OK. Otherwise, compress2() shall return a value to indicate the error.

Errors
On error, compress2() shall return a value as described below:

Z_BUF_ERROR
The buffer dest was not large enough to hold the compressed data.

Z_MEM_ERROR
Insufficient memory.

Z_STREAM_ERROR
The level was not Z_DEFAULT_LEVEL, or was not between 0 and 9.
**compressBound**

**Name**
compressBound — compute compressed data size

**Synopsis**

```c
#include <zlib.h>
int compressBound(uLong sourceLen);
```

**Description**

The `compressBound()` function shall estimate the size of buffer required to compress `sourceLen` bytes of data using the `compress()` or `compress2()` functions. If successful, the value returned shall be an upper bound for the size of buffer required to compress `sourceLen` bytes of data, using the parameters stored in `stream`, in a single call to `compress()` or `compress2()`.

**Return Value**

The `compressBound()` shall return a value representing the upper bound of an array to allocate to hold the compressed data in a single call to `compress()` or `compress2()`. This function may return a conservative value that may be larger than `sourceLen`.

**Errors**

None defined.
**Name**
crc32 — compute CRC-32 Checksum

**Synopsis**

```c
#include <zlib.h>
uLong crc32(uLong crc, const Bytef * buf, uInt len);
```

**Description**

The `crc32()` function shall compute a running Cyclic Redundancy Check checksum, as defined in ITU-T V.42. On entry, `crc` is the previous value for the checksum, and `buf` shall point to an array of `len` bytes of data to be added to this checksum. The `crc32()` function shall return the new checksum.

If `buf` is NULL (or `Z_NULL`), `crc32()` shall return the initial checksum.

**Return Value**

The `crc32()` function shall return the new checksum value.

**Errors**

None defined.

**Application Usage (informative)**

The following code fragment demonstrates typical usage of the `crc32()` function:

```c
uLong crc = crc32(0L, Z_NULL, 0);

while (read_buffer(buffer, length) != EOF) {
    crc = crc32(crc, buffer, length);
}
if (crc != original_crc) error();
```
deflate

Name
deflate — compress data

Synopsis
#include <zlib.h>
int deflate(z_streamp stream, int flush);

Description
The deflate() function shall attempt to compress data until either the input buffer
is empty or the output buffer is full. The stream references a z_stream structure.
Before the first call to deflate(), this structure should have been initialized by a
call to deflateInit2().

Note: deflateInit2() is only in the binary standard; source level applications should
initialize stream via a call to deflateInit() or deflateInit2().

In addition, the stream input and output buffers should have been initialized as
follows:

next_in
    should point to the data to be compressed.

avail_in
    should contain the number of bytes of data in the buffer referenced by
    next_in.

next_out
    should point to a buffer where compressed data may be placed.

avail_out
    should contain the size in bytes of the buffer referenced by next_out.

The deflate() function shall perform one or both of the following actions:

1. Compress input data from next_in and update next_in, avail_in and
total_in to reflect the data that has been compressed.

2. Fill the output buffer referenced by next_out, and update next_out,
avail_out and total_out to reflect the compressed data that has been placed
there. If flush is not Z_NO_FLUSH, and avail_out indicates that there is still
space in output buffer, this action shall always occur (see below for further
details).

The deflate() function shall return when either avail_in reaches zero (indicating
that all the input data has been compressed), or avail_out reaches zero (indicating
that the output buffer is full).

On success, the deflate() function shall set the adler field of the stream to the
adler32() checksum of all the input data compressed so far (represented by
total_in).
If the `deflate()` function shall attempt to determine the type of input data, and set field `data_type` in `stream` to `Z_ASCII` if the majority of the data bytes fall within the ASCII (ISO 646) printable character range. Otherwise, it shall set `data_type` to `Z_BINARY`. This data type is informational only, and does not affect the compression algorithm.

**Note:** Future versions of the LSB may remove this requirement, since it is based on an outdated character set that does not support Internationalization, and does not affect the algorithm. It is included for information only at this release. Applications should not depend on this field.

**Flush Operation**

The parameter `flush` determines when compressed bits are added to the output buffer in `next_out`. If `flush` is `Z_NO_FLUSH`, `deflate()` may return with some data pending output, and not yet added to the output buffer.

If `flush` is `Z_SYNC_FLUSH`, `deflate()` shall flush all pending output to `next_out` and align the output to a byte boundary. A synchronization point is generated in the output.

If `flush` is `Z_FULL_FLUSH`, all output shall be flushed, as for `Z_SYNC_FLUSH`, and the compression state shall be reset. A synchronization point is generated in the output.

**Rationale:** `Z_SYNC_FLUSH` is intended to ensure that the compressed data contains all the data compressed so far, and allows a decompressor to reconstruct all of the input data. `Z_FULL_FLUSH` allows decompression to restart from this point if the previous compressed data has been lost or damaged. Flushing is likely to degrade the performance of the compression system, and should only be used where necessary.

If `flush` is set to `Z_FINISH`, all pending input shall be processed and `deflate()` shall return with `Z_STREAM_END` if there is sufficient space in the output buffer at `next_out`, as indicated by `avail_out`. If `deflate()` is called with `flush` set to `Z_FINISH` and there is insufficient space to store the compressed data, and no other error has occurred during compression, `deflate()` shall return `Z_OK`, and the application should call `deflate()` again with `flush` unchanged, and having updated `next_out` and `avail_out`.

If all the compression is to be done in a single step, `deflate()` may be called with `flush` set to `Z_FINISH` immediately after the stream has been initialized if `avail_out` is set to at least the value returned by `deflateBound()`.

**Return Value**

On success, `deflate()` shall return `Z_OK`, unless `flush` was set to `Z_FINISH` and there was sufficient space in the output buffer to compress all of the input data. In this case, `deflate()` shall return `Z_STREAM_END`. On error, `deflate()` shall return a value to indicate the error.

**Note:** If `deflate()` returns `Z_OK` and has set `avail_out` to zero, the function should be called again with the same value for `flush`, and with updated `next_out` and `avail_out` until `deflate()` returns with `Z_OK` (or `Z_STREAM_END` if `flush` is set to `Z_FINISH`) and a non-zero `avail_out`.

**Errors**

On error, `deflate()` shall return a value as described below, and set the `msg` field of `stream` to point to a string describing the error:
Z_BUF_ERROR
   No progress is possible; either avail_in or avail_out was zero.

Z_MEM_ERROR
   Insufficient memory.

Z_STREAM_ERROR
   The state (as represented in stream) is inconsistent, or stream was NULL.

deflateBound

Name
   deflateBound — compute compressed data size

Synopsis
#include <zlib.h>
int deflateBound(z_stream *stream, uLong sourceLen);

Description
   The deflateBound() function shall estimate the size of buffer required to compress
   sourceLen bytes of data. If successful, the value returned shall be an upper bound
   for the size of buffer required to compress sourceLen bytes of data, using the
   parameters stored in stream, in a single call to deflate() with flush set to
   Z_FINISH.

   On entry, stream should have been initialized via a call to deflateInit_() or
   deflateInit2_().

Return Value
   The deflateBound() shall return a value representing the upper bound of an array
   to allocate to hold the compressed data in a single call to deflate(). If the stream
   is not correctly initialized, or is NULL, then deflateBound() may return a
   conservative value that may be larger than sourceLen.

Errors
   None defined.
deflateCopy

Name
deflateCopy — copy compression stream

Synopsis
#include <zlib.h>
int deflateCopy(z_streamp dest, z_streamp source);

Description
The deflateCopy() function shall copy the compression state information in
source to the uninitialzed z_stream structure referenced by dest.
On successful return, dest will be an exact copy of the stream referenced by
source. The input and output buffer pointers in next_in and next_out will
reference the same data.

Return Value
On success, deflateCopy() shall return Z_OK. Otherwise it shall return a value
less than zero to indicate the error.

Errors
On error, deflateCopy() shall return a value as described below:

Z_STREAM_ERROR
The state in source is inconsistent, or either source or dest was NULL.

Z_MEM_ERROR
Insufficient memory available.

Application Usage (informative)
This function can be useful when several compression strategies will be tried, for
example when there are several ways of pre-processing the input data with a filter.
The streams that will be discarded should then be freed by calling deflateEnd().
Note that deflateCopy() duplicates the internal compression state which can be
quite large, so this strategy may be slow and can consume lots of memory.
deflateEnd

Name
deflateEnd — free compression stream state

Synopsis
#include <zlib.h>
int deflateEnd(z_streamp stream);

Description
The deflateEnd() function shall free all allocated state information referenced by stream. All pending output is discarded, and unprocessed input is ignored.

Return Value
On success, deflateEnd() shall return Z_OK, or Z_DATA_ERROR if there was pending output discarded or input unprocessed. Otherwise it shall return Z_STREAM_ERROR to indicate the error.

Errors
On error, deflateEnd() shall return Z_STREAM_ERROR. The following conditions shall be treated as an error:
• The state in stream is inconsistent or inappropriate.
• stream is NULL.
**deflateInit2_**

**Name**
deflateInit2_ – initialize compression system

**Synopsis**

```c
#include <zlib.h>
int deflateInit2_ (z_streamp strm, int level, int method, int windowBits, int memLevel, int strategy, char * version, int stream_size);
```

**Description**
The `deflateInit2_()` function shall initialize the compression system. On entry, `strm` shall refer to a user supplied `z_stream` object (a `z_stream_s` structure). The following fields shall be set on entry:

- **zalloc**
  - a pointer to an alloc_func function, used to allocate state information. If this is `NULL`, a default allocation function will be used.

- **zfree**
  - a pointer to a free_func function, used to free memory allocated by the `zalloc` function. If this is `NULL` a default free function will be used.

- **opaque**
  - If `alloc_func` is not `NULL`, `opaque` is a user supplied pointer to data that will be passed to the `alloc_func` and `free_func` functions.

If the `version` requested is not compatible with the version implemented, or if the size of the `z_stream_s` structure provided in `stream_size` does not match the size in the library implementation, `deflateInit2_()` shall fail, and return `Z_VERSION_ERROR`.

The `level` supplied shall be a value between 0 and 9, or the value `Z_DEFAULT_COMPRESSION`. A `level` of 1 requests the highest speed, while a `level` of 9 requests the highest compression. A `level` of 0 indicates that no compression should be used, and the output shall be the same as the input.

The `method` selects the compression algorithm to use. LSB conforming implementation shall support the `Z_DEFLATED` method, and may support other implementation defined methods.

The `windowBits` parameter shall be a base 2 logarithm of the window size to use, and shall be a value between 8 and 15. A smaller value will use less memory, but will result in a poorer compression ratio, while a higher value will give better compression but utilize more memory.

The `memLevel` parameter specifies how much memory to use for the internal state. The value of `memLevel` shall be between 1 and `MAX_MEM_LEVEL`. Smaller values use less memory but are slower, while higher values use more memory to gain compression speed.

The `strategy` parameter selects the compression strategy to use:

- `Z_DEFAULT_STRATEGY`
use the system default compression strategy. Z_DEFAULT_STRATEGY is particularly appropriate for text data.

Z_FILTERED

use a compression strategy tuned for data consisting largely of small values with a fairly random distribution. Z_FILTERED uses more Huffman encoding and less string matching than Z_DEFAULT_STRATEGY.

Z_HUFFMAN_ONLY

force Huffman encoding only, with no string match.

The deflateInit2() function is not in the source standard; it is only in the binary standard. Source applications should use the deflateInit2() macro.

Return Value

On success, the deflateInit2() function shall return Z_OK. Otherwise, deflateInit2() shall return a value as described below to indicate the error.

Errors

On error, deflateInit2() shall return one of the following error indicators:

Z_STREAM_ERROR

Invalid parameter.

Z_MEM_ERROR

Insufficient memory available.

Z_VERSION_ERROR

The version requested is not compatible with the library version, or the z_stream size differs from that used by the library.

In addition, the msg field of the strm may be set to an error message.
**deflateInit_**

**Name**
deflateInit_ — initialize compression system

**Synopsis**

```c
#include <zlib.h>
int deflateInit_(z_stream* stream, int level, const char * version, int stream_size);
```

**Description**
The **deflateInit_** function shall initialize the compression system. On entry, `stream` shall refer to a user supplied `z_stream` object (a `z_stream_s` structure). The following fields shall be set on entry:

- `zalloc`
  a pointer to an alloc_func function, used to allocate state information. If this is `NULL`, a default allocation function will be used.

- `zfree`
  a pointer to a free_func function, used to free memory allocated by the `zalloc` function. If this is `NULL` a default free function will be used.

- `opaque`
  If `alloc_func` is not `NULL`, `opaque` is a user supplied pointer to data that will be passed to the `alloc_func` and `free_func` functions.

If the `version` requested is not compatible with the version implemented, or if the size of the `z_stream_s` structure provided in `stream_size` does not match the size in the library implementation, `deflateInit_` shall fail, and return `Z_VERSION_ERROR`.

The `level` supplied shall be a value between 0 and 9, or the value `Z_DEFAULT_COMPRESSION`. A `level` of 1 requests the highest speed, while a `level` of 9 requests the highest compression. A `level` of 0 indicates that no compression should be used, and the output shall be the same as the input.

The **deflateInit_** function is not in the source standard; it is only in the binary standard. Source applications should use the `deflateInit()` macro.

The `deflateInit_()` function is equivalent to

```c
deflateInit2_(stream, level, Z_DEFLATED, MAX_WBITS, DEF_MEM_LEVEL,
```

...
Return Value

On success, the deflateInit_() function shall return Z_OK. Otherwise, deflateInit_() shall return a value as described below to indicate the error.

Errors

On error, deflateInit_() shall return one of the following error indicators:

Z_STREAM_ERROR

Invalid parameter.

Z_MEM_ERROR

Insufficient memory available.

Z_VERSION_ERROR

The version requested is not compatible with the library version, or the z_stream size differs from that used by the library.

In addition, the msg field of the stream may be set to an error message.
**deflateParams**

**Name**

deflateParams — set compression parameters

**Synopsis**

```c
#include <zlib.h>
int deflateParams(z_streamp stream, int level, int strategy);
```

**Description**

The `deflateParams()` function shall dynamically alter the compression parameters for the compression stream object `stream`. On entry, `stream` shall refer to a user supplied `z_stream` object (a `z_stream_s` structure), already initialized via a call to `deflateInit_()` or `deflateInit2_()`.

The `level` supplied shall be a value between 0 and 9, or the value `Z_DEFAULT_COMPRESSION`. A `level` of 1 requests the highest speed, while a `level` of 9 requests the highest compression. A `level` of 0 indicates that no compression should be used, and the output shall be the same as the input. If the compression level is altered by `deflateParams()`, and some data has already been compressed with this `stream` (i.e. `total_in` is not zero), and the new `level` requires a different underlying compression method, then `stream` shall be flushed by a call to `deflate()`.

The `strategy` parameter selects the compression strategy to use:

- **Z_DEFAULT_STRATEGY**
  - Use the system default compression strategy. `Z_DEFAULT_STRATEGY` is particularly appropriate for text data.

- **Z_FILTERED**
  - Use a compression strategy tuned for data consisting largely of small values with a fairly random distribution. `Z_FILTERED` uses more Huffman encoding and less string matching than `Z_DEFAULT_STRATEGY`.

- **Z_HUFFMAN_ONLY**
  - Force Huffman encoding only, with no string match.

**Return Value**

On success, the `deflateParams()` function shall return `Z_OK`. Otherwise, `deflateParams()` shall return a value as described below to indicate the error.

**Errors**

On error, `deflateParams()` shall return one of the following error indicators:

- **Z_STREAM_ERROR**
  - Invalid parameter.

- **Z_MEM_ERROR**
  - Insufficient memory available.
Z_BUF_ERROR

Insufficient space in stream to flush the current output.
In addition, the msg field of the strm may be set to an error message.

Application Usage (Informative)

Applications should ensure that the stream is flushed, e.g. by a call to
deflate(stream, Z_SYNC_FLUSH) before calling deflateParams(), or ensure that
there is sufficient space in next_out (as identified by avail_out) to ensure that all
pending output and all uncompressed input can be flushed in a single call to
deflate().

Rationale: Although the deflateParams() function should flush pending output and
compress all pending input, the result is unspecified if there is insufficient space in the
output buffer. Applications should only call deflateParams() when the stream is
effectively empty (flushed).
The deflateParams() can be used to switch between compression and straight copy of
the input data, or to switch to a different kind of input data requiring a different
strategy.

deflateReset

Name
deflateReset — reset compression stream state

Synopsis
#include <zlib.h>
int deflateReset(z_streamp stream);

Description
The deflateReset() function shall reset all state associated with stream. All
pending output shall be discarded, and the counts of processed bytes (total_in
and total_out) shall be reset to zero.

Return Value
On success, deflateReset() shall return Z_OK. Otherwise it shall return
Z_STREAM_ERROR to indicate the error.

Errors
On error, deflateReset() shall return Z_STREAM_ERROR. The following
conditions shall be treated as an error:
• The state in stream is inconsistent or inappropriate.
• stream is NULL.
deflateSetDictionary

Name
deflateSetDictionary — initialize compression dictionary

Synopsis

#include <zlib.h>
int deflateSetDictionary(z_stream * stream, const Bytef * dictionary, uInt dictlen);

Description

The deflateSetDictionary() function shall initialize the compression dictionary associated with stream using the dictlen bytes referenced by dictionary. The implementation may silently use a subset of the provided dictionary if the dictionary cannot fit in the current window associated with stream (see deflateInit2()). The application should ensure that the dictionary is sorted such that the most commonly used strings occur at the end of the dictionary.

If the dictionary is successfully set, the Adler32 checksum of the entire provided dictionary shall be stored in the adler member of stream. This value may be used by the decompression system to select the correct dictionary. The compression and decompression systems must use the same dictionary.

stream shall reference an initialized compression stream, with total_in zero (i.e. no data has been compressed since the stream was initialized).

Return Value

On success, deflateSetDictionary() shall return Z_OK. Otherwise it shall return Z_STREAM_ERROR to indicate an error.

Errors

On error, deflateSetDictionary() shall return a value as described below:

Z_STREAM_ERROR

The state in stream is inconsistent, or stream was NULL.

Application Usage (informative)

The application should provide a dictionary consisting of strings that are likely to be encountered in the data to be compressed. The application should ensure that the dictionary is sorted such that the most commonly used strings occur at the end of the dictionary.

The use of a dictionary is optional; however if the data to be compressed is relatively short and has a predictable structure, the use of a dictionary can substantially improve the compression ratio.
**get_crc_table**

**Name**
get_crc_table — generate a table for crc calculations

**Synopsis**
```c
#include <zlib.h>
const uLongf * get_crc_table(void);
```

**Description**
Generate tables for a byte-wise 32-bit CRC calculation based on the polynomial:
\[ x^{32} + x^{24} + x^{16} + x^8 + x^4 + x^2 + x + 1 \]

In a multi-threaded application, get_crc_table() should be called by one thread to initialize the tables before any other thread calls any libz function.

**Return Value**
The get_crc_table() function shall return a pointer to the first of a set of tables used internally to calculate CRC-32 values (see crc32()).

**Errors**
None defined.
gzclose

Name

gzclose — close a compressed file stream

Synopsis

#include <zlib.h>
int gzclose (gzFile file);

Description

The gzclose() function shall close the compressed file stream file. If file was
open for writing, gzclose() shall first flush any pending output. Any state
information allocated shall be freed.

Return Value

On success, gzclose() shall return Z_OK. Otherwise, gzclose() shall return an
error value as described below.

Errors

On error, gzclose() may set the global variable errno to indicate the error. The
gzclose() shall return a value other than Z_OK on error.

Z_STREAM_ERROR

file was NULL (or Z_NULL), or did not refer to an open compressed file stream.

Z_ERRNO

An error occurred in the underlying base libraries, and the application should
check errno for further information.

Z_BUF_ERROR

no compression progress is possible during buffer flush (see deflate()).
gzdopen

Name

gzdopen — open a compressed file

Synopsis

#include <zlib.h>
gzFile gzdopen ( int fd, const char *mode );

Description

The gzdopen() function shall attempt to associate the open file referenced by fd with a gzFile object. The mode argument is based on that of fopen(), but the mode parameter may also contain the following characters:

digit

set the compression level to digit. A low value (e.g. 1) means high speed, while a high value (e.g. 9) means high compression. A compression level of 0 (zero) means no compression. See defaultInit2() for further details.

[fhR]

set the compression strategy to [fhR]. The letter f corresponds to filtered data, the letter h corresponds to Huffman only compression, and the letter R corresponds to Run Length Encoding. See defaultInit2() for further details.

If fd refers to an uncompressed file, and mode refers to a read mode, gzdopen() shall attempt to open the file and return a gzFile object suitable for reading directly from the file without any decompression.

If mode is NULL, or if mode does not contain one of r, w, or a, gzdopen() shall return Z_NULL, and need not set any other error condition.

Example

gzdopen(fileno(stdin), "r");

Attempt to associate the standard input with a gzFile object.

Return Value

On success, gzdopen() shall return a gzFile object. On failure, gzdopen() shall return Z_NULL and may set errno accordingly.

Note: At version 1.2.2, zlib does not set errno for several error conditions. Applications may not be able to determine the cause of an error.

Errors

On error, gzdopen() may set the global variable errno to indicate the error.
gzeof

Name

gzeof — check for end-of-file on a compressed file stream

Synopsis

#include <zlib.h>
int gzeof (gzFile file);

Description

The gzeof() function shall test the compressed file stream file for end of file.

Return Value

If file was open for reading and end of file has been reached, gzeof() shall return 1. Otherwise, gzeof() shall return 0.

Errors

None defined.
gzerror

Name
gzerror — decode an error on a compressed file stream

Synopsis
#include <zlib.h>
const char * gzerror (gzFile file, int * errnum);

Description
The gzerror() function shall return a string describing the last error to have occurred associated with the open compressed file stream referred to by file. It shall also set the location referenced by errnum to an integer value that further identifies the error.

Return Value
The gzerror() function shall return a string that describes the last error associated with the given file compressed file stream. This string shall have the format “%s: %s”, with the name of the file, followed by a colon, a space, and the description of the error. If the compressed file stream was opened by a call to gzopen(), the format of the filename is unspecified.

Rationale: Although in all current implementations of libz file descriptors are named “<fd:%d>”, the code suggests that this is for debugging purposes only, and may change in a future release.

It is unspecified if the string returned is determined by the setting of the LC_MESSAGES category in the current locale.

Errors
None defined.
gzflush

**Name**
gzflush — flush a compressed file stream

**Synopsis**
#include <zlib.h>
int gzflush(gzFile file, int flush);

**Description**
The gzflush() function shall flush pending output to the compressed file stream identified by file, which must be open for writing.

**Flush Operation**
The parameter flush determines which compressed bits are added to the output file. If flush is Z_NO_FLUSH, gzflush() may return with some data pending output, and not yet written to the file.

If flush is Z_SYNC_FLUSH, gzflush() shall flush all pending output to file and align the output to a byte boundary. There may still be data pending compression that is not flushed.

If flush is Z_FULL_FLUSH, all output shall be flushed, as for Z_SYNC_FLUSH, and the compression state shall be reset. There may still be data pending compression that is not flushed.

**Rationale:** Z_SYNC_FLUSH is intended to ensure that the compressed data contains all the data compressed so far, and allows a decompressor to reconstruct all of the input data. Z_FULL_FLUSH allows decompression to restart from this point if the previous compressed data has been lost or damaged. Flushing is likely to degrade the performance of the compression system, and should only be used where necessary.

If flush is set to Z_FINISH, all pending uncompressed data shall be compressed and all output shall be flushed.

**Return Value**
On success, gzflush() shall return the value Z_OK. Otherwise gzflush() shall return a value to indicate the error, and may set the error number associated with the compressed file stream file.

**Note:** If flush is set to Z_FINISH and the flush operation is successful, gzflush() will return Z_OK, but the compressed file stream error value may be set to Z_STREAM_END.

**Errors**
On error, gzwrite() shall return an error value, and may set the error number associated with the stream identified by file to indicate the error. Applications may use gzerror() to access this error value.

**Z_ERRNO**
An underlying base library function has indicated an error. The global variable errno may be examined for further information.

**Z_STREAM_ERROR**
The stream is invalid, is not open for writing, or is in an invalid state.

**Z_BUF_ERROR**

no compression progress is possible (see `deflate()`).

**Z_MEM_ERROR**

Insufficient memory available to compress.

### gzgetc

**Name**

gzgetc — read a character from a compressed file

**Synopsis**

```c
#include <zlib.h>
int gzgetc (gzFile file);
```

**Description**

The `gzgetc()` function shall read the next single character from the compressed file stream referenced by `file`, which shall have been opened in a read mode (see `gzopen()` and `gzdopen()`).

**Return Value**

On success, `gzgetc()` shall return the uncompressed character read, otherwise, on end of file or error, `gzgetc()` shall return -1.

**Errors**

On end of file or error, `gzgetc()` shall return -1. Further information can be found by calling `gzerror()` with a pointer to the compressed file stream.
**gzgets**

**Name**
gzgets — read a string from a compressed file

**Synopsis**

```c
#include <zlib.h>
char * gzgets (gzFile file, char * buf, int len);
```

**Description**
The `gzgets()` function shall attempt to read data from the compressed file stream `file`, uncompressing it into `buf` until either `len-1` bytes have been inserted into `buf`, or until a newline character has been uncompressed into `buf`. A null byte shall be appended to the uncompressed data. The `file` shall have been opened in for reading (see `gzopen()` and `gzdopen()`).

**Return Value**
On success, `gzgets()` shall return a pointer to `buf`. Otherwise, `gzgets()` shall return `Z_NULL`. Applications may examine the cause using `gzerror()`.

**Errors**
On error, `gzgets()` shall return `Z_NULL`. The following conditions shall always be treated as an error:

- `file` is `NULL`, or does not refer to a file open for reading;
- `buf` is `NULL`;
- `len` is less than or equal to zero.
gzopen

Name

gzopen — open a compressed file

Synopsis

```
#include <zlib.h>

gzFile gzopen (const char *path, const char *mode);
```

Description

The `gzopen()` function shall open the compressed file named by `path`. The `mode` argument is based on that of `fopen()`, but the `mode` parameter may also contain the following characters:

- `digit`

  set the compression level to `digit`. A low value (e.g. 1) means high speed, while a high value (e.g. 9) means high compression. A compression level of 0 (zero) means no compression. See `defaultInit2`() for further details.

- `[fhR]`

  set the compression strategy to `[fhR]`. The letter `f` corresponds to filtered data, the letter `h` corresponds to Huffman only compression, and the letter `R` corresponds to Run Length Encoding. See `defaultInit2`() for further details.

If `path` refers to an uncompressed file, and `mode` refers to a read mode, `gzopen()` shall attempt to open the file and return a `gzFile` object suitable for reading directly from the file without any decompression.

If `path` or `mode` is `NULL`, or if `mode` does not contain one of `r`, `w`, or `a`, `gzopen()` shall return `Z_NULL`, and need not set any other error condition.

The `gzFile` object is also referred to as a compressed file stream.

Example

```
gzopen("file.gz", "w6h");
```

Attempt to create a new compressed file, `file.gz`, at compression level 6 using Huffman only compression.

Return Value

On success, `gzopen()` shall return a `gzFile` object (also known as a compressed file stream). On failure, `gzopen()` shall return `Z_NULL` and may set `errno` accordingly.

Note: At version 1.2.2, `zlib` does not set `errno` for several error conditions. Applications may not be able to determine the cause of an error.

Errors

On error, `gzopen()` may set the global variable `errno` to indicate the error.
gzprintf

Name
gzprintf — format data and compress

Synopsis
#include <zlib.h>
int gzprintf (gzFile file, const char * fmt, ...);

Description
The gzprintf() function shall format data as for fprintf(), and write the
resulting string to the compressed file stream file.

Return Value
The gzprintf() function shall return the number of uncompressed bytes actually
written, or a value less than or equal to 0 in the event of an error.

Errors
If file is NULL, or refers to a compressed file stream that has not been opened for
writing, gzprintf() shall return Z_STREAM_ERROR. Otherwise, errors are as for
gzwrite().

gzputc

Name
gzputc — write character to a compressed file

Synopsis
#include <zlib.h>
int gzputc (gzFile file, int c);

Description
The gzputc() function shall write the single character c, converted from integer to
unsigned character, to the compressed file referenced by file, which shall have
been opened in a write mode (see gzopen() and gzdopen()).

Return Value
On success, gzputc() shall return the value written, otherwise gzputc() shall
return -1.

Errors
On error, gzputc() shall return -1.
gzputs

Name
gzputs — string write to a compressed file

Synopsis
#include <zlib.h>
int gzputs (gzFile file, const char * s);

Description
The gzputs() function shall write the null terminated string s to the compressed
file referenced by file, which shall have been opened in a write mode (see
gzopen() and gzopen()). The terminating null character shall not be written. The
gzputs() function shall return the number of uncompressed bytes actually written.

Return Value
On success, gzputs() shall return the number of uncompressed bytes actually
written to file. On error gzputs() shall return a value less than or equal to 0.
Applications may examine the cause using gzerror().

Errors
On error, gzputs() shall set the error number associated with the stream identified
by file to indicate the error. Applications should use gzerror() to access this
error value. If file is NULL, gzputs() shall return Z_STREAM_ERR.

Z_ERRNO
An underlying base library function has indicated an error. The global variable
errno may be examined for further information.

Z_STREAM_ERROR
The stream is invalid, is not open for writing, or is in an invalid state.

Z_BUF_ERROR
no compression progress is possible (see deflate()).

Z_MEM_ERROR
Insufficient memory available to compress.
gzread

Name
gzread — read from a compressed file

Synopsis
#include <zlib.h>
int gzread (gzFile file, voidp buf, unsigned int len);

Description
The gzread() function shall read data from the compressed file referenced by file, which shall have been opened in a read mode (see gzopen() and gzdopen()). The gzread() function shall read data from file, and uncompress it into buf. At most, len bytes of uncompressed data shall be copied to buf. If the file is not compressed, gzread() shall simply copy data from file to buf without alteration.

Return Value
On success, gzread() shall return the number of bytes decompressed into buf. If gzread() returns 0, either the end-of-file has been reached or an underlying read error has occurred. Applications should use gzeror() or gzeof() to determine which occurred. On other errors, gzread() shall return a value less than 0 and and applications may examine the cause using gzerror().

Errors
On error, gzread() shall set the error number associated with the stream identified by file to indicate the error. Applications should use gzeror() to access this error value.

Z_ERRNO
An underlying base library function has indicated an error. The global variable errno may be examined for further information.

Z_STREAM_END
End of file has been reached on input.

Z_DATA_ERROR
A CRC error occurred when reading data; the file is corrupt.

Z_STREAM_ERROR
The stream is invalid, or is in an invalid state.

Z_NEED_DICT
A dictionary is needed (see inflateSetDictionary()).

Z_MEM_ERROR
Insufficient memory available to decompress.
**gzrewind**

**Name**
gzrewind — reset the file-position indicator on a compressed file stream

**Synopsis**
#include <zlib.h>
int gzrewind(gzFile file);

**Description**
The `gzrewind()` function shall set the starting position for the next read on compressed file stream `file` to the beginning of file. `file` must be open for reading.

`gzrewind()` is equivalent to

(int)gzseek(file, 0L, SEEK_SET)

.

**Return Value**
On success, `gzrewind()` shall return 0. On error, `gzrewind()` shall return -1, and may set the error value for `file` accordingly.

**Errors**
On error, `gzrewind()` shall return -1, indicating that `file` is NULL, or does not represent an open compressed file stream, or represents a compressed file stream that is open for writing and is not currently at the beginning of file.
gzseek

Name
gzseek — reposition a file-position indicator in a compressed file stream

Synopsis

#include <zlib.h>

z_off_t gzseek(gzFile file, z_off_t offset, int whence);

Description

The gzseek() function shall set the file-position indicator for the compressed file stream file. The file-position indicator controls where the next read or write operation on the compressed file stream shall take place. The offset indicates a byte offset in the uncompressed data. The whence parameter may be one of:

SEEK_SET
  the offset is relative to the start of the uncompressed data.

SEEK_CUR
  the offset is relative to the current position in the uncompressed data.

Note: The value SEEK_END need not be supported.

If the file is open for writing, the new offset must be greater than or equal to the current offset. In this case, gzseek() shall compress a sequence of null bytes to fill the gap from the previous offset to the new offset.

Return Value

On success, gzseek() shall return the resulting offset in the file expressed as a byte position in the uncompressed data stream. On error, gzseek() shall return -1, and may set the error value for file accordingly.

Errors

On error, gzseek() shall return -1. The following conditions shall always result in an error:

- file is NULL
- file does not represent an open compressed file stream.
- file refers to a compressed file stream that is open for writing, and the newly computed offset is less than the current offset.
- The newly computed offset is less than zero.
- whence is not one of the supported values.

Application Usage (informative)

If file is open for reading, the implementation may still need to uncompress all of the data up to the new offset. As a result, gzseek() may be extremely slow in some circumstances.
gzsetparams

Name

gzsetparams — dynamically set compression parameters

Synopsis

#include <zlib.h>

int gzsetparams (gzFile file, int level, int strategy);

Description

The gzsetparams() function shall set the compression level and compression strategy on the compressed file stream referenced by file. The compressed file stream shall have been opened in a write mode. The level and strategy are as defined in deflateInit2_. If there is any data pending writing, it shall be flushed before the parameters are updated.

Return Value

On success, the gzsetparams() function shall return Z_OK.

Errors

On error, gzsetparams() shall return one of the following error indications:

Z_STREAM_ERROR

Invalid parameter, or file not open for writing.

Z_BUF_ERROR

An internal inconsistency was detected while flushing the previous buffer.
gztell

Name
gztell — find position on a compressed file stream

Synopsis
#include <zlib.h>
z_off_t gztell (gzFile file);

Description
The gztell() function shall return the starting position for the next read or write operation on compressed file stream file. This position represents the number of bytes from the beginning of file in the uncompressed data.
gztell() is equivalent to
gzseek(file, 0L, SEEK_SET)

Return Value
gztell() shall return the current offset in the file expressed as a byte position in the uncompressed data stream. On error, gztell() shall return -1, and may set the error value for file accordingly.

Errors
On error, gztell() shall return -1, indicating that file is NULL, or does not represent an open compressed file stream.
gzwrite

Name
gzwrite — write to a compressed file

Synopsis
#include <zlib.h>
int gzwrite (gzFile file, void *buf, unsigned int len);

Description
The gzwrite() function shall write data to the compressed file referenced by file, which shall have been opened in a write mode (see gzopen() and gzopen()). On entry, buf shall point to a buffer containing len bytes of uncompressed data. The gzwrite() function shall compress this data and write it to file. The gzwrite() function shall return the number of uncompressed bytes actually written.

Return Value
On success, gzwrite() shall return the number of uncompressed bytes actually written to file. On error gzwrite() shall return a value less than or equal to 0. Applications may examine the cause using gzerror().

Errors
On error, gzwrite() shall set the error number associated with the stream identified by file to indicate the error. Applications should use gzerror() to access this error value.

Z_ERRNO
An underlying base library function has indicated an error. The global variable errno may be examined for further information.

Z_STREAM_ERROR
The stream is invalid, is not open for writing, or is in an invalid state.

Z_BUF_ERROR
no compression progress is possible (see deflate()).

Z_MEM_ERROR
Insufficient memory available to compress.
inflates

Name

inflate — decompress data

Synopsis

#include <zlib.h>
int inflate(z_streamp stream, int flush);

Description

The inflate() function shall attempt to decompress data until either the input buffer is empty or the output buffer is full. The stream references a z_stream structure. Before the first call to inflate(), this structure should have been initialized by a call to inflateInit2().

Note: inflateInit2() is only in the binary standard; source level applications should initialize stream via a call to inflateInit() or inflateInit2().

In addition, the stream input and output buffers should have been initialized as follows:

next_in

should point to the data to be decompressed.

avail_in

should contain the number of bytes of data in the buffer referenced by next_in.

next_out

should point to a buffer where decompressed data may be placed.

avail_out

should contain the size in bytes of the buffer referenced by next_out.

The inflate() function shall perform one or both of the following actions:

1. Decompress input data from next_in and update next_in, avail_in and total_in to reflect the data that has been decompressed.

2. Fill the output buffer referenced by next_out, and update next_out, avail_out, and total_out to reflect the decompressed data that has been placed there. If flush is not Z_NO_FLUSH, and avail_out indicates that there is still space in output buffer, this action shall always occur (see below for further details).

The inflate() function shall return when either avail_in reaches zero (indicating that all the input data has been compressed), or avail_out reaches zero (indicating that the output buffer is full).

On success, the inflate() function shall set the adler field of the stream to the Adler-32 checksum of all the input data compressed so far (represented by total_in).

Flush Operation
The parameter *flush* determines when uncompressed bytes are added to the output buffer in *next_out*. If *flush* is Z_NO_FLUSH, *inflate()* may return with some data pending output, and not yet added to the output buffer.

If *flush* is Z_SYNC_FLUSH, *inflate()* shall flush all pending output to *next_out*, and update *next_out* and *avail_out* accordingly.

If *flush* is set to Z_BLOCK, *inflate()* shall stop adding data to the output buffer if and when the next compressed block boundary is reached (see RFC 1951: DEFLATE Compressed Data Format Specification).

If *flush* is set to Z_FINISH, all of the compressed input shall be decompressed and added to the output. If there is insufficient output space (i.e. the compressed input uncompresses to more than *avail_out* bytes), then *inflate()* shall fail and return Z_BUF_ERROR.

**Return Value**

On success, *inflate()* shall return Z_OK if decompression progress has been made, or Z_STREAM_END if all of the input data has been decompressed and there was sufficient space in the output buffer to store the uncompressed result. On error, *inflate()* shall return a value to indicate the error.

**Note:** If *inflate()* returns Z_OK and has set *avail_out* to zero, the function should be called again with the same value for *flush*, and with updated *next_out* and *avail_out* until *inflate()* returns with either Z_OK or Z_STREAM_END and a non-zero *avail_out*.

On success, *inflate()* shall set the *adler* to the Adler-32 checksum of the output produced so far (i.e. *total_out* bytes).

**Errors**

On error, *inflate()* shall return a value as described below, and may set the *msg* field of *stream* to point to a string describing the error:

Z_BUF_ERROR

No progress is possible; either *avail_in* or *avail_out* was zero.

Z_MEM_ERROR

Insufficient memory.

Z_STREAM_ERROR

The state (as represented in *stream*) is inconsistent, or *stream* was NULL.

Z_NEED_DICT

A preset dictionary is required. The *adler* field shall be set to the Adler-32 checksum of the dictionary chosen by the compressor.
inflateEnd

Name
inflateEnd — free decompression stream state

Synopsis
#include <zlib.h>
int inflateEnd(z_streamp stream);

Description
The inflateEnd() function shall free all allocated state information referenced by stream. All pending output is discarded, and unprocessed input is ignored.

Return Value
On success, inflateEnd() shall return Z_OK. Otherwise it shall return Z_STREAM_ERROR to indicate the error.

Errors
On error, inflateEnd() shall return Z_STREAM_ERROR. The following conditions shall be treated as an error:

• The state in stream is inconsistent.
• stream is NULL.
• The zfree function pointer is NULL.
**inflateInit2_**

**Name**

inflateInit2_ — initialize decompression system

**Synopsis**

```c
#include <zlib.h>
int inflateInit2_(z_stream strm, int windowBits, char * version, int stream_size);
```

**Description**

The `inflateInit2_()` function shall initialize the decompression system. On entry, `strm` shall refer to a user supplied `z_stream` object (a `z_stream_s` structure). The following fields shall be set on entry:

- `zalloc`
  a pointer to an alloc_func function, used to allocate state information. If this is NULL, a default allocation function will be used.

- `zfree`
  a pointer to a free_func function, used to free memory allocated by the `zalloc` function. If this is NULL a default free function will be used.

- `opaque`
  If `alloc_func` is not NULL, `opaque` is a user supplied pointer to data that will be passed to the `alloc_func` and `free_func` functions.

If the `version` requested is not compatible with the version implemented, or if the size of the `z_stream_s` structure provided in `stream_size` does not match the size in the library implementation, `inflateInit2_()` shall fail, and return `Z_VERSION_ERROR`.

The `windowBits` parameter shall be a base 2 logarithm of the maximum window size to use, and shall be a value between 8 and 15. If the input data was compressed with a larger window size, subsequent attempts to decompress this data will fail with `Z_DATA_ERROR`, rather than try to allocate a larger window.

The `inflateInit2_()` function is not in the source standard; it is only in the binary standard. Source applications should use the `inflateInit2()` macro.

**Return Value**

On success, the `inflateInit2_()` function shall return `Z_OK`. Otherwise, `inflateInit2_()` shall return a value as described below to indicate the error.

**Errors**

On error, `inflateInit2_()` shall return one of the following error indicators:

- `Z_STREAM_ERROR`
  Invalid parameter.

- `Z_MEM_ERROR`
  Insufficient memory available.
Z_VERSION_ERROR

The version requested is not compatible with the library version, or the
$z\_stream$ size differs from that used by the library.

In addition, the $msg$ field of the $strm$ may be set to an error message.
inflatingInit_

Name

inflatingInit_ — initialize decompression system

Synopsis

#include <zlib.h>
int inflatingInit_(z_stream *stream, const char *version, int stream_size);

Description

The inflatingInit() function shall initialize the decompression system. On entry, 
stream shall refer to a user supplied z_stream object (a z_stream_s structure). The 
following fields shall be set on entry:

zalloc

a pointer to an alloc_func function, used to allocate state information. If this is 
NULL, a default allocation function will be used.

zfree

a pointer to a free_func function, used to free memory allocated by the zalloc 
function. If this is NULL a default free function will be used.

opaque

If alloc_func is not NULL, opaque is a user supplied pointer to data that will be 
passed to the alloc_func and free_func functions.

If the version requested is not compatible with the version implemented, or if the 
size of the z_stream_s structure provided in stream_size does not match the size 
in the library implementation, inflatingInit() shall fail, and return 
Z_VERSION_ERROR.

The inflatingInit() function is not in the source standard; it is only in the binary 
standard. Source applications should use the inflatingInit() macro.

The inflatingInit() shall be equivalent to

inflatingInit2_(strm, DEF_WBITS, version, stream_size);

Return Value

On success, the inflatingInit() function shall return Z_OK. Otherwise, 
inflatingInit() shall return a value as described below to indicate the error.

Errors

On error, inflatingInit() shall return one of the following error indicators:

Z_STREAM_ERROR

Invalid parameter.

Z_MEM_ERROR

Insufficient memory available.

Z_VERSION_ERROR


The version requested is not compatible with the library version, or the z_stream size differs from that used by the library. In addition, the msg field of the strm may be set to an error message.

**inflateReset**

**Name**

inflateReset — reset decompression stream state

**Synopsis**

```c
#include <zlib.h>
int inflateReset(z_stream *stream);
```

**Description**

The inflateReset() function shall reset all state associated with stream. All pending output shall be discarded, and the counts of processed bytes (total_in and total_out) shall be reset to zero.

**Return Value**

On success, inflateReset() shall return Z_OK. Otherwise it shall return Z_STREAM_ERROR to indicate the error.

**Errors**

On error, inflateReset() shall return Z_STREAM_ERROR. The following conditions shall be treated as an error:

- The state in stream is inconsistent or inappropriate.
- stream is NULL.
inflaterSetDictionary

Name

inflateSetDictionary — initialize decompression dictionary

Synopsis

#include <zlib.h>
int inflateSetDictionary(z_stream *stream, const Bytef *dictionary, uInt dictlen);

Description

The inflateSetDictionary() function shall initialize the decompression dictionary associated with stream using the dictlen bytes referenced by dictionary.

The inflateSetDictionary() function should be called immediately after a call to inflate() has failed with return value Z_NEED_DICT. The dictionary must have the same Adler-32 checksum as the dictionary used for the compression (see deflateSetDictionary()).

stream shall reference an initialized decompression stream, with total_in zero (i.e. no data has been decompressed since the stream was initialized).

Return Value

On success, inflateSetDictionary() shall return Z_OK. Otherwise it shall return a value as indicated below.

Errors

On error, inflateSetDictionary() shall return a value as described below:

Z_STREAM_ERROR

   The state in stream is inconsistent, or stream was NULL.

Z_DATA_ERROR

   The Adler-32 checksum of the supplied dictionary does not match that used for the compression.

Application Usage (informative)

The application should provide a dictionary consisting of strings (ed note: do we really mean "strings"? Null terminated?) that are likely to be encountered in the data to be compressed. The application should ensure that the dictionary is sorted such that the most commonly used strings occur at the end of the dictionary.

The use of a dictionary is optional; however if the data to be compressed is relatively short and has a predictable structure, the use of a dictionary can substantially improve the compression ratio.
inflateSync

Name
inflateSync — advance compression stream to next sync point

Synopsis
#include <zlib.h>
int inflateSync(z_stream *stream);

Description
The inflateSync() function shall advance through the compressed data in
stream, skipping any invalid compressed data, until the next full flush point is
reached, or all input is exhausted. See the description for deflate() with flush
level Z_FULL_FLUSH. No output is placed in next_out.

Return Value
On success, inflateSync() shall return Z_OK, and update the next_in,,
avail_in, and, total_in fields of stream to reflect the number of bytes of
compressed data that have been skipped. Otherwise, inflateSync() shall return a
value as described below to indicate the error.

Errors
On error, inflateSync() shall return a value as described below:

Z_STREAM_ERROR
The state (as represented in stream) is inconsistent, or stream was NULL.

Z_BUF_ERROR
There is no data available to skip over.

Z_DATA_ERROR
No sync point was found.
inflateSyncPoint

Name
inflateSyncPoint — test for synchronization point

Synopsis
#include <zlib.h>
int inflateSyncPoint(z_streamp stream);

Description
The inflateSyncPoint() function shall return a non-zero value if the compressed data stream referenced by stream is at a synchronization point.

Return Value
If the compressed data in stream is at a synchronization point (see deflate() with a flush level of Z_SYNC_FLUSH or Z_FULL_FLUSH), inflateSyncPoint() shall return a non-zero value, other than Z_STREAM_ERROR. Otherwise, if the stream is valid, inflateSyncPoint() shall return 0. If stream is invalid, or in an invalid state, inflateSyncPoint() shall return Z_STREAM_ERROR to indicate the error.

Errors
On error, inflateSyncPoint() shall return a value as described below:

Z_STREAM_ERROR

The state (as represented in stream) is inconsistent, or stream was NULL.
uncompress

Name
uncompress — uncompress data

Synopsis
#include <zlib.h>
int uncompress(Bytef * dest, uLongf * destLen, const Bytef * source, uLong sourceLen);

Description
The uncompress() function shall attempt to uncompress sourceLen bytes of data in the buffer source, placing the result in the buffer dest.

On entry, destLen should point to a value describing the size of the dest buffer. The application should ensure that this value is large enough to hold the entire uncompressed data.

Note: The LSB does not describe any mechanism by which a compressor can communicate the size required to the uncompressor.

On successful exit, the variable referenced by destLen shall be updated to hold the length of uncompressed data in dest.

Return Value
On success, uncompress() shall return Z_OK. Otherwise, uncompress() shall return a value to indicate the error.

Errors
On error, uncompress() shall return a value as described below:

Z_BUF_ERROR
The buffer dest was not large enough to hold the uncompressed data.

Z_MEM_ERROR
Insufficient memory.

Z_DATA_ERROR
The compressed data (referenced by source) was corrupted.
14 Utility Libraries

**zError**

**Name**
zError — translate error number to string

**Synopsis**

```c
#include <zlib.h>
const char * zError(int err);
```

**Description**

The `zError()` function shall return the string identifying the error associated with `err`. This allows for conversion from error code to string for functions such as `compress()` and `uncompress()`, that do not always set the string version of an error.

**Return Value**

The `zError()` function shall return a the string identifying the error associated with `err`, or NULL if `err` is not a valid error code.

It is unspecified if the string returned is determined by the setting of the `LC_MESSAGES` category in the current locale.

**Errors**

None defined.

**zlibVersion**

**Name**
zlibVersion — discover library version at run time

**Synopsis**

```c
#include <zlib.h>
const char * zlibVersion (void);
```

**Description**

The `zlibVersion()` function shall return the string identifying the interface version at the time the library was built.

Applications should compare the value returned from `zlibVersion()` with the macro constant `ZLIB_VERSION` for compatibility.

**Return Value**

The `zlibVersion()` function shall return a the string identifying the version of the library currently implemented.

**Errors**

None defined.
14.5 Interfaces for libncurses

Table 14-3 defines the library name and shared object name for the libncurses library.

Table 14-3 libncurses Definition

<table>
<thead>
<tr>
<th>Library:</th>
<th>libncurses</th>
</tr>
</thead>
<tbody>
<tr>
<td>SONAME:</td>
<td>libncurses.so.5</td>
</tr>
</tbody>
</table>

The Parameters or return value of the following interface have had the const qualifier added as shown here.

```c
extern const char *keyname (int);
extern int mvscanw (int, int, const char *, ...);
extern int mvwscanw (WINDOW *, int, int, const char *, ...);
extern SCREEN *newterm (const char *, FILE *, FILE *);
extern int scanw (const char *, ...);
extern int vwscanw (WINDOW *, const char *, va_list);
extern int vw_scanw (WINDOW *, const char *, va_list);
extern int wscanw (WINDOW *, const char *, ...);
```

The behavior of the interfaces in this library is specified by the following specifications:

X/Open Curses

14.5.1 Curses

14.5.1.1 Interfaces for Curses

An LSB conforming implementation shall provide the generic functions for Curses specified in Table 14-4, with the full mandatory functionality as described in the referenced underlying specification.

Table 14-4 libncurses - Curses Function Interfaces

<table>
<thead>
<tr>
<th></th>
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<td>---------------</td>
</tr>
</tbody>
</table>
Referenced Specification(s)

[1]. X/Open Curses

An LSB conforming implementation shall provide the generic data interfaces for Curses specified in Table 14-5, with the full mandatory functionality as described in the referenced underlying specification.

Table 14-5 libncurses - Curses Data Interfaces

|------------|---------|-------------|------------|

295
14 Utility Libraries

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**Referenced Specification(s)**

[1]. X/Open Curses

### 14.6 Data Definitions for libncurses

This section defines global identifiers and their values that are associated with interfaces contained in libncurses. These definitions are organized into groups that correspond to system headers. This convention is used as a convenience for the reader, and does not imply the existence of these headers, or their content.

These definitions are intended to supplement those provided in the referenced underlying specifications.

This specification uses ISO/IEC 9899 C Language as the reference programming language, and data definitions are specified in ISO C format. The C language is used here as a convenient notation. Using a C language description of these data objects does not preclude their use by other programming languages.

#### 14.6.1 curses.h

```
#define ERR     (-1)
#define OK      (0)
#define ACS_RARROW      (acs_map['+'])
#define ACS_LARROW      (acs_map[','])
#define ACS_UARROW      (acs_map['-'])
#define ACS_DARROW      (acs_map['.'])
#define ACS_BLOCK       (acs_map['0'])
#define ACS_CKBOARD     (acs_map['a'])
#define ACS_DEGREE      (acs_map['f'])
#define ACS_PLMINUS     (acs_map['g'])
#define ACS_BOARD       (acs_map['h'])
#define ACS_LANTERN     (acs_map['i'])
#define ACS_LRCORNER    (acs_map['j'])
#define ACS_URCORNER    (acs_map['k'])
#define ACS_ULCORNER    (acs_map['l'])
#define ACS_LLCORNER    (acs_map['m'])
#define ACS_PLUS        (acs_map['n'])
#define ACS_S1  (acs_map['o'])
#define ACS_HLINE       (acs_map['q'])
#define ACS_S9  (acs_map['s'])
#define ACS_LTEE        (acs_map['t'])
#define ACS_RTEE        (acs_map['u'])
#define ACS_BTEE        (acs_map['v'])
#define ACS_TTEE        (acs_map['w'])
#define ACS_VLINE       (acs_map['x'])
#define ACS_DIAMOND     (acs_map['`'])
#define ACS_BULLET      (acs_map['~'])

#define getmaxyx(win,y,x)       (y=(win)?((win)->_maxy+1):ERR,x=(win)?((win)->_maxx+1):ERR)
#define getbegyx(win,y,x)       (y=(win)?(win)->_begy:ERR,x=(win)?(win)->_begx:ERR)
#define getyx(win,y,x)  (y=(win)?(win)->_cury:ERR,x=(win)?(win)->_curx:ERR)
#define getparyx(win,y,x)       (y=(win)?(win)->_pary:ERR,x=(win)?(win)->_parx:ERR)
```

```c
#define WA_ALTCHARSET   A_ALTCHARSET
```
#define WA_ATTRIBUTES   A_ATTRIBUTES
#define WA_BLINK        A_BLINK
#define WA_BOLD A_BOLD
#define WA_DIM  A_DIM
#define WA_HORIZONTAL   A_HORIZONTAL
#define WA_INVIS        A_INVIS
#define WA_LEFT A_LEFT
#define WA_LOW  A_LOW
#define WA_NORMAL      A_NORMAL
#define WA_PROTECT      A_PROTECT
#define WA.Reverse      A.Reverse
#define WA_RIGHT        A_RIGHT
#define WA.STANDOUT     A.STANDOUT
#define WA.TOP A_TOP
#define WA.UNDERLINE   A.UNDERLINE
#define WA.VERTICAL A.VERTICAL
#define A.Reverse NCURSES_BITS(1UL,10)
#define COLOR.BLACK     0
#define COLOR.RED       1
#define COLOR.GREEN     2
#define COLOR.YELLOW    3
#define COLOR.BLUE      4
#define COLOR.MAGENTA   5
#define COLOR.CYAN      6
#define COLOR.WHITE     7
#define _SUBWIN 0x01
#define _ENDLINE        0x02
#define _FULLWIN        0x04
#define _ISPAD  0x10
#define _HASMOVED       0x20
typedef unsigned char bool;
typedef unsigned long int chtype;
typedef struct screen SCREEN;
typedef struct _win_st WINDOW;
typedef chtype attr_t;
typedef struct
{
    attr_t attr;
    wchar_t chars[5];
}
cchar_t;
struct pdat
{
    short _pad.y;
    short _pad.x;
    short _pad.top;
    short _pad.left;
    short _pad.bottom;
    short _pad.right;
}
;
struct _win_st
{
    short _cury;
    short _curx;
    short _maxy;
    short _maxx;
    short _begy;
    short _begx;
}
short _flags;
attr_t _attrs;
cttype _bkgd;
bool _notimeout;
bool _clear;
bool _leaveok;
bool _scroll;
bool _idlok;
bool _idcok;
bool _immed;
bool _sync;
bool _use_keypad;
int _delay;
struct ldat * _line;
short _regtop;
short _regbottom;
int _parx;
int _pary;
WINDOW * _parent;
struct pdat _pad;
short _yoffset;
cchar_t _bkgrnd;
}

#define KEY_CODE_YES    0400
#define KEY_BREAK       0401
#define KEY_MIN 0401
#define KEY_DOWN        0402
#define KEY_UP  0403
#define KEY_LEFT        0404
#define KEY_RIGHT       0405
#define KEY_HOME        0406
#define KEY_BACKSPACE   0407
#define KEY_F0  0410
#define KEY_DL  0510
#define KEY_IL  0511
#define KEY_DC  0512
#define KEY_IC  0513
#define KEY_EIC 0514
#define KEY_CLEAR       0515
#define KEY_EOS 0516
#define KEY_EOL 0517
#define KEY_SF  0520
#define KEY_SR  0521
#define KEY_NPAGE       0522
#define KEY_PPAGE 0523
#define KEY_STAB        0524
#define KEY_CTAB       0525
#define KEY_CATAB      0526
#define KEY_ENTER       0527
#define KEY_SRESET      0528
#define KEY_RESET       0529
#define KEY_PRINT       0530
#define KEY_LL  0531
#define KEY_A1  0532
#define KEY_A3  0533
#define KEY_B2  0534
#define KEY_C1  0535
#define KEY_C3  0540
#define KEY_BTAB        0541
#define KEY_BEG 0542
#define KEY_CANCEL      0543
#define KEY_CLOSE       0544
#define KEY_COMMAND     0545
```c
#define KEY_COPY 0546
#define KEY_CREATE 0547
#define KEY_END 0550
#define KEY_EXIT 0551
#define KEY_FIND 0552
#define KEY_HELP 0553
#define KEY_MARK 0554
#define KEY_MESSAGE 0555
#define KEY_MOVE 0556
#define KEY_NEXT 0557
#define KEY_OPEN 0560
#define KEY_OPTIONS 0561
#define KEY_PREVIOUS 0562
#define KEY_REDO 0563
#define KEY_REFERENCE 0564
#define KEY_REFRESH 0565
#define KEY_REPLACE 0566
#define KEY_RESTART 0567
#define KEY_RESELECT 0567
#define KEY_RESUME 0570
#define KEY_SAVE 0571
#define KEY_SBEG 0572
#define KEY_SCANCEL 0573
#define KEY_SCOMMAND 0574
#define KEY_SCOPY 0575
#define KEY_SCREATE 0576
#define KEY_SDC 0577
#define KEY_SDL 0600
#define KEY_SELECT 0601
#define KEY_SEND 0602
#define KEY_SEOL 0603
#define KEY_SEXIT 0604
#define KEY_SFIND 0605
#define KEY_SHELP 0606
#define KEY_SHOME 0607
#define KEY_SIC 0610
#define KEY_SLEFT 0611
#define KEY_SMMESSAGE 0612
#define KEY_SMOVE 0613
#define KEY_SNEXT 0614
#define KEY_SOPTIONS 0615
#define KEY_SPREVIOUS 0616
#define KEY_SPRINT 0617
#define KEY_SREDO 0620
#define KEY_SREPLACE 0621
#define KEY_SRIGHT 0622
#define KEY_SRESUME 0623
#define KEY_SSAVE 0624
#define KEY_SSUSPEND 0625
#define KEY_SUNDO 0626
#define KEY_SUSPEND 0627
#define KEY_UNDO 0630
#define KEY_MOUSE 0631
#define KEY_RESIZE 0632
#define KEY_MAX 0777

#define PAIR_NUMBER(a) (((a)& A_COLOR)>>8)
#define NCURSES_BITS(mask,shift) ((mask)<<((shift)+8))
#define A_CHARTEXT (NCURSES_BITS(1UL,0)-1UL)
#define A_NORMAL 0L
#define NCURSES_ATTR_SHIFT 8
#define A_COLOR NCURSES_BITS((1UL)<<8)-1UL,0)
#define A_BLINK NCURSES_BITS(1UL,11)
#define A_DIM NCURSES_BITS(1UL,12)
#define A_BOLD NCURSES_BITS(1UL,13)
```
### 14.7 Interfaces for libutil

Table 14-6 defines the library name and shared object name for the libutil library.

<table>
<thead>
<tr>
<th>Library:</th>
<th>libutil</th>
</tr>
</thead>
<tbody>
<tr>
<td>SONAME:</td>
<td>libutil.so.1</td>
</tr>
</tbody>
</table>

The behavior of the interfaces in this library is specified by the following specifications:

- this specification

#### 14.7.1 Utility Functions

##### 14.7.1.1 Interfaces for Utility Functions

An LSB conforming implementation shall provide the generic functions for Utility Functions specified in Table 14-7, with the full mandatory functionality as described in the referenced underlying specification.

|-------------|--------------|-------------|

Referenced Specification(s)

[1]. this specification

#### 14.8 Interface Definitions for libutil

The following interfaces are included in libutil and are defined by this specification. Unless otherwise noted, these interfaces shall be included in the source standard.

Other interfaces listed above for libutil shall behave as described in the referenced base document.
forkpty

Name
forkpty — Create a new process attached to an available pseudo-terminal

Synopsis
#include <pty.h>
int forkpty(int *amaster, char *name, struct termios *termp, struct
winsize *winp);

Description
The forkpty() function shall find and open a pseudo-terminal device pair in the
same manner as the openpty() function. If a pseudo-terminal is available,
forkpty() shall create a new process in the same manner as the fork() function,
and prepares the new process for login in the same manner as login_tty().

If termp is not null, it shall refer to a termios structure that shall be used to
initialize the characteristics of the slave device. If winp is not null, it shall refer to a
winsize structure used to initialize the window size of the slave device.

Return Value
On success, the parent process shall return the process id of the child, and the child
shall return 0. On error, no new process shall be created, -1 shall be returned, and
errno shall be set appropriately. On success, the parent process shall receive the file
descriptor of the master side of the pseudo-terminal in the location referenced by
amaster, and, if name is not NULL, the filename of the slave device in name.

Errors
EAGAIN
   Unable to create a new process.
ENOENT
   There are no available pseudo-terminals.
ENOMEM
   Insufficient memory was available.
**login**

**Name**

`login` — login utility function

**Synopsis**

```c
#include <utmp.h>
void login (struct utmp * ut);
```

**Description**

The `login()` function shall update the user accounting databases. The `ut` parameter shall reference a `utmp` structure for all fields except the following:

1. The `ut_type` field shall be set to `USER_PROCESS`.
2. The `ut_pid` field shall be set to the process identifier for the current process.
3. The `ut_line` field shall be set to the name of the controlling terminal device. The name shall be found by examining the device associated with the standard input, output and error streams in sequence, until one associated with a terminal device is found. If none of these streams refers to a terminal device, the `ut_line` field shall be set to "???. If the terminal device is in the `/dev` directory hierarchy, the `ut_line` field shall not contain the leading "/dev/", otherwise it shall be set to the final component of the pathname of the device. If the user accounting database imposes a limit on the size of the `ut_line` field, it shall truncate the name, but any such limit shall not be smaller than `UT_LINESIZE` (including a terminating null character).

**Return Value**

None

**Errors**

None
login_tty

Name

login_tty — Prepare a terminal for login

Synopsis

#include <utmp.h>
int login_tty (int fdr);

Description

The login_tty() function shall prepare the terminal device referenced by the file descriptor fdr. This function shall create a new session, make the terminal the controlling terminal for the current process, and set the standard input, output, and error streams of the current process to the terminal. If fdr is not the standard input, output or error stream, then login_tty() shall close fdr.

Return Value

On success, login_tty() shall return zero; otherwise -1 is returned, and errno shall be set appropriately.

Errors

ENOTTY

fdr does not refer to a terminal device.

logout

Name

logout — logout utility function

Synopsis

#include <utmp.h>
int logout (const char * line);

Description

Given the device line, the logout() function shall search the user accounting database which is read by getutent() for an entry with the corresponding line, and with the type of USER_PROCESS. If a corresponding entry is located, it shall be updated as follows:

1. The ut_name field shall be set to zeroes (UT_NAMESIZE NUL bytes).
2. The ut_host field shall be set to zeroes (UT_HOSTSIZE NUL bytes).
3. The ut_tv shall be set to the current time of day.
4. The ut_type field shall be set to DEAD_PROCESS.

Return Value

On success, the logout() function shall return non-zero. Zero is returned if there was no entry to remove, or if the utmp file could not be opened or updated.
logwtmp

Name

logwtmp — append an entry to the wtmp file

Synopsis

#include <utmp.h>
void logwtmp (const char * line, const char * name, const char * host);

Description

If the process has permission to update the user accounting databases, the
logwtmp() function shall append a record to the user accounting database that
records all logins and logouts. The record to be appended shall be constructed as
follows:

1. The ut_line field shall be initialized from line. If the user accounting
database imposes a limit on the size of the ut_line field, it shall truncate the
value, but any such limit shall not be smaller than UT_LINESIZE (including a
terminating null character).

2. The ut_name field shall be initialized from name. If the user accounting
database imposes a limit on the size of the ut_name field, it shall truncate the
value, but any such limit shall not be smaller than UT_NAMESIZE (including a
terminating null character).

3. The ut_host field shall be initialized from host. If the user accounting
database imposes a limit on the size of the ut_host field, it shall truncate the
value, but any such limit shall not be smaller than UT_HOSTSIZE (including a
terminating null character).

4. If the name parameter does not refer to an empty string (i.e. ""), the ut_type
field shall be set to USER_PROCESS; otherwise the ut_type field shall be set to
DEAD_PROCESS.

5. The ut_id field shall be set to the process identifier for the current process.

6. The ut_tv field shall be set to the current time of day.

Note: If a process does not have write access to the user accounting database, the
logwtmp() function will not update it. Since the function does not return any value, an
application has no way of knowing whether it succeeded or failed.

Return Value

None.
openpty

Name
openpty — find and open an available pseudo-terminal

Synopsis
#include <pty.h>
int openpty(int *amaster, int *slave, char *name, struct termios *termp,
struct winsize *winp);

Description
The openpty() function shall find an available pseudo-terminal and return file
descriptors for the master and slave devices in the locations referenced by amaster
and slave respectively. If name is not NULL, the filename of the slave shall be
placed in the user supplied buffer referenced by name. If termp is not NULL, it shall
point to a termios structure used to initialize the terminal parameters of the slave
pseudo-terminal device. If winp is not NULL, it shall point to a winsize structure
used to initialize the window size parameters of the slave pseudo-terminal device.

Return Value
On success, zero is returned. On error, -1 is returned, and errno is set appropriately.

Errors
ENOENT
There are no available pseudo-terminals.
15 Commands and Utilities

15.1 Commands and Utilities

An LSB conforming implementation shall provide the commands and utilities as described in Table 15-1, with at least the behavior described as mandatory in the referenced underlying specification, with the following exceptions:

1. If any operand (except one which follows --) starts with a hyphen, the behavior is unspecified.

**Rationale (Informative):** Applications should place options before operands, or use --, as needed. This text is needed because, by default, GNU option parsing differs from POSIX, unless the environment variable POSIXLY_CORRECT is set. For example, ls . -a in GNU ls means to list the current directory, showing all files (that is, . is an operand and -a is an option). In POSIX, . and -a are both operands, and the command means to list the current directory, and also the file named -a. Suggesting that applications rely on the setting of the POSIXLY_CORRECT environment variable, or try to set it, seems worse than just asking the applications to invoke commands in ways which work with either the POSIX or GNU behaviors.

Table 15-1 Commands And Utilities

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
</table>
### Table 15-2 Built In Utilities

<table>
<thead>
<tr>
<th>Command</th>
<th>Referenced Specification(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>getopts</td>
<td>[1]. this specification</td>
</tr>
<tr>
<td>read</td>
<td></td>
</tr>
<tr>
<td>umask</td>
<td></td>
</tr>
<tr>
<td>wait</td>
<td></td>
</tr>
</tbody>
</table>

An LSB conforming implementation shall provide the shell built-in utilities as described in Table 15-2, with at least the behavior described as mandatory in the referenced underlying specification, with the following exceptions:

1. The built-in commands and utilities shall be provided by the `sh` utility itself, and need not be implemented in a manner so that they can be accessed via the exec family of functions as defined in ISO POSIX (2003) and should not be invoked directly by those standard utilities that execute other utilities (env, find, nice, nohup, time, xargs).

**Rationale (Informative):** Since the built-in utilities must affect the environment of the calling process, they have no effect when executed as a file.

### 15.2 Command Behavior

This section contains descriptions for commands and utilities whose specified behavior in the LSB contradicts or extends the standards referenced. It also contains commands and utilities only required by the LSB and not specified by other standards.
ar

Name

ar — create and maintain library archives (DEPRECATED)

Description

ar is deprecated from the LSB and is expected to disappear from a future version of the LSB.

Rationale: The LSB generally does not include software development utilities nor does it specify .o and .a file formats.

ar is as specified in ISO POSIX (2003) but with differences as listed below.

Differences

-T
-C

need not be accepted.

-l

has unspecified behavior.

-q

has unspecified behavior; using -r is suggested.
at

Name
at — examine or delete jobs for later execution

Description
at is as specified in ISO POSIX (2003) but with differences as listed below.

Differences
Options
-d
is functionally equivalent to the -r option specified in ISO POSIX (2003).
-r
need not be supported, but the '-d' option is equivalent.
-t time
need not be supported.

Optional Control Files
The implementation shall support the XSI optional behavior for access control; however the files at.allow and at.deny may reside in /etc rather than /usr/lib/cron.

awk

Name
awk — pattern scanning and processing language

Description
awk is as specified in ISO POSIX (2003) but with differences as listed below.

Differences
Certain aspects of internationalized regular expressions are optional; see Internationalization and Regular Expressions.
15 Commands and Utilities

batch

Name
batch — schedule commands to be executed in a batch queue

Description
The specification for batch is as specified in ISO POSIX (2003), but with differences as listed below.

Optional Control Files
The implementation shall support the XSI optional behavior for access control; however the files at.allow and at.deny may reside in /etc rather than /usr/lib/cron.

bc

Name
bc — an arbitrary precision calculator language

Description
bc is as specified in ISO POSIX (2003) but with extensions as listed below.

Extensions
The bc language may be extended in an implementation defined manner. If an implementation supports extensions, it shall also support the additional options:

-s | --standard
    processes exactly the POSIX bc language.
-w | --warn
    gives warnings for extensions to POSIX bc.

chfn

Name
chfn — change user name and information

Synopsis
chfn [-f full_name] [-h home_phone] [user]

Description
chfn shall update the user database. An unprivileged user may only change the fields for their own account, a user with appropriate privileges may change the fields for any account.

The fields full_name and home_phone may contain any character except:

310
any control character
comma
colon
equal sign

If none of the options are selected, `chfn` operates in an interactive fashion. The
prompts and expected input in interactive mode are unspecified and should not be
relied upon.

As it is possible for the system to be configured to restrict which fields a non-
privileged user is permitted to change, applications should be written to gracefully
handle these situations.

**Standard Options**

`-f full_name`

sets the user's full name.

`-h home_phone`

sets the user's home phone number.

**Future Directions**

The following two options are expected to be added in a future version of the LSB:

`-o office`

sets the user's office room number.

`-p office_phone`

sets the user's office phone number.

Note that some implementations contain a "-o other" option which specifies an
additional field called "other". Traditionally, this field is not subject to the
constraints about legitimate characters in fields. Also, one traditionally shall have
appropriate privileges to change the other field. At this point there is no consensus
about whether it is desirable to specify the other field; applications may wish to
avoid using it.

The "-w work_phone" field found in some implementations should be replaced by
the "-p office_phone" field. The "-r room_number" field found in some
implementations is the equivalent of the "-o office" option mentioned above; which
one of these two options to specify will depend on implementation experience and
the decision regarding the other field.
15 Commands and Utilities

chsh

**Name**
chsh — change login shell

**Synopsis**
chsh [-s login_shell] [user]

**Description**
chsh changes the user login shell. This determines the name of the user's initial login command. An unprivileged user may only change the login shell for their own account, a user with appropriate privilege may change the login shell for any account specified by user.

Unless the user has appropriate privilege, the initial login command name shall be one of those listed in /etc/shells. The login_shell shall be the absolute path (i.e. it must start with '/') to an executable file. Accounts which are restricted (in an implementation-defined manner) may not change their login shell.

If the -s option is not selected, chsh operates in an interactive mode. The prompts and expected input in this mode are unspecified.

**Standard Options**

- `-s login_shell`
  sets the login shell.

col

**Name**
col — filter reverse line feeds from input

**Description**
col is as specified in SUSv2 but with differences as listed below.

**Differences**
The -p option has unspecified behavior.

**Note:** Although col is shown as legacy in SUSv2, it is not (yet) deprecated in the LSB.
**cpio**

**Name**
cpio — copy file archives in and out

**Description**
cpio is as specified in ISO POSIX (2003), but with differences as listed below.

**Differences**
Some elements of the Pattern Matching Notation are optional; see Internationalization and Pattern Matching Notation.

**crontab**

**Name**
crontab — maintain crontab files for individual users

**Synopsis**
crontab [-u user] file
crontab [-u user] {-l | -r | -e}

**Description**
crontab is as specified in ISO POSIX (2003), but with differences as listed below.

**Optional Control Files**
The implementation shall support the XSI optional behavior for access control; however the files cron.allow and cron.deny may reside in /etc rather than /usr/lib/cron.

**cut**

**Name**
cut — split a file into sections determined by context lines

**Description**
cut is as specified in ISO POSIX (2003), but with differences as listed below.

**Differences**
-\n  has unspecified behavior.
df

Name

df — report file system disk space usage

Description

The df command shall behave as specified in ISO POSIX (2003), but with differences as listed below.

Differences

Options

If the -k option is not specified, disk space is shown in unspecified units. If the -P option is specified, the size of the unit shall be printed on the header line in the format "%4s-blocks". Applications should specify -k.

The XSI option -t has unspecified behavior. Applications should not specify -t.

**Rationale:** The most common implementation of df uses the -t option for a different purpose (restricting output to a particular file system type), and use of -t is therefore non-portable.

Operand May Identify Special File

If an argument is the absolute file name of a special file containing a mounted file system, df shall show the space available on that file system rather than on the file system containing the special file (which is typically the root file system).

**Note:** In ISO POSIX (2003) the XSI optional behavior permits an operand to name a special file, but appears to require the operation be performed on the file system containing the special file. A defect report has been submitted for this case.
dmesg

Name
dmesg — print or control the system message buffer

Synopsis
dmesg [-c | -n level | -s bufsize]

Description
dmesg examines or controls the system message buffer. Only a user with appropriate privileges may modify the system message buffer parameters or contents.

Standard Options
- c
  If the user has appropriate privilege, clears the system message buffer contents after printing.
- n level
  If the user has appropriate privilege, sets the level at which logging of messages is done to the console.
- s bufsize
  uses a buffer of bufsize to query the system message buffer. This is 16392 by default.

du

Name
du — estimate file space usage

Description
du is as specified in ISO POSIX (2003), but with differences as listed below.

Differences
If the -k option is not specified, disk space is shown in unspecified units. Applications should specify -k.
**echo**

**Name**

*echo* — write arguments to standard output

**Synopsis**

```
echo [string...]```

**Description**

The *echo* command is as specified in ISO POSIX (2003), but with the following differences.

Implementations may support implementation-defined options to *echo*. The behavior of *echo* if any arguments contain backslashes is also implementation defined.

Conforming applications shall not run *echo* with a first argument starting with a hyphen, or with any arguments containing backslashes; they should use *printf* in those cases.

*Note:* The behavior specified here is similar to that specified by ISO POSIX (2003) without the XSI option. However, the LSB forbids a conforming application from using any options (even if the implementation provides them) while ISO POSIX (2003) specifies behavior if the first operand is the string *-n*.

**egrep**

**Name**

*egrep* — search a file with an Extended Regular Expression pattern

**Description**

*egrep* is equivalent to *grep -E*. For further details, see the specification for *grep*.

**fgrep**

**Name**

*fgrep* — search a file with a fixed pattern

**Description**

*fgrep* is equivalent to *grep -F*. For further details, see the specification for *grep*. 
**file**

**Name**

file – determine file type

**Description**

file is as specified in ISO POSIX (2003), but with differences as listed below.

**Differences**

The -M, -h, -d, and -i options need not be supported.

**find**

**Name**

find – search for files in a directory hierarchy

**Description**

find shall behave as specified in ISO POSIX (2003), except as described below.

**Differences**

**Pattern Matching**

Some elements of the Pattern Matching Notation are optional; see Internationalization and Pattern Matching Notation.

**Option and Operand Handling**

Options and operands to find shall behave as described in ISO POSIX (2003), except as follows:

- **-H**
  
  need not be supported

- **-L**
  
  need not be supported

- **exec ... +**
  
  argument aggregation need not be supported

**Rationale:** The -H and -L options are not yet widely available in implementations of the find command, nor is argument aggregation. A future version of this specification will require these features be supported.
**fuser**

**Name**

*fuser* — identify processes using files or sockets

**Description**

*fuser* is as specified in ISO POSIX (2003), but with differences as listed below.

**Differences**

The *fuser* command is a system administration utility, see Path For System Administration Utilities.

**Option Differences**

- `-c`
  - has unspecified behavior.

- `-f`
  - has unspecified behavior.
gettext

Name
gettext — retrieve text string from message catalog

Synopsis
gettext [options] [textdomain] msgid gettext -s [options] msgid...

Description
The gettext utility retrieves a translated text string corresponding to string msgid from a message object generated with msgfmt utility.

The message object name is derived from the optional argument textdomain if present, otherwise from the TEXTDOMAIN environment variable. If no domain is specified, or if a corresponding string cannot be found, gettext prints msgid.

Ordinarily gettext looks for its message object in dirname/lang/LC_MESSAGES where dirname is the implementation-defined default directory and lang is the locale name. If present, the TEXTDOMAINDIR environment variable replaces the dirname.

This utility interprets C escape sequences such as \	 for tab. Use \\
 to print a backslash. To produce a message on a line of its own, either put a \n at the end of msgid, or use this command in conjunction with the printf utility.

When used with the -s option the gettext utility behaves like the echo utility, except that the message corresponding to msgid in the selected catalog provides the arguments.

Options
-d domainname
--domain=domainname

PARAMETER translated messages from domainname.

-e

Enable expansion of some escape sequences.

-n

Suppress trailing newline.

Operands
The following operands are supported:

textdomain

A domain name used to retrieve the messages.

msgid

A key to retrieve the localized message.

Environment Variables
LANGUAGE

Specifies one or more locale names.
15 Commands and Utilities

LANG
   Specifies locale name.

LC_MESSAGES
   Specifies messaging locale, and if present overrides LANG for messages.

TEXTDOMAIN
   Specifies the text domain name, which is identical to the message object filename without .mo suffix.

TEXTDOMAINDIR
   Specifies the pathname to the message catalog, and if present replaces the implementation-defined default directory.

Exit Status
The following exit values are returned:

   0
   Successful completion.

   >0
   An error occurred.

grep

Name
   grep — print lines matching a pattern

Description
   grep is as specified in ISO POSIX (2003), but with differences as listed below.

LSB Differences
   Certain aspects of regular expression matching are optional; see Internationalization and Regular Expressions.
**groupadd**

**Name**

`groupadd` — create a new group

**Synopsis**

```
groupadd [-g gid [-o]] group
```

**Description**

If the caller has appropriate privilege, the `groupadd` command shall create a new group named `group`. The group name shall be unique in the group database. If no `gid` is specified, `groupadd` shall create the new group with a unique group ID.

The `groupadd` command is a system administration utility, see Path For System Administration Utilities.

**Options**

```
-g gid [-o]
```

The new group shall have group ID `gid`. If the `-o` option is not used, no other group shall have this group ID. The value of `gid` shall be non-negative.

**groupdel**

**Name**

`groupdel` — delete a group

**Synopsis**

```
groupdel group
```

**Description**

If the caller has sufficient privilege, the `groupdel` command shall modify the system group database, deleting the group named `group`. If the group named `group` does not exist, `groupdel` shall issue a diagnostic message and exit with a non-zero exit status.

The `groupdel` command is a system administration utility, see Path For System Administration Utilities.
**groupmod**

**Name**
groupmod — modify a group

**Synopsis**
groupmod [-g gid [-o]] [-n group_name] group

**Description**
If the caller has appropriate privilege, the `groupmod` command shall modify the entry in the system group database corresponding to a group named `group`. The `groupmod` command is a system administration utility, see Path For System Administration Utilities.

**Options**

- `-g gid [-o]`
  Modify the group's group ID, setting it to `gid`. If the `-o` option is not used, no other group shall have this group ID. The value of `gid` shall be non-negative.

  **Note:** Only the group ID in the database is altered; any files with group ownership set to the original group ID are unchanged by this modification.

- `-n group_name`
  changes the name of the group from `group` to `group_name`.

**groups**

**Name**
groups — display a group

**Synopsis**
groups [user]

**Description**
The `groups` command shall behave as `id -Gn [user]`, as specified in ISO POSIX (2003). The optional `user` parameter will display the groups for the named user.

**gunzip**

**Name**
gunzip — uncompress files

**Description**
gunzip is equivalent to `gzip -d`. See the specification for `gzip` for further details.
gzip

Name
gzip — compress or expand files

Synopsis
gzip [-cdfhllNrtvV19] [-S suffix] [name...]

Description
The gzip command shall attempt to reduce the size of the named files. Whenever
possible, each file is replaced by one with the extension .gz, while keeping the same
ownership, modes, access and modification times. If no files are specified, or if a file
name is -, the standard input is compressed to the standard output. gzip shall only
attempt to compress regular files. In particular, it will ignore symbolic links.
When compressing, gzip uses the deflate algorithm specified in RFC 1951:
DEFLATE Compressed Data Format Specification and stores the result in a file

Options
-c, --stdout, --to-stdout
writes output on standard output, leaving the original files unchanged. If there
are several input files, the output consists of a sequence of independently
compressed members. To obtain better compression, concatenate all input files
before compressing them.

-d, --decompress, --uncompress
the name operands are compressed files, and gzip shall decompress them.

-f, --force
forces compression or decompression even if the file has multiple links or the
corresponding file already exists, or if the compressed data is read from or
written to a terminal. If the input data is not in a format recognized by gzip,
and if the option --stdout is also given, copy the input data without change to
the standard output: let gzip behave as cat. If -f is not given, and when not
running in the background, gzip prompts to verify whether an existing file
should be overwritten.

-l, --list
lists the compressed size, uncompressed size, ratio and uncompressed name
for each compressed file. For files that are not in gzip format, the
uncompressed size shall be given as -1. If the --verbose or -v option is also
specified, the crc and timestamp for the uncompressed file shall also be
displayed.
For decompression, gzip shall support at least the following compression
methods:
• deflate (RFC 1951: DEFLATE Compressed Data Format Specification)
• compress (ISO POSIX (2003))
The crc shall be given as $\texttt{ffffffff}$ for a file not in gzip format.

If the --name or -N option is also specified, the uncompressed name, date and time are those stored within the compressed file, if present.

If the --quiet or -q option is also specified, the title and totals lines are not displayed.

-L, --license

displays the gzip license and quit.

-n, --no-name

does not save the original file name and time stamp by default when compressing. (The original name is always saved if the name had to be truncated.) When decompressing, do not restore the original file name if present (remove only the gzip suffix from the compressed file name) and do not restore the original time stamp if present (copy it from the compressed file). This option is the default when decompressing.

-N, --name

always saves the original file name and time stamp when compressing; this is the default. When decompressing, restore the original file name and time stamp if present. This option is useful on systems which have a limit on file name length or when the time stamp has been lost after a file transfer.

-q, --quiet

suppresses all warnings.

-r, --recursive

travels the directory structure recursively. If any of the file names specified on the command line are directories, gzip will descend into the directory and compress all the files it finds there (or decompress them in the case of gunzip).

-S .suf, --suffix .suf

uses suffix .suf instead of .gz.

-t, --test

checks the compressed file integrity.

-v, --verbose

displays the name and percentage reduction for each file compressed or decompressed.

-#, --fast, --best

regulates the speed of compression using the specified digit #, where -1 or --fast indicates the fastest compression method (less compression) and -9 or --best indicates the slowest compression method (best compression). The default compression level is -6 (that is, biased towards high compression at expense of speed).

**LSB Deprecated Options**
The behaviors specified in this section are expected to disappear from a future version of the LSB; applications should only use the non-LSB-deprecated behaviors.

- `V`, `--version`
  displays the version number and compilation options, then quits.

**hostname**

**Name**

`hostname` — show or set the system's host name

**Synopsis**

```
hostname [name]
```

**Description**

`hostname` is used to either display or, with appropriate privileges, set the current host name of the system. The host name is used by many applications to identify the machine.

When called without any arguments, the program displays the name of the system as returned by the `gethostname()` function.

When called with a `name` argument, and the user has appropriate privilege, the command sets the host name.

**Note:** It is not specified if the hostname displayed will be a fully qualified domain name. Applications requiring a particular format of hostname should check the output and take appropriate action.
install

Name
install — copy files and set attributes

Synopsis
install [option...] SOURCE DEST install [option...] SOURCE... DEST install [-d | --directory] [option...] DIRECTORY...

Description
In the first two formats, copy SOURCE to DEST or multiple SOURCE(s) to the existing DEST directory, optionally setting permission modes and file ownership. In the third format, each DIRECTORY and any missing parent directories shall be created.

Standard Options
--backup[=METHOD]
makes a backup of each existing destination file. METHOD may be one of the following:

none or off
never make backups.

numbered or t
make numbered backups. A numbered backup has the form "%s.~%d~", target_name, version_number. Each backup shall increment the version number by 1.

existing or nil
behave as numbered if numbered backups exist, or simple otherwise.

simple or never
append a suffix to the name. The default suffix is '~', but can be overriden by setting SIMPLE_BACKUP_SUFFIX in the environment, or via the -S or --suffix option.

If no METHOD is specified, the environment variable VERSION_CONTROL shall be examined for one of the above. Unambiguous abbreviations of METHOD shall be accepted. If no METHOD is specified, or if METHOD is empty, the backup method shall default to existing.

If METHOD is invalid or ambiguous, install shall fail and issue a diagnostic message.

-b
is equivalent to --backup=existing.

-d, --directory
treats all arguments as directory names; creates all components of the specified directories.
-D
  creates all leading components of DEST except the last, then copies SOURCE to
  DEST; useful in the 1st format.

-g GROUP, --group=GROUP
  if the user has appropriate privilege, sets group ownership, instead of process'
  current group. GROUP is either a name in the user group database, or a positive
  integer, which shall be used as a group-id.

-m MODE, --mode=MODE
  sets permission mode (specified as in chmod), instead of the default rwxr-xr-x.

-o OWNER, --owner=OWNER
  if the user has appropriate privilege, sets ownership. OWNER is either a name in
  the user login database, or a positive integer, which shall be used as a user-id.

-p, --preserve-timestamps
  copies the access and modification times of SOURCE files to corresponding
  destination files.

-s, --strip
  strips symbol tables, only for 1st and 2nd formats.

-S SUFFIX, --suffix=SUFFIX
  equivalent to --backup=existing, except if a simple suffix is required, use
  SUFFIX.

--verbose
  prints the name of each directory as it is created.

-v, --verbose
  print the name of each file before copying it to stdout.

install_initd

Name
install_initd — activate an init script

Synopsis
/usr/lib/lsb/install_initd initd_file

Description
install_initd shall activate a system initialization file that has been copied to an
implementation defined location such that this file shall be run at the appropriate
point during system initialization. The install_initd command is typically called in
the postinstall script of a package, after the script has been copied to /etc/init.d.
See also Installation and Removal of Init Scripts.
ipcrm

Name

    ipcrm — remove IPC Resources

Synopsis

    ipcrm [-q msgid | -Q msgkey | -s semid | -S semkey | -m shmid | -Mshmkey]...ipcrm [shm | msg | msg] id...

Description

    If any of the -q, -Q, -s, -S, -m, or -M arguments are given, the ipcrm shall behave as described in ISO POSIX (2003).

    Otherwise, ipcrm shall remove the resource of the specified type identified by id.

Future Directions

    A future revision of this specification may deprecate the second synopsis form.

    Rationale: In its first Linux implementation, ipcrm used the second syntax shown in the SYNOPSIS. Functionality present in other implementations of ipcrm has since been added, namely the ability to delete resources by key (not just identifier), and to respect the same command line syntax. The previous syntax is still supported for backwards compatibility only.
ipcs

Name
ipcs — provide information on ipc facilities

Synopsis

ipcs [-smq] [-tcp]

Description

ipcs provides information on the ipc facilities for which the calling process has read access.

Note: Although this command has many similarities with the optional ipcs utility described in ISO POSIX (2003), it has substantial differences and is therefore described separately. The options specified here have similar meaning to those in ISO POSIX (2003); other options specified there have unspecified behavior on an LSB conforming implementation. See Application Usage below. The output format is not specified.

Resource display options

-m
  shared memory segments.

-q
  message queues.

-s
  semaphore arrays.

Output format options

-t
  time.

-p
  pid.

-c
  creator.

Application Usage

In some implementations of ipcs the -a option will print all information available. In other implementations the -a option will print all resource types. Therefore, applications shall not use the -a option.

Some implementations of ipcs provide more output formats than are specified here. These options are not consistent between differing implementations of ipcs. Therefore, only the -t, -c and -p option formatting flags may be used. At least one of the -t, -c and -p options and at least one of -m, -q and -s options shall be specified. If no options are specified, the output is unspecified.
**killall**

**Name**

killall – kill processes by name

**Synopsis**

```
killall [-egiqvw] [-signal] name... killall -l killall -V
```

**Description**

killall sends a signal to all processes running any of the specified commands. If no signal name is specified, **SIGTERM** is sent.

Signals can be specified either by name (e.g. `-HUP`) or by number (e.g. `-1`). Signal **0** (check if a process exists) can only be specified by number.

If the command name contains a slash (`/`), processes executing that particular file will be selected for killing, independent of their name.

killall returns a non-zero return code if no process has been killed for any of the listed commands. If at least one process has been killed for each command, **killall** returns zero.

A **killall** process never kills itself (but may kill other **killall** processes).

**Standard Options**

- `e`
  
  requires an exact match for very long names. If a command name is longer than 15 characters, the full name may be unavailable (i.e. it is swapped out). In this case, **killall** will kill everything that matches within the first 15 characters. With `-e`, such entries are skipped. **killall** prints a message for each skipped entry if `-v` is specified in addition to `-e`.

- `g`
  
  kills the process group to which the process belongs. The kill signal is only sent once per group, even if multiple processes belonging to the same process group were found.

- `i`
  
  asks interactively for confirmation before killing.

- `l`
  
  lists all known signal names.

- `q`
  
  does not complain if no processes were killed.

- `v`
  
  reports if the signal was successfully sent.

**LSB Deprecated Options**
The behaviors specified in this section are expected to disappear from a future version of the LSB; applications should only use the non-LSB-deprecated behaviors.

-V
    displays version information.

lpr

Name
lpr – off line print

Synopsis

Description
lpr uses a spooling daemon to print the named files when facilities become available. If no names appear, the standard input is assumed.

Standard Options
-1
    identifies binary data that is not to be filtered but sent as raw input to printer.

-p
    formats with "pr" before sending to printer.

-Pprinter
    sends output to the printer named printer instead of the default printer.

-h
    suppresses header page.

-s
    uses symbolic links.

-#copies
    specifies copies as the number of copies to print.

-J name
    specifies name as the job name for the header page.

-T title
    specifies title as the title used for "pr".
15 Commands and Utilities

ls

Name

ls — list directory contents

Description

ls shall behave as specified in ISO POSIX (2003), but with extensions listed below.

Extensions

-l

If the file is a character special or block special file, the size of the file shall be replaced with two unsigned numbers in the format "%u, %u", representing the major and minor device numbers associated with the special file.

Note: The LSB does not specify the meaning of the major and minor devices numbers.

-p

in addition to ISO POSIX (2003) XSI optional behavior of printing a slash for a directory, ls -p may display other characters for other file types.
**lsb_release**

**Name**

`lsb_release` — print distribution specific information

**Synopsis**

`lsb_release [OPTION...]`

**Description**

The `lsb_release` command prints certain LSB (Linux Standard Base) and Distribution information.

If no options are given, the -v option is assumed.

**Options**

- **-v, --version**
  
  displays version of LSB against which distribution is compliant. The version is expressed as a colon separated list of LSB module descriptions. LSB module descriptions are dash separated tuples containing the module name, version, and architecture name. The output is a single line of text of the following format:

  `LSB Version:\t<ListAsDescribedAbove>`

- **-i, --id**

  displays string id of distributor. The output is a single line of text of the following format:

  `Distributor ID:\t<DistributorID>`

- **-d, --description**

  displays single line text description of distribution. The output is of the following format:

  `Description:\t<Description>`

- **-r, --release**

  displays release number of distribution. The output is a single line of text of the following format:

  `Release:\t<Release>`

- **-c, --codename**

  displays codename according to distribution release. The output is a single line of text of the following format.

  `Codename:\t<Codename>`

- **-a, --all**

  displays all of the above information.

- **-s, --short**

  displays all of the above information in short output format.
-h, --help

displays a human-readable help message.

Examples
The following command will list the LSB Profiles which are currently supported on this platform.

example% lsb_release -v

m4

Name
m4 — macro processor

Description
m4 is as specified in ISO POSIX (2003), but with extensions as listed below.

Extensions
-P
forces all builtins to be prefixed with m4_. For example, define becomes m4_define.

-I directory
Add directory to the end of the search path for includes.
md5sum

Name
md5sum — generate or check MD5 message digests

Synopsis
md5sum [-c [file] | file]

Description
For each file, write to standard output a line containing the MD5 message digest of that file, followed by one or more blank characters, followed by the name of the file. The MD5 message digest shall be calculated according to RFC 1321: The MD5 Message-Digest Algorithm and output as 32 hexadecimal digits.

If no file names are specified as operands, read from standard input and use "-" as the file name in the output.

Options
-c [file]

checks the MD5 message digest of all files named in file against the message digest listed in the same file. The actual format of file is the same as the output of md5sum. That is, each line in the file describes a file. If file is not specified, read message digests from stdin.

Exit Status
md5sum shall exit with status 0 if the sum was generated successfully, or, in check mode, if the check matched. Otherwise, md5sum shall exit with a non-zero status.
**mknod**

**Name**

*mknod* — make special files

**Synopsis**

```bash
mknod [-m mode | --mode=mode] name type [major minor] mknod [--version]
```

**Description**

The *mknod* command shall create a special file named *name* of the given *type*.

The *type* shall be one of the following:

- **b**
  
  creates a block (buffered) special file with the specified *major* and *minor* device numbers.

- **c, u**
  
  creates a character (unbuffered) special file with the specified *major* and *minor* device numbers.

- **p**
  
  creates a FIFO.

**Options**

- **-m mode, --mode=mode**
  
  create the special file with file access permissions set as described in *mode*. The permissions may be any absolute value (i.e. one not containing ‘+’ or ‘-’) acceptable to the *chmod* command.

- **--version**
  
  output version information and exit.

**Note:** This option may be deprecated in a future release of this specification.

If *type* is *p*, *major* and *minor* shall not be specified. Otherwise, these parameters are mandatory.

**Future Directions**

This command may be deprecated in a future version of this specification. The *major* and *minor* operands are insufficiently portable to be specified usefully here. Only a FIFO can be portably created by this command, and the *mkfifo* command is a simpler interface for that purpose.
**mktemp**

**Name**

`mktemp` – make temporary file name (unique)

**Synopsis**

```
mktemp [-q] [-u] template
```

**Description**

The `mktemp` command takes the given file name `template` and overwrites a portion of it to create a file name. This file name shall be unique and suitable for use by the application.

The `template` should have at least six trailing 'X' characters. These characters are replaced with characters from the portable filename character set in order to generate a unique name.

If `mktemp` can successfully generate a unique file name, and the `-u` option is not present, the file shall be created with read and write permission only for the current user. The `mktemp` command shall write the filename generated to the standard output.

**Options**

- `-q`
  fail silently if an error occurs. Diagnostic messages to `stderr` are suppressed, but the command shall still exit with a non-zero exit status if an error occurs.

- `-u`
  operates in 'unsafe' mode. A unique name is generated, but the temporary file shall be unlinked before `mktemp` exits. Use of this option is not encouraged.
more

Name
more — display files on a page-by-page basis

Description
more is as specified in ISO POSIX (2003), but with differences as listed below.

Differences
The more command need not respect the LINES and COLUMNS environment variables.
The following additional options may be supported:

- `num`
specifies an integer which is the screen size (in lines).

+ `num`
starts at line number num.

+/pattern
Start at the first line matching the pattern, equivalent to executing the search forward (/) command with the given pattern immediately after opening each file.

The following options from ISO POSIX (2003) may behave differently:

-e
has unspecified behavior.

-i
has unspecified behavior.

-n
has unspecified behavior.

-p
Either clear the whole screen before displaying any text (instead of the usual scrolling behavior), or provide the behavior specified by ISO POSIX (2003). In the latter case, the syntax is "-p command".

-t
has unspecified behavior.

The more command need not support the following interactive commands:
Rationale

The `+num` and `+/string` options are deprecated in SUSv2, and have been removed in ISO POSIX (2003); however this specification continues to specify them because the publicly available `util-linux` package does not support the replacement (`-p command`). The `+command` option as found in SUSv2 is more general than is specified here, but the `util-linux` package appears to only support the more specific `+num` and `+/string` forms.
mount

Name

mount — mount a file system

Synopsis


Description

As described in ISO POSIX (2003), all files in the system are organized in a directed graph, known as the file hierarchy, rooted at / . These files can be spread out over several underlying devices. The mount command shall attach the file system found on some underlying device to the file hierarchy.

Options

-v

invoke verbose mode. The mount command shall provide diagnostic messages on stdout.

-a

mount all file systems (of the given types) mentioned in /etc/fstab.

-F

If the -a option is also present, fork a new incarnation of mount for each device to be mounted. This will do the mounts on different devices or different NFS servers in parallel.

-f

cause everything to be done except for the actual system call; if it's not obvious, this `fakes' mounting the file system.

-n

mount without writing in /etc/mtab. This is necessary for example when /etc is on a read-only file system.

-s

ignore mount options not supported by a file system type. Not all file systems support this option.

-r

mount the file system read-only. A synonym is -o ro.

-w

mount the file system read/write. (default) A synonym is -o rw.

-L label
If the file /proc/partitions is supported, mount the partition that has the specified label.

-`U uuid`

If the file /proc/partitions is supported, mount the partition that has the specified uuid.

-`t vfstype`

indicate a file system type of `vfstype`.

More than one type may be specified in a comma separated list. The list of file system types can be prefixed with `no` to specify the file system types on which no action should be taken.

-`o`

options are specified with a `-o` flag followed by a comma-separated string of options. Some of these options are only useful when they appear in the /etc/fstab file. The following options apply to any file system that is being mounted:

`async`

perform all I/O to the file system asynchronously.

`atime`

update inode access time for each access. (default)

`auto`

in /etc/fstab, indicate the device is mountable with `-a`.

`defaults`

use default options: `rw`, `suid`, `dev`, `exec`, `auto`, `nouser`, `async`.

`dev`

interpret character or block special devices on the file system.

`exec`

permit execution of binaries.

`noatime`

do not update file access times on this file system.

`noauto`

in /etc/fstab, indicates the device is only explicitly mountable.

`nodev`

do not interpret character or block special devices on the file system.

`noexec`

do not allow execution of any binaries on the mounted file system.

`nosuid`
do not allow set-user-identifier or set-group-identifier bits to take effect.

nouser
forbid an unprivileged user to mount the file system. (default)

remount
remount an already-mounted file system. This is commonly used to change the mount options for a file system, especially to make a read-only file system writable.

ro
mount the file system read-only.

rw
mount the file system read-write.

suid
allow set-user-identifier or set-group-identifier bits to take effect.

sync
do all I/O to the file system synchronously.

user
allow an unprivileged user to mount the file system. This option implies the options noexec, nosuid, nodev unless overridden by subsequent options.

**LSB Deprecated Options**

The behaviors specified in this section are expected to disappear from a future version of the LSB; applications should only use the non-LSB-deprecated behaviors.

-V
output version and exit.
msgfmt

Name
msgfmt — create a message object from a message file

Synopsis
msgfmt [options...] filename...

Description
The msgfmt command generates a binary message catalog from a textual translation description. Message catalogs, or message object files, are stored in files with a .mo extension.

Note: The format of message object files is not guaranteed to be portable. Message catalogs should always be generated on the target architecture using the msgfmt command.

The source message files, otherwise known as portable object files, have a .po extension.

The filename operands shall be portable object files. The .po file contains messages to be displayed to users by system utilities or by application programs. The portable object files are text files, and the messages in them can be rewritten in any language supported by the system.

If any filename is -, a portable object file shall be read from the standard input.

The msgfmt command interprets data as characters according to the current setting of the LC_CTYPE locale category.

Options
-c
--check
   Detect and diagnose input file anomalies which might represent translation errors. The msgid and msgstr strings are studied and compared. It is considered abnormal that one string starts or ends with a newline while the other does not.

   If the message is flagged as c-format (see Comment Handling), check that the msgid string and the msgstr translation have the same number of % format specifiers, with matching types.

-D directory
--directory=directory
   Add directory to list for input files search. If filename is not an absolute pathname and filename cannot be opened, search for it in directory. This option may be repeated. Directories shall be searched in order, with the leftmost directory searched first.

-f
--use-fuzzy
   Use entries marked as fuzzy in output. If this option is not specified, such entries are not included into the output. See Comment Handling below.
15 Commands and Utilities

- `o output-file`
  `--output-file=output-file`

  Specify the output file name as `output-file`. If multiple domains or duplicate msgids in the `.po` file are present, the behavior is unspecified. If `output-file` is `-`, output is written to standard output.

- `--strict`

  Ensure that all output files have a `.mo` extension. Output files are named either by the `-o` (or `--output-file`) option, or by domains found in the input files.

- `-v`
  `--verbose`

  Print additional information to the standard error, including the number of translated strings processed.

### Operands

The `filename` operands are treated as portable object files. The format of portable object files is defined in EXTENDED DESCRIPTION.

### Standard Input

The standard input is not used unless a `filename` operand is specified as `"."`.

### Environment Variables

#### LANGUAGE

Provides one or more locale names.

#### LANG

Specifies locale name.

#### LC_ALL

Specifies locale name for all categories. If defined, overrides LANG, LC_CTYPE and LC_MESSAGES.

#### LC_CTYPE

Determines the locale for the interpretation of sequences of bytes of text data as characters (for example, single-byte as opposed to multi-byte characters in arguments and input files).

#### LC_MESSAGES

Specifies messaging locale, and if present overrides LANG for messages.

### Standard Output

The standard output is not used unless the option-argument of the `-o` option is specified as `-`.

### Extended Description
The format of portable object files (.po files) is defined as follows. Each .po file contains one or more lines, with each line containing either a comment or a statement. Comments start the line with a hash mark (#) and end with the newline character. Empty lines, or lines containing only white-space, shall be ignored. Comments can in certain circumstances alter the behavior of msgfmt. See Comment Handling below for details on comment processing. The format of a statement is:

directive value

Each directive starts at the beginning of the line and is separated from value by white space (such as one or more space or tab characters). The value consists of one or more quoted strings separated by white space. If two or more strings are specified as value, they are normalized into single string using the string normalization syntax specified in ISO C (1999). The following directives are supported:

domain domainname
msgid message_identifier
msgid_plural untranslated_string_plural
msgstr message_string
msgstr[n] message_string

The behavior of the domain directive is affected by the options used. See OPTIONS for the behavior when the -o option is specified. If the -o option is not specified, the behavior of the domain directive is as follows:

1. All msgids from the beginning of each .po file to the first domain directive are put into a default message object file, messages (or messages.mo if the --strict option is specified).
2. When msgfmt encounters a domain domainname directive in the .po file, all following msgids until the next domain directive are put into the message object file domainname (or domainname.mo if --strict option is specified).
3. Duplicate msgids are defined in the scope of each domain. That is, a msgid is considered a duplicate only if the identical msgid exists in the same domain.
4. All duplicate msgids are ignored.

Themsgid directive specifies the value of a message identifier associated with the directive that follows it. The msgid_plural directive specifies the plural form message specified to the plural message handling functions ngettext(), dngettext() or dcngettext(). The message_identifier string identifies a target string to be used at retrieval time. Each statement containing a msgid directive shall be followed by a statement containing a msgstr directive or msgstr[n] directives.

The msgstr directive specifies the target string associated with the message_identifier string declared in the immediately preceding msgid directive.

The msgstr[n] (where n = 0, 1, 2, ...) directive specifies the target string to be used with plural form handling functions ngettext(), dngettext() and dcngettext(). Message strings can contain the following escape sequences:

**Table 15-1 Escape Sequences**

| \n | newline |
15 Commands and Utilities

<table>
<thead>
<tr>
<th>\t</th>
<th>tab</th>
</tr>
</thead>
<tbody>
<tr>
<td>\v</td>
<td>vertical tab</td>
</tr>
<tr>
<td>\b</td>
<td>backspace</td>
</tr>
<tr>
<td>\r</td>
<td>carriage return</td>
</tr>
<tr>
<td>\f</td>
<td>formfeed</td>
</tr>
<tr>
<td>&quot;</td>
<td>double quote</td>
</tr>
<tr>
<td>\ddd</td>
<td>octal bit pattern</td>
</tr>
<tr>
<td>\xHH</td>
<td>hexadecimal bit pattern</td>
</tr>
</tbody>
</table>

**Comment Handling**

Comments are introduced by a `#`, and continue to the end of the line. The second character (i.e. the character following the `#`) has special meaning. Regular comments should follow a space character. Other comment types include:

```
# normal-comments
#. automatic-comments
#: reference...
#, flag
```

Automatic and reference comments are typically generated by external utilities, and are not specified by the LSB. The `msgfmt` command shall ignore such comments.

**Note:** Portable object files may be produced by unspecified tools. Some of the comment types described here may arise from the use of such tools. It is beyond the scope of this specification to describe these tools.

The `#,` comments require one or more flags separated by the comma (`,`) character. The following flags can be specified:

**fuzzy**

This flag shows that the following `msgstr` string might not be a correct translation. Only the translator (i.e. the individual undertaking the translation) can judge if the translation requires further modification, or is acceptable as is. Once satisfied with the translation, the translator then removes this fuzzy flag.

If this flag is specified, the `msgfmt` utility will not generate the entry for the immediately following `msgid` in the output message catalog, unless the `--use-fuzzy` is specified.

**c-format**

The `c-format` flag indicates that the `msgid` string is used as format string by `printf()`-like functions. If the `c-format` flag is given for a string the `msgfmt` utility may perform additional tests to check the validity of the translation.

**Plurals**
The msgid entry with empty string ("") is called the header entry and is treated specially. If the message string for the header entry contains `nplurals=value`, the value indicates the number of plural forms. For example, if `nplurals=4`, there are 4 plural forms. If `nplurals` is defined, there should be a `plural=expression` on the same line, separated by a semicolon (;) character. The expression is a C language expression to determine which version of `msgstr[n]` to be used based on the value of `n`, the last argument of `ngettext()`, `dngettext()` or `dcngettext()`. For example:

```
nplurals=2; plural=n == 1 ? 0 : 1
```

indicates that there are 2 plural forms in the language; `msgstr[0]` is used if `n == 1`, otherwise `msgstr[1]` is used. Another example:

```
nplurals=3; plural=n==1 ? 0 : n==2 ? 1 : 2
```

indicates that there are 3 plural forms in the language; `msgstr[0]` is used if `n == 1`, `msgstr[1]` is used if `n == 2`, otherwise `msgstr[2]` is used.

If the header entry contains `charset=codeset string`, the `codeset` is used to indicate the codeset to be used to encode the message strings. If the output string’s codeset is different from the message string’s codeset, codeset conversion from the message strings’s codeset to the output string’s codeset will be performed upon the call of `gettext()`, `dgettext()`, `dcgettext()`, `ngettext()`, `dngettext()`, and `dcngettext()`. The output string’s codeset is determined by the current locale’s codeset (the return value of `nl_langinfo(CODESET)`) by default, and can be changed by the call of `bind_textdomain_codeset()`.

**Exit Status**

The following exit values are returned:

0

Successful completion.

>0

An error occurred.

**Application Usage**

Neither `msgfmt` nor any `gettext()` function imposes a limit on the total length of a message. Installing message catalogs under the C locale is pointless, since they are ignored for the sake of efficiency.

**Examples**

Example 1: Examples of creating message objects from message files.

In this example `module1.po`, `module2.po` and `module3.po` are portable message object files.

```
example% cat module1.po

# default domain "messages"

msgid "message one"

msgid "mensaje número uno"
```
#
domain "help_domain"
msgid "help two"
msgstr "ayuda número dos"
#
domain "error_domain"
msgid "error three"
msgstr "error número tres"

eexample% cat module2.po
# default domain "messages"
msgid "message four"
msgstr "mensaje número cuatro"
#
domain "error_domain"
msgid "error five"
msgstr "error número cinco"
#
domain "window_domain"
msgid "window six"
msgstr "ventana número seises"

eexample% cat module3.po
# default domain "messages"
msgid "message seven"
msgstr "mensaje número siete"
The following command will produce the output files `messages`, `help_domain`, and `error_domain`.

```bash
example% msgfmt module1.po
```

The following command will produce the output files `messages.mo`, `help_domain.mo`, `error_domain.mo`, and `window_domain.mo`.

```bash
example% msgfmt module1.po module2.po
```

The following example will produce the output file `hello.mo`.

```bash
example% msgfmt -o hello.mo module3.po
```

### newgrp

**Name**

`newgrp` — change group ID

**Synopsis**

```
newgrp [group]
```

**Description**

The `newgrp` command is as specified in ISO POSIX (2003), but with differences as listed below.

**Differences**

The `-l` option specified in ISO POSIX (2003) need not be supported.
od

Name
od — dump files in octal and other formats

Synopsis

Description
The od command shall provide all of the mandatory functionality specified in ISO POSIX (2003), but with extensions and differences to the XSI optional behavior as listed below.

Extensions and Differences
-s
unspecified behavior.

Note: Applications wishing to achieve the ISO POSIX (2003) behavior for -s should instead use -t d2.

-w width, --width=width
each output line is limited to width bytes from the input.

--traditional
accepts arguments in traditional form, see Traditional Usage below.

Note: The XSI optional behavior for offset handling described in ISO POSIX (2003) is not supported unless the --traditional option is also specified.

Pre-POSIX and XSI Specifications
The LSB supports mixing options between the mandatory and XSI optional synopsis forms in ISO POSIX (2003). The LSB shall support the following options:

-a
is equivalent to -t a, selects named characters.

-b
is equivalent to -t o1, selects octal bytes.

-c
is equivalent to -t c, selects characters.

-d
is equivalent to -t u2, selects unsigned decimal two byte units.

-f
is equivalent to -t fF, selects floats.
-i

is equivalent to -t d2, selects decimal two byte units.

Note: This usage may change in future releases; portable applications should use -t d2.

-l

is equivalent to -t d4, selects decimal longs.

-o

is equivalent to -t o2, selects octal two byte units.

-x

is equivalent to -t x2, selects hexadecimal two byte units.

Note that the XSI option -s need not be supported.

Traditional Usage
If the --traditional option is specified, there may be between zero and three operands specified.

If no operands are specified, then od shall read the standard input.

If there is exactly one operand, and it is an offset of the form [+]+offset[.][b], then it shall be interpreted as specified in ISO POSIX (2003). The file to be dumped shall be the standard input.

If there are exactly two operands, and they are both of the form [+]+offset[.][b], then the first shall be treated as an offset (as above), and the second shall be a label, in the same format as the offset. If a label is specified, then the first output line produced for each input block shall be preceded by the input offset, cumulative across input files, of the next byte to be written, followed by the label, in parentheses. The label shall increment in the same manner as the offset.

If there are three operands, then the first shall be the file to dump, the second the offset, and the third the label.

Note: Recent versions of coreutils contain an od utility that conforms to ISO POSIX (2003). However, in April 2005, this version was not in widespread use. A future version of this specification may remove the differences.
**passwd**

**Name**

`passwd` — change user password

**Synopsis**

```
passwd [-x max] [-n min] [-w warn] [-i inact] name passwd {-l | -u} name
```

**Description**

`passwd` changes authentication information for user and group accounts, including passwords and password expiry details, and may be used to enable and disable accounts. Only a user with appropriate privilege may change the password for other users or modify the expiry information.

**Options**

-x max
   sets the maximum number of days a password remains valid.

-n min
   sets the minimum number of days before a password may be changed.

-w warn
   sets the number of days warning the user will receive before their password will expire.

-i inactive
   disables an account after the password has been expired for the given number of days.

-l
   disables an account by changing the password to a value which matches no possible encrypted value.

-u
   re-enables an account by changing the password back to its previous value.
patch

Name
patch — apply a diff file to an original

Description
patch is as specified in ISO POSIX (2003), but with extensions as listed below.

Extensions
--binary
   reads and write all files in binary mode, except for standard output and /dev/tty. This option has no effect on POSIX-compliant systems.

-u, --unified
   interprets the patch file as a unified context diff.

pidof

Name
pidof — find the process ID of a running program

Synopsis
pidof [-s] [-x] [-o omitpid...] program...

Description
Return the process ID of a process which is running the program named on the command line.

The pidof command is a system administration utility, see Path For System Administration Utilities.

Options
-s
   instructs the program to only return one pid.

-x
   causes the program to also return process id's of shells running the named scripts.

-o
   omits processes with specified process id.
remove_initd

Name
remove_initd — clean up init script system modifications introduced by install_initd

Synopsis
/usr/lib/lsb/remove_initd initd_file

Description
remove_initd processes the removal of the modifications made to a distribution's init script system by the install_initd program. This cleanup is performed in the preuninstall script of a package; however, the package manager is still responsible for removing the script from the repository. See also Installation and Removal of Init Scripts.

renice

Name
renice — alter priority of running processes

Description
renice is as specified in ISO POSIX (2003), but with differences as listed below.

Differences
-n increment
  has unspecified behavior.

sed

Name
sed — stream editor

Description
sed is as specified in ISO POSIX (2003), but with differences as listed below.

LSB Differences
Certain aspects of internationalized regular expressions are optional; see Internationalization and Regular Expressions.
sendmail

Name
sendmail — an electronic mail transport agent

Synopsis
/usr/sbin/sendmail [options] [address...]

Description
To deliver electronic mail (email), applications shall support the interface provided by sendmail (described here). This interface shall be the default delivery method for applications.

This program sends an email message to one or more recipients, routing the message as necessary. This program is not intended as a user interface routine.

With no options, sendmail reads its standard input up to an end-of-file or a line consisting only of a single dot and sends a copy of the message found there to all of the addresses listed. It determines the network(s) to use based on the syntax and contents of the addresses.

If an address is preceded by a backslash, '\', it is unspecified if the address is subject to local alias expansion.

The format of messages shall be as defined in RFC 2822:Internet Message Format.

Options

\-bm

read mail from standard input and deliver it to the recipient addresses. This is the default mode of operation.

\-bp

If the user has sufficient privilege, list information about messages currently in the mail queue.

\-bs

use the SMTP protocol as described in RFC 2821:Simple Mail Transfer Protocol; read SMTP commands on standard input and write SMTP responses on standard output.

In this mode, sendmail shall accept \r\n (CR-LF), as required by RFC 2821:Simple Mail Transfer Protocol, and \n (LF) line terminators.

\-F fullname

explicitly set the full name of the sender for incoming mail unless the message already contains a From: message header.

If the user running sendmail is not sufficiently trusted, then the actual sender may be indicated in the message, depending on the configuration of the agent.

\-f name

explicitly set the envelope sender address for incoming mail. If there is no From: header, the address specified in the From: header will also be set.
If the user running sendmail is not sufficiently trusted, then the actual sender shall be indicated in the message.

-i
ignore dots alone on lines by themselves in incoming messages. If this options is not specified, a line consisting of a single dot shall terminate the input. If -bs is also used, the behavior is unspecified.

-odb
deliver any mail in background, if supported; otherwise ignored.

-odf
deliver any mail in foreground, if supported; otherwise ignored.

-oem or -em
mail errors back to the sender. (default)

-oep or -ep
write errors to the standard error output.

-oeq or -eq
do not send notification of errors to the sender. This only works for mail delivered locally.

-oi
is equivalent to -i.

-om
indicate that the sender of a message should receive a copy of the message if the sender appears in an alias expansion. Ignored if aliases are not supported.

-t
read the message to obtain recipients from the To:, Cc:, and Bcc: headers in the message instead of from the command arguments. If a Bcc: header is present, it is removed from the message unless there is no To: or Cc: header, in which case a Bcc: header with no data is created, in accordance with RFC 2822:Internet Message Format.

If there are any operands, the recipients list is unspecified.

This option may be ignored when not in -bm mode (the default).

**Note:** It is recommended that applications use as few options as necessary, none if possible.

**Exit status**

0
successful completion on all addresses. This does not indicate successful delivery.

>0
there was an error.

Notes/Rationale

The sendmail command specified here is intended to reflect functionality provided by smail, exim and other implementations, not just the sendmail implementation.

sh

Name

sh — shell, the standard command language interpreter

Description

The sh utility shall behave as specified in ISO POSIX (2003), but with extensions listed below.

Shell Invocation

The shell shall support an additional option, -l (the letter ell). If the -l option is specified, or if the first character of argument zero (the command name) is a '-', this invocation of the shell is a login shell.

An interactive shell, as specified in ISO POSIX (2003), that is also a login shell, or any shell if invoked with the -l option, shall, prior to reading from the input file, first read and execute commands from the file /etc/profile, if that file exists, and then from a file called ~/.profile, if such a file exists.
shUTDOWN

Name
shutdown — shut the system down

Synopsis
/sbin/shutdown [-t sec] [-h | -r] [-akF] time [warning-message]
/sbin/shutdown -c [warning-message]

Description
The shutdown command shall shut the system down in a secure way (first
synopsis), or cancel a pending shutdown (second synopsis). When the shutdown is
initiated, all logged-in users shall be notified immediately that the system is going
down, and users shall be prevented from logging in to the system. The time
specifies when the actual shutdown shall commence. See below for details. At the
specified time all processes are first notified that the system is going down by the
signal SIGTERM. After an interval (see -t) all processes shall be sent the signal
SIGKILL. If neither the -h or the -r argument is specified, then the default behavior
shall be to take the system to a runlevel where administrative tasks can be run. See
also Run Levels.

Note: This is sometimes referred to as "single user mode".

The -h and -r options are mutually exclusive. If either the -h or -r options are
specified, the system shall be halted or rebooted respectively.

Standard Options

-a
use access control. See below.

-t sec
tell the system to wait sec seconds between sending processes the warning and
the kill signal, before changing to another runlevel. The default period is
unspecified.

-k
do not really shutdown; only send the warning messages to everybody.

-r
reboot after shutdown.

-h
halt after shutdown. Actions after halting are unspecified (e.g. power off).

-f
advise the system to skip file system consistency checks on reboot.

-F
advise the system to force file system consistency checks on reboot.
-c
cancel an already running shutdown.

time
specify when to shut down.
The time argument shall have the following format: [now | [+|]mins | hh:mm] If the format is hh:mm, hh shall specify the hour (1 or 2 digits) and mm is the minute of the hour (exactly two digits), and the shutdown shall commence at the next occurrence of the specified time. If the format is mins (or +mins), where mins is a decimal number, shutdown shall commence in the specified number of minutes. The word now is an alias for +0.

warning-message
specify a message to send to all users.

Access Control
If the shutdown utility is invoked with the -a option, it shall check that an authorized user is currently logged in on the system console. Authorized users are listed, one per line, in the file /etc/shutdown.allow. Lines in this file that begin with a '#' or are blank shall be ignored.

Note: The intent of this scheme is to allow a keyboard sequence entered on the system console (e.g., CTRL-ALT-DEL, or STOP-A) to automatically invoke shutdown -a, and can be used to prevent unauthorized users from shutting the system down in this fashion.
su

Name

su – change user ID or become super-user

Synopsis

su [options] [-] [username [ARGS]]

Description

su is used to become another user during a login session. Invoked without a username, su defaults to becoming the super user. The optional argument - may be used to provide an environment similar to what the user would expect had the user logged in directly.

The user will be prompted for a password, if appropriate. Invalid passwords will produce an error message. All attempts, both valid and invalid, are logged to detect abuses of the system. Applications may not assume the format of prompts and anticipated input for user interaction, because they are unspecified.

An optional command can be executed. This is done by the shell specified in /etc/passwd for the target user unless the -s or -m options are used. Any arguments supplied after the username will be passed to the invoked shell (shell shall support the -c command line option in order for a command to be passed to it).

The current environment is passed to the new shell. The value of PATH is reset to /bin:/usr/bin for unprivileged users, or /sbin:/bin:/usr/sbin:/usr/bin for users with appropriate privilege. This may be changed with the ENV_PATH and ENV_SUPATH definitions in /etc/login.defs. When using the -m or -p options, the user’s environment is not changed.

A subsystem login is indicated by the presence of a "*" as the first character of the login shell. If this character is present, it shall be removed, and the remaining path (or /bin/sh if the remaining path is empty) shall be executed after changing the root directory to the directory specified as the home directory.

Standard Options

-  

makes this a login shell.

-c, --command=command

passes command to the invoked shell. It is passed directly to the invoked shell (using the shell’s -c option), so its syntax is whatever that shell can accept.

-m, -p, --preserve-environment

does not reset environment variables, and keeps the same shell if it is present in /etc/shells.

-s, --shell=shell

uses shell instead of the default in /etc/passwd. The shell specified shall be present in /etc/shells.
sync

Name
sync – flush file system buffers

Synopsis
sync

Description
Force changed blocks to disk, update the super block.

tar

Name
tar – file archiver

Description
tar is as specified in SUSv2, but with differences as listed below.

Differences
Some elements of the Pattern Matching Notation are optional; see Internationalization and Pattern Matching Notation.

-h
  doesn't dump symlinks; dumps the files they point to.

-z
  filters the archive through gzip.
umount

Name
umount — umount file systems

Synopsis
umount [-hV]umount -a [-nr] [-t vfstype]umount [-nr] device | dir

Description
umount detaches the file system(s) mentioned from the file hierarchy. A file system is specified by giving the directory where it has been mounted.

Standard Options
-v
invokes verbose mode.
-n
umounts without writing in /etc/mtab.
-r
tries to remount read-only if unmounting fails.
-a
umounts all of the file systems described in /etc/mtab except for the proc file system.
-t vfstype
indicates that the actions should only be taken on file systems of the specified type. More than one type may be specified in a comma separated list. The list of file system types can be prefixed with no to specify the file system types on which no action should be taken.
-f
forces umount (in case of an unreachable NFS system).

LSB Deprecated Options
The behaviors specified in this section are expected to disappear from a future version of the LSB; applications should only use the non-LSB-deprecated behaviors.
-V
print version and exits.
useradd

Name
useradd – create a new user or update default new user information

Synopsis
useradd [-c comment] [-d home_dir] [-g initial_group] [-G group...] [-m [-k skeleton_dir]] [-p passwd] [-r] [-s shell] [-u uid [-o]] login useradd -D [-g default_group] [-b default_home] [-s default_shell]

Description
When invoked without the -D option, and with appropriate privilege, useradd creates a new user account using the values specified on the command line and the default values from the system. The new user account will be entered into the system files as needed, the home directory will be created, and initial files copied, depending on the command line options.

When invoked with the -D option, useradd will either display the current default values, or, with appropriate privilege, update the default values from the command line. If no options are specified, useradd displays the current default values.

The useradd command is a system administration utility, see Path For System Administration Utilities.

Standard Options
-c comment
    specifies the new user’s password file comment field value.

-d home_dir
    creates the new user using home_dir as the value for the user’s login directory. The default is to append the login name to default_home and use that as the login directory name.

-g initial_group
    specifies the group name or number of the user’s initial login group. The group name shall exist. A group number shall refer to an already existing group. If -g is not specified, the implementation will follow the normal user default for that system. This may create a new group or choose a default group that normal users are placed in. Applications which require control of the groups into which a user is placed should specify -g.

-G group[,...]
    specifies a list of supplementary groups which the user is also a member of. Each group is separated from the next by a comma, with no intervening whitespace. The groups are subject to the same restrictions as the group given with the -g option. The default is for the user to belong only to the initial group.

-m [-k skeleton_dir]
specifies the user's home directory will be created if it does not exist. The files contained in skeleton_dir will be copied to the home directory if the \texttt{-k} option is used, otherwise the files contained in \texttt{/etc/skel} will be used instead. Any directories contained in \texttt{skeleton_dir} or \texttt{/etc/skel} will be created in the user's home directory as well. The \texttt{-k} option is only valid in conjunction with the \texttt{-m} option. The default is to not create the directory and to not copy any files.

\texttt{-p passwd}

is the encrypted password, as returned by \texttt{crypt()}. The default is to disable the account.

\texttt{-r}

creates a system account, that is, a user with a User ID in the range reserved for system account users. If there is not a User ID free in the reserved range the command will fail.

\texttt{-s shell}

specifies the name of the user's login shell. The default is to leave this field blank, which causes the system to select the default login shell.

\texttt{-u uid [-o]}

specifies the numerical value of the user's ID. This value shall be unique, unless the \texttt{-o} option is used. The value shall be non-negative. The default is the smallest ID value greater than 499 which is not yet used.

\textbf{Change Default Options}

\texttt{-b default_home}

specifies the initial path prefix for a new user's home directory. The user's name will be affixed to the end of default_home to create the new directory name if the \texttt{-d} option is not used when creating a new account.

\texttt{-g default_group}

specifies the group name or ID for a new user's initial group. The named group shall exist, and a numerical group ID shall have an existing entry.

\texttt{-s default_shell}

specifies the name of the new user's login shell. The named program will be used for all future new user accounts.

\texttt{-c comment}

specifies the new user's password file comment field value.

\textbf{Application Usage}

The \texttt{-o} option will typically be used by system administration packages. Most applications should not change defaults which will affect other applications and users.
userdel

Name
userdel — delete a user account and related files

Synopsis
userdel [-r] login

Description
Delete the user account named login. If there is also a group named login, this
command may delete the group as well, or may leave it alone.

The userdel command is a system administration utility, see Path For System
Administration Utilities.

Options

-r

removes files in the user's home directory along with the home directory itself.
Files located in other file system will have to be searched for and deleted
manually.
usermod

**Name**
usermod — modify a user account

**Synopsis**
usermod [-c comment] [-d home_dir [-m]] [-g initial_group] [-G group [,...]] [-l login_name] [-p passwd] [-s shell] [-u uid [-o]] login

**Description**
The usermod command shall modify an entry in the user account database.

The usermod command is a system administration utility, see Path For System Administration Utilities.

**Options**
- **-c comment**
  specifies the new value of the user's password file comment field.
- **-d home_dir**
  specifies the user's new login directory. If the -m option is given the contents of the current home directory will be moved to the new home directory, which is created if it does not already exist.
- **-g initial_group**
  specifies the group name or number of the user's new initial login group. The group name shall exist. A group number shall refer to an already existing group.
- **-G group[,...]**
  specifies a list of supplementary groups which the user is also a member of. Each group is separated from the next by a comma, with no intervening whitespace. The groups are subject to the same restrictions as the group given with the -g option. If the user is currently a member of a group which is not listed, the user will be removed from the group.
- **-l login_name**
  changes the name of the user from login to login_name. Nothing else is changed. In particular, the user's home directory name should probably be changed to reflect the new login name.
- **-p passwd**
  is the encrypted password, as returned by crypt(3).
- **-s shell**
  specifies the name of the user's new login shell. Setting this field to blank causes the system to select the default login shell.
- **-u uid [-o]**
specifies the numerical value of the user's ID. This value shall be unique, unless the -o option is used. The value shall be non-negative. Any files which the user owns and which are located in the directory tree rooted at the user's home directory will have the file user ID changed automatically. Files outside of the user's home directory shall be altered manually.

xargs

Name
xargs — build and execute command lines from standard input

Description
xargs is as specified in ISO POSIX (2003), but with differences as listed below.

Differences
-E
has unspecified behavior.

-I
has unspecified behavior.

-L
has unspecified behavior.

Note: These options have been implemented in findutils-4.2.9, but this version of the utilities is not in widespread use as of April 2005. However, future versions of this specification will require support for these arguments.
16 File System Hierarchy

An LSB conforming implementation shall provide the mandatory portions of the
file system hierarchy specified in the Filesystem Hierarchy Standard (FHS), together
with any additional requirements made in this specification.

An LSB conforming application shall conform to the Filesystem Hierarchy
Standard.

The FHS allows many components or subsystems to be optional. An application
shall check for the existence of an optional component before using it, and should
behave in a reasonable manner if the optional component is not present.

The FHS requirement to locate the operating system kernel in either / or /boot
does not apply if the operating system kernel does not exist as a file in the file
system.

The FHS specifies certain behaviors for a variety of commands if they are present
(for example, ping or python). However, LSB conforming applications shall not
rely on any commands beyond those specified by the LSB. The mere existence of a
command may not be used as an indication that the command behaves in any
particular way.

The following directories or links need not be present: /etc/X11 /usr/bin/X11
/usr/lib/X11 /proc

16.1 /dev: Device Files

The following shall exist under /dev. Other devices may also exist in /dev. Device
names may exist as symbolic links to other device nodes located in /dev or
subdirectories of /dev. There is no requirement concerning major/minor number
values.

/dev/null

An infinite data source and data sink. Data written to this device shall be
discarded. Reads from this device shall always return end-of-file (EOF).

/dev/zero

This device is a source of zeroed out data. All data written to this device shall
be discarded. A read from this device shall always return the requested
number of bytes, each initialized to the value '\0'.

/dev/tty

In each process, a synonym for the controlling terminal associated with the
process group of that process, if any. All reads and writes to this device shall
behave as if the actual controlling terminal device had been opened.

16.2 /etc: Host-specific system configuration

In addition to the requirements for /etc in the Filesystem Hierarchy Standard, an
LSB conforming system shall also provide the following directories or symbolic
links to directories:

/etc/cron.d

A directory containing extended crontab files; see Cron Jobs.
/etc/cron.daily
A directory containing shell scripts to be executed once a day; see Cron Jobs.

/etc/cron.hourly
A directory containing shell scripts to be executed once per hour; see Cron Jobs.

/etc/cron.monthly
A directory containing shell scripts to be executed once per month; see Cron Jobs.

/etc/cron.weekly
A directory containing shell scripts to be executed once a week; see Cron Jobs.

/etc/init.d
A directory containing system initialization scripts; see Installation and Removal of Init Scripts.

/etc/profile.d
A directory containing shell scripts. Script names should follow the same conventions as specified for cron jobs (see Cron Jobs, but should have the suffix .sh. The behavior is unspecified if a script is installed in this directory that does not have the suffix .sh.

The sh utility shall read and execute commands in its current execution environment from all the shell scripts in this directory that have the suffix .sh when invoked as an interactive login shell, or if the -l (the letter ell) is specified (see Shell Invocation).

Future Directions: These directories are required at this version of the LSB since there is not yet an agreed method for abstracting the implementation so that applications need not be aware of these locations during installation. However, Future Directions describes a tool, lsbinstall, that will make these directories implementation specific and no longer required.

16.2.1 File Naming Conventions
Applications installing files into any of the above locations under /etc may only use filenames from the following managed namespaces:

- Assigned names. Such names must be chosen from the character set [a-z0-9]. In order to avoid conflicts these names shall be reserved through the Linux Assigned Names and Numbers Authority (LANANA). Information about the LANANA may be found at www.lanana.org (http://www.lanana.org).

  Note: Commonly used names should be reserved in advance; developers for projects are encouraged to reserve names from LANANA, so that each distribution can use the same name, and to avoid conflicts with other projects.

- Hierarchical names. Script names in this category take the form: <hier1>-<hier2>-...-<name>, where name is taken from the character set [a-z0-9], and where there may be one or more <hier-n> components. <hier1> may either be an LSB provider name assigned by the LANANA, or it may be owners' DNS name in lower case, with at least one '.' e.g. "debian.org"
"staroffice.sun.com", etc. The LSB provider name assigned by LANANA shall only consist of the ASCII characters [a-z0-9].

- Reserved names. Names that begin with the character '_' are reserved for distribution use only. These names should be used for essential system packages only.

**Note:** In general, if a package or some system function is likely to be used on multiple systems, the package developers or the distribution should get a registered name through LANANA, and distributions should strive to use the same name whenever possible. For applications which may not be essential or may not be commonly installed, the hierarchical namespace may be more appropriate. An advantage to the hierarchical namespace is that there is no need to consult with the LANANA before obtaining an assigned name.

Short names are highly desirable, since system administrators may need to manually start and stop services. Given this, they should be standardized on a per-package basis. This is the rationale behind having the LANANA organization assign these names. The LANANA may be called upon to handle other namespace issues, such as package/prerequisites naming.

### 16.3 User Accounting Databases

The Filesystem Hierarchy Standard specifies two optional locations for user accounting databases used by the `getutent()`, `getutent_r()`, `getutxent()`, `getutxid()`, `getutxline()`, and `pututxline()` functions. These are `/var/run/utmp` and `/var/run/wtmp`.

The LSB does not specify the format or structure of these files, or even if they are files at all. They should be used only as "magic cookies" to the `utmpname()` function.

### 16.4 Path For System Administration Utilities

Certain utilities used for system administration (and other privileged commands) may be stored in `/sbin`, `/usr/sbin`, and `/usr/local/sbin`. Applications requiring to use commands identified as system administration utilities should add these directories to their PATH. By default, as described in ISO POSIX (2003), standard utilities shall be found on the PATH returned by `getconf PATH` (or `command -p getconf PATH`) to be guaranteed to invoke the correct version of `getconf`.
17 Additional Recommendations

17.1 Recommendations for applications on ownership and permissions

17.1.1 Directory Write Permissions

The application should not depend on having directory write permission in any directory except /tmp, /var/tmp, and the invoking user's home directory.

In addition, the application may store variable data in /var/opt/package, (where package is the name of the application package), if such a directory is created with appropriate permissions during the package installation.

For these directories the application should be able to work with directory write permissions restricted by the S_ISVTXT bit, implementing the restricted deletion mode as described for the XSI option for ISO POSIX (2003).

17.1.2 File Write Permissions

The application should not depend on file write permission to any file that it does not itself create.

17.1.3 File Read and execute Permissions

The application should not depend on having read permission to every file and directory.

17.1.4 SUID and SGID Permissions

The application should not depend on the set user ID or set group ID (the S_ISUID or S_ISGID permission bits) permissions of a file not packaged with the application.

Instead, the distribution is responsible for assuming that all system commands have the required permissions and work correctly.

Rationale: In order to implement common security policies it is strongly advisable for applications to use the minimum set of security attributes necessary for correct operation. Applications that require substantial appropriate privilege are likely to cause problems with such security policies.

17.1.5 Privileged users

In general, applications should not depend on running as a privileged user. This specification uses the term "appropriate privilege" throughout to identify operations that cannot be achieved without some special granting of additional privilege.

Applications that have a reason to run with appropriate privilege should outline this reason clearly in their documentation. Users of the application should be informed, that "this application demands security privileges, which could interfere with system security".

The application should not contain binary-only software that requires being run with appropriate privilege, as this makes security auditing harder or even impossible.
17.1.6 Changing permissions

The application shall not change permissions of files and directories that do not belong to its own package. Should an application require that certain files and directories not directly belonging to the package have a particular ownership, the application shall document this requirement, and may fail during installation if the permissions on these files is inappropriate.

17.1.7 Removable Media (Cdrom, Floppy, etc.)

Applications that expect to be runnable from removable media should not depend on logging in as a privileged user, and should be prepared to deal with a restrictive environment. Examples of such restrictions could be default mount options that disable set-user/group-ID attributes, disabling block or character-special files on the medium, or remapping the user and group IDs of files away from any privileged value.

**Rationale:** System vendors and local system administrators want to run applications from removable media, but want the possibility to control what the application can do.

17.1.8 Installable applications

Where the installation of an application needs additional privileges, it must clearly document all files and system databases that are modified outside of those in `/opt/pkg-name` and `/var/opt/pkg-name`, other than those that may be updated by system logging or auditing activities.

Without this, the local system administrator would have to blindly trust a piece of software, particularly with respect to its security.
18 Additional Behaviors

18.1 Mandatory Optional Behaviors

This section specifies behaviors in which there is optional behavior in one of the standards on which the LSB relies, and where the LSB requires a specific behavior.

**Note:** The LSB does not require the kernel to be Linux; the set of mandated options reflects current existing practice, but may be modified in future releases.

LSB conforming implementations shall support the following options defined within the *ISO POSIX (2003)*:

- `_POSIX_FSYNC`
- `_POSIX_MAPPED_FILES`
- `_POSIX_MEMLOCK`
- `_POSIX_MEMLOCK_RANGE`
- `_POSIX_MEMORY_PROTECTION`
- `_POSIX_PRIORITY_SCHEDULING`
- `_POSIX_REALTIME_SIGNALS`
- `_POSIX_THREAD_ATTR_STACKADDR`
- `_POSIX_THREAD_ATTR_STACKSIZE`
- `_POSIX_THREAD_PROCESS_SHARED`
- `_POSIX_THREAD_SAFE_FUNCTIONS`
- `_POSIX_THREADS`

The `opendir()` function shall consume a file descriptor in the same fashion as `open()`, and therefore may fail with `EMFILE` or `ENFILE`.

The `START` and `STOP` `termios` characters shall be changeable, as described as optional behavior in the "General Terminal Interface" section of the *ISO POSIX (2003)*.

The `access()` function shall fail with `errno` set to `EINVAL` if the `amode` argument contains bits other than those set by the bitwise inclusive OR of `R_OK`, `W_OK`, `X_OK` and `F_OK`.

The `link()` function shall require access to the existing file in order to succeed, as described as optional behavior in the *ISO POSIX (2003)*.

Calling `unlink()` on a directory shall fail. Calling `link()` specifying a directory as the first argument shall fail. See also `unlink`.

**Note:** Linux allows `rename()` on a directory without having write access, but the LSB does not require this.

18.1.1 Special Requirements

LSB conforming systems shall enforce certain special additional restrictions above and beyond those required by *ISO POSIX (2003)*.

**Note:** These additional restrictions are required in order to support the testing and certification programs associated with the LSB. In each case, these are values that defined macros must not have; conforming applications that use these values shall trigger a failure in the interface that is otherwise described as a "may fail".

The `fcntl()` function shall treat the "cmd" value -1 as invalid.
The `whence` value -1 shall be an invalid value for the `lseek()`, `fseek()` and `fcntl()` functions.

The value -5 shall be an invalid signal number.

If the `sigaddset()` or `sigdelset()` functions are passed an invalid signal number, they shall return with EINVAL. Implementations are only required to enforce this requirement for signal numbers which are specified to be invalid by this specification (such as the -5 mentioned above).

The mode value -1 to the `access()` function shall be treated as invalid.

A value of -1 shall be an invalid "_PC_..." value for `pathconf()`.

A value of -1 shall be an invalid "_SC_..." value for `sysconf()`.

The `nl_item` value -1 shall be invalid for `nl_langinfo()`.

The value -1 shall be an invalid "_CS_..." value for `confstr()`.

The value "a" shall be an invalid mode argument to `popen()`.
19 Localization

19.1 Introduction

In order to install a message catalog, the installation procedure shall supply the message catalog in a format readable by the msgfmt utility, which shall be invoked to compile the message catalog into an appropriate binary format on the target system.

**Rationale:** The original intent was to allow an application to contain the binary GNU MO format files. However, the format of these files is not officially stable, hence it is necessary to compile these catalogs on the target system. These binary catalogs may differ from architecture to architecture as well.

The resulting binary message catalog shall be located in the package’s private area under /opt, and the application may use bindtextdomain() to specify this location.

Implementations shall support the POSIX and C locales as specified in ISO POSIX (2003). Implementations may define additional locale categories not defined by that standard.

**Note:** Implementations choosing additional locale categories should be aware of ISO/IEC TR14652 and are advised not to choose names that conflict with that specification. If implementations provide locale categories whose names are part of the FDCC set of ISO/IEC TR14652, they should behave as defined by that specification.

19.2 Regular Expressions

Utilities that process regular expressions shall support Basic Regular Expressions and Extended Regular Expressions as specified in ISO POSIX (2003), with the following exceptions:

Range expression (such as [a-z]) can be based on code point order instead of collating element order.

Equivalence class expression (such as [=a=]) and multi-character collating element expression (such as [.ch.]) are optional.

Handling of a multi-character collating element is optional.

This affects at least the following utilities:

- awk (see awk)
- grep (see grep) (including egrep, see egrep)
- sed (see sed)

It also affects the behavior of interfaces in the base libraries, including at least

- regexec() (see regexec)

19.3 Pattern Matching Notation

Utilities that perform filename pattern matching (also known as Filename Globbing) shall do it as specified in ISO POSIX (2003), Pattern Matching Notation, with the following exceptions:

Pattern bracket expressions (such as [a-z]) can be based on code point order instead of collating element order.
Equivalence class expression (such as \([=a=]\)) and multi-character collating element expression (such as \([.\,\text{ch.}\)]\) are optional.

Handling of a multi-character collating element is optional.

This affects at least the following utilities: \texttt{cpio} (cpio), \texttt{find} (find) and \texttt{tar} (tar).
20 System Initialization

20.1 Cron Jobs

In addition to the individual user crontab files specified by ISO POSIX (2003) stored under /var/spool/cron, the process that executes scheduled commands shall also process the following additional crontab files: /etc/crontab, /etc/cron.d/*. The installation of a package shall not modify the configuration file /etc/crontab.

If a package wishes to install a job that has to be executed periodically, it shall place an executable cron script in one of the following directories:

/etc/cron.hourly
/etc/cron.daily
/etc/cron.weekly
/etc/cron.monthly

As these directory names suggest, the files within them are executed on a hourly, daily, weekly, or monthly basis, respectively, under the control of an entry in one of the system crontab files, at an unspecified time of day. See below for the rules concerning the names of cron scripts.

Note: It is recommended that cron scripts installed in any of these directories be script files rather than compiled binaries so that they may be modified by the local system administrator. Conforming applications may only install cron scripts which use an interpreter required by this specification or provided by this or another conforming application.

This specification does not define the concept of a package upgrade. Implementations may do different things when packages are upgraded, including not replacing a cron script if it marked as a configuration file, particularly if the cron script appears to have been modified since installation. In some circumstances, the cron script may not be removed when the package is uninstalled. Applications should design their installation procedure and cron scripts to be robust in the face of such behavior. In particular, cron scripts should not fail obscurely if run in unexpected circumstances. Testing for the existence of application binaries before executing them is suggested.

Future versions of this specification may remove the need to install file directly into these directories, and instead abstract the interface to the cron utility in such a way as to hide the implementation. Please see Future Directions.

If a certain task has to be executed at other than the predefined frequencies, the package shall install a file /etc/cron.d/cron-name. The file shall have the same format as that described for the crontab command in ISO POSIX (2003), except that there shall be an additional field, username, before the name of the command to execute. For completeness, the seven fields shall be:

1. Minute [0,59]
2. Hour [0,23]
3. Day of the month [1,31]
4. Month of the year [1,12]
5. Day of the week [0,6] (with 0=Sunday)
6. Username
7. command [args ...]
This file shall be processed by the system automatically, with the named command being run at the specified time, as the specified username.

Applications installing files in these directories shall use the LSB naming conventions (see File Naming Conventions).

## 20.2 Init Script Actions

Conforming applications which need to execute commands on changes to the system run level (including boot and shutdown), may install one or more *init scripts*. Init scripts provided by conforming applications shall accept a single argument which selects the action:

<table>
<thead>
<tr>
<th>Command</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>start</code></td>
<td>start the service</td>
</tr>
<tr>
<td><code>stop</code></td>
<td>stop the service</td>
</tr>
<tr>
<td><code>restart</code></td>
<td>stop and restart the service if the service is already running, otherwise start the service</td>
</tr>
<tr>
<td><code>try-restart</code></td>
<td>restart the service if the service is already running</td>
</tr>
<tr>
<td><code>reload</code></td>
<td>cause the configuration of the service to be reloaded without actually stopping and restarting the service</td>
</tr>
<tr>
<td><code>force-reload</code></td>
<td>cause the configuration to be reloaded if the service supports this, otherwise restart the service if it is running</td>
</tr>
<tr>
<td><code>status</code></td>
<td>print the current status of the service</td>
</tr>
</tbody>
</table>

The `start`, `stop`, `restart`, `force-reload`, and `status` actions shall be supported by all init scripts; the `reload` and the `try-restart` actions are optional. Other init-script actions may be defined by the init script.

Init scripts shall ensure that they will behave sensibly if invoked with `start` when the service is already running, or with `stop` when not running, and that they do not kill similarly-named user processes. The best way to achieve this is to use the init-script functions provided by `/lib/lsb/init-functions` (see Init Script Functions).

If a service reloads its configuration automatically (as in the case of cron, for example), the `reload` action of the init script shall behave as if the configuration was reloaded successfully. The `restart`, `try-restart`, `reload` and `force-reload` actions may be atomic; that is, if a service is known not to be operational after a restart or reload, the script may return an error without any further action.

**Note:** This specification does not define the concept of a package *upgrade*.

Implementations may do different things when packages are upgraded, including not replacing an init script if it is marked as a configuration file, particularly if the file appears to have been modified since installation. In some circumstances, the init script may not be removed when the package is uninstalled. Applications should design their installation procedure and init scripts to be robust in the face of such behavior. In particular, init scripts should not fail obscurely if run in unexpected circumstances. Testing for the existence of application binaries before executing them is suggested.

If the `status` action is requested, the init script will return the following exit status codes.

<table>
<thead>
<tr>
<th>Exit Status Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>program is running or service is OK</td>
</tr>
<tr>
<td>1</td>
<td>program is dead and <code>/var/run pid file exists</code></td>
</tr>
</tbody>
</table>
For all other init-script actions, the init script shall return an exit status of zero if the action was successful. Otherwise, the exit status shall be non-zero, as defined below. In addition to straightforward success, the following situations are also to be considered successful:

- restarting a service (instead of reloading it) with the **force-reload** argument
- running **start** on a service already running
- running **stop** on a service already stopped or not running
- running **restart** on a service already stopped or not running
- running **try-restart** on a service already stopped or not running

In case of an error while processing any init-script action except for **status**, the init script shall print an error message and exit with a non-zero status code:

1  generic or unspecified error (current practice)
2  invalid or excess argument(s)
3  unimplemented feature (for example, "reload")
4  user had insufficient privilege
5  program is not installed
6  program is not configured
7  program is not running
8-99 reserved for future LSB use
100-149 reserved for distribution use
150-199 reserved for application use
200-254 reserved

Error and status messages should be printed with the logging functions (see **Init Script Functions**) `log_success_msg()`, `log_failure_msg()` and `log_warning_msg()`. Scripts may write to standard error or standard output, but implementations need not present text written to standard error/output to the user or do anything else with it.

**Note:** Since init scripts may be run manually by a system administrator with non-standard environment variable values for **PATH**, **USER**, **LOGNAME**, etc., init scripts should not depend on the values of these environment variables. They should set them to some known/default values if they are needed.

### 20.3 Comment Conventions for Init Scripts

Conforming applications may install one or more init scripts. These init scripts must be activated by invoking the **install_initd** command. Prior to package removal, the changes applied by **install_initd** must be undone by invoking **remove_initd**. See Installation and Removal of Init Scripts for more details.
install_initd and remove_initd determine actions to take by decoding a specially formatted block of lines in the script. This block shall be delimited by the lines

### BEGIN INIT INFO
### END INIT INFO

The delimiter lines may contain trailing whitespace, which shall be ignored. All lines inside the block shall begin with a hash character '#' in the first column, so the shell interprets them as comment lines which do not affect operation of the script. The lines shall be of the form:

```bash
# {keyword}: arg1 [arg2...]
```

with exactly one space character between the '#' and the keyword, with a single exception. In lines following a line containing the `Description` keyword, and until the next keyword or block ending delimiter is seen, a line where the '#' is followed by more than one space or a tab character shall be treated as a continuation of the previous line.

The information extracted from the block is used by the installation tool or the init-script system to assure that init scripts are run in the correct order. It is unspecified whether the information is evaluated only when install_initd runs, when the init scripts are executed, or both. The information extracted includes run levels, defined in Run Levels, and boot facilities, defined in Facility Names.

The following keywords, with their arguments, are defined:

**Provides**: `boot_facility_1 [boot_facility_2...]`

Boot facilities provided by this init script. When an init script is run with a `start` argument, the boot facility or facilities specified by the `Provides` keyword shall be deemed present and hence init scripts which require those boot facilities should be started later. When an init script is run with a `stop` argument, the boot facilities specified by the `Provides` keyword are deemed no longer present.

**Required-Start**: `boot_facility_1 [boot_facility_2...]`

Facilities which must be available during startup of this service. The init-script system should insure init scripts which provide the `Required-Start` facilities are started before starting this script.

**Required-Stop**: `boot_facility_1 [boot_facility_2...]`

Facilities which must be available during the shutdown of this service. The init-script system should avoid stopping init scripts which provide the `Required-Stop` facilities until this script is stopped.

**Should-Start**: `boot_facility_1 [boot_facility_2...]`

Facilities which, if present, should be available during startup of this service. This allows for weak dependencies which do not cause the service to fail if a facility is not available. The service may provide reduced functionality in this situation. Conforming applications should not rely on the existence of this feature.

**Should-Stop**: `boot_facility_1 [boot_facility_2...]`

Facilities which should be available during shutdown of this service.
**Default-Start:** run_level_1 [run_level_2...]
**Default-Stop:** run_level_1 [run_level_2...]

which run levels should by default run the init script with a start (stop) argument to start (stop) the services controlled by the init script.

For example, if a service should run in runlevels 3, 4, and 5 only, specify "Default-Start: 3 4 5" and "Default-Stop: 0 1 2 6".

**Short-Description:** short_description

provide a brief description of the actions of the init script. Limited to a single line of text.

**Description:** multiline_description

provide a more complete description of the actions of the init script. May span multiple lines. In a multiline description, each continuation line shall begin with a '#' followed by tab character or a '#' followed by at least two space characters. The multiline description is terminated by the first line that does not match this criteria.

Additional keywords may be defined in future versions of this specification. Also, implementations may define local extensions by using the prefix `X-implementor`. For example, `X-RedHat-foobardecl`, or `X-Debian-xyzzydecl`.

Example:

```bash
### BEGIN INIT INFO
# Provides: lsb-ourdb
# Required-Start: $local_fs $network $remote_fs
# Required-Stop: $local_fs $network $remote_fs
# Default-Start:  2 3 4 5
# Default-Stop: 0 1 6
# Short-Description: start and stop OurDB
# Description: OurDB is a very fast and reliable database
#               engine used for illustrating init scripts
### END INIT INFO
```

The comment conventions described in this section are only required for init scripts installed by conforming applications. Conforming runtime implementations are not required to use this scheme in their system provided init scripts.

**Note:** This specification does not require, but is designed to allow, the development of a system which runs init scripts in parallel. Hence, enforced-serialization of scripts is avoided unless it is explicitly necessary.

### 20.4 Installation and Removal of Init Scripts

Conforming applications may install one or more initialization scripts (or *init scripts*). An init script shall be installed in `/etc/init.d` (which may be a symbolic link to another location), by the package installer.

**Note:** The requirement to install scripts in `/etc/init.d` may be removed in future versions of this specification. See Host-specific system configuration and Future Directions for further details.

During the installer's post-install processing phase the program `/usr/lib/lsb/install_initd` must be called to activate the init script. Activation consists of arranging for the init script to be called in the correct order on system
run-level changes (including system boot and shutdown), based on dependencies supplied in the init script (see Comment Conventions for Init Scripts). The `install_initd` command should be thought of as a wrapper which hides the implementation details; how any given implementation arranges for the init script to be called at the appropriate time is not specified.

Example: if an init script specified "Default-Start: 3 4 5" and "Default-Stop: 0 1 2 6", `install_initd` might create 'start' symbolic links with names starting with 'S' in `/etc/rc3.d`, `/etc/rc4.d` and `/etc/rc5.d` and 'stop' symbolic links with names starting with 'K' in `/etc/rc0.d`, `/etc/rc1.d`, `/etc/rc2.d` and `/etc/rc6.d`. Such a scheme would be similar to the System V Init mechanism, but is by no means the only way this specification could be implemented.

The `install_initd` command takes a single argument, the full pathname of the installed init script. The init script must already be installed in `/etc/init.d`. The `install_initd` command will not copy it there, only activate it once it has been installed. For example:

```
/usr/lib/lsb/install_initd /etc/init.d/example.com-coffee
```

The `install_initd` command shall return an exit status of zero if the init-script activation was successful or if the init script was already activated. If the dependencies in the init script (see Comment Conventions for Init Scripts) cannot be met, an exit status of one shall be returned and the init script shall not be activated.

When a software package is removed, `/usr/lib/lsb/remove_initd` must be called to deactivate the init script. This must occur before the init script itself is removed, as the dependency information in the script may be required for successful completion. Thus the installer's pre-remove processing phase must call `remove_initd`, and pass the full pathname of the installed init script. The package installer is still responsible for removing the init script. For example:

```
/usr/lib/lsb/remove_initd /etc/init.d/example.com-coffee
```

The `remove_initd` program shall return an exit status of zero if the init script has been successfully deactivated or if the init script is not activated. If another init script which depends on a boot facility provided by this init script is activated, an exit status of one shall be returned and the init script shall remain activated. The installer must fail on such an exit code so it does not subsequently remove the init script.

**Note:** This specification does not describe a mechanism for the system administrator to manipulate the run levels at which an init script is started or stopped. There is no assurance that modifying the comment block for this purpose will have the desired effect.

### 20.5 Run Levels

The following **run levels** are specified for use by the `Default-Start` and `Default-Stop` actions defined in Comment Conventions for Init Scripts as hints to the `install_initd` command. Conforming implementations are not required to provide these exact run levels or give them the meanings described here, and may map any level described here to a different level which provides the equivalent functionality. Applications may not depend on specific run-level numbers.

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td><strong>halt</strong></td>
</tr>
</tbody>
</table>
1 single user mode
2 multiuser with no network services exported
3 normal/full multiuser exported
4 reserved for local use, default is normal/full multiuser
5 multiuser with a display manager or equivalent
6 reboot

Note: These run levels were chosen as reflecting the most frequent existing practice, and in the absence of other considerations, implementors are strongly encouraged to follow this convention to provide consistency for system administrators who need to work with multiple distributions.

20.6 Facility Names

Boot facilities are used to indicate dependencies in initialization scripts, as defined in Comment Conventions for Init Scripts. Facility names are assigned to scripts by the Provides: keyword. Facility names that begin with a dollar sign (‘$’) are reserved system facility names.

Note: Facility names are only recognized in the context of the init script comment block and are not available in the body of the init script. In particular, the use of the leading ‘$’ character does not imply system facility names are subject to shell variable expansion, since they appear inside comments.

Conforming applications shall not provide facilities that begin with a dollar sign. Implementations shall provide the following facility names:

$local_fs
all local file systems are mounted

$network
basic networking support is available. Example: a server program could listen on a socket.

$named
IP name-to-address translation, using the interfaces described in this specification, are available to the level the system normally provides them. Example: if a DNS query daemon normally provides this facility, then that daemon has been started.

$portmap
daemons providing SunRPC/ONCRPC portmapping service as defined in RFC 1833: Binding Protocols for ONC RPC Version 2 (if present) are running.

$remote_fs
all remote file systems are available. In some configurations, file systems such as /usr may be remote. Many applications that require $local_fs will probably also require $remote_fs.
$syslog

system logger is operational.

$time

the system time has been set, for example by using a network-based time program such as ntp or rdate, or via the hardware Real Time Clock.

Other (non-system) facilities may be defined by other conforming applications. These facilities shall be named using the same conventions defined for naming init scripts (see Script Names). Commonly, the facility provided by a conforming init script will have the same name as the name assigned to the init script.

20.7 Script Names

Since init scripts live in a single directory, they must share a single namespace. To avoid conflicts, applications installing files in this directories shall use the LSB naming conventions (see File Naming Conventions).

20.8 Init Script Functions

Each conforming init script shall execute the commands in the file /lib/lsb/init-functions in the current environment (see shell special built-in command dot). This file shall cause the following shell script commands to be defined in an unspecified manner.

Note: This can be done either by adding a directory to the PATH variable which defines these commands, or by defining shell aliases or functions.

Although the commands made available via this mechanism need not be conforming applications in their own right, applications that use them should only depend on features described in this specification.

Conforming scripts shall not specify the "exit on error" option (i.e. set -e) when sourcing this file, or calling any of the commands thus made available.

The start_daemon, killproc and pidofproc functions shall use the following algorithm for determining the status and the process identifiers of the specified program.

1. If the -p pidfile option is specified, and the named pidfile exists, a single line at the start of the pidfile shall be read. If this line contains one or more numeric values, separated by spaces, these values shall be used. If the -p pidfile option is specified and the named pidfile does not exist, the functions shall assume that the daemon is not running.

2. Otherwise, /var/run/basename.pid shall be read in a similar fashion. If this contains one or more numeric values on the first line, these values shall be used. Optionally, implementations may use unspecified additional methods to locate the process identifiers required.

The method used to determine the status is implementation defined, but should allow for non-binary programs.

Note: Commonly used methods check either for the existence of the /proc/pid directory or use /proc/pid/exe and /proc/pid/cmdline. Relying only on /proc/pid/exe is discouraged since this specification does not specify the existence of, or semantics for, /proc. Additionally, using /proc/pid/exe may result in a not-running status for daemons that are written in a script language.
Conforming implementations may use other mechanisms besides those based on pidfiles, unless the \texttt{-p pidfile} option has been used. Conforming applications should not rely on such mechanisms and should always use a pidfile. When a program is stopped, it should delete its pidfile. Multiple process identifiers shall be separated by a single space in the pidfile and in the output of \texttt{pidofproc}.

\begin{verbatim}
start_daemon \[-f\] \[-n nicelevel\] \[-p pidfile\] pathname \[args...\]
\end{verbatim}
runs the specified program as a daemon. The \texttt{start_daemon} function shall check if the program is already running using the algorithm given above. If so, it shall not start another copy of the daemon unless the \texttt{-f} option is given. The \texttt{-n} option specifies a nice level. See \texttt{nice}. The \texttt{start_daemon} shall return the LSB defined exit status codes. It shall return 0 if the program has been successfully started or is running and not 0 otherwise.

\begin{verbatim}
killproc \[-p pidfile\] pathname \[signal\]
\end{verbatim}
The \texttt{killproc} function shall stop the specified program. The program is found using the algorithm given above. If a signal is specified, using the \texttt{-signal\_name} or \texttt{-signal\_number} syntaxes as specified by the \texttt{kill} command, the program is sent that signal. Otherwise, a \texttt{SIGTERM} followed by a \texttt{SIGKILL} after an unspecified number of seconds shall be sent. If a program has been terminated, the pidfile should be removed if the terminated process has not already done so. The \texttt{killproc} function shall return the LSB defined exit status codes. If called without a signal, it shall return 0 if the program has been stopped or is not running and not 0 otherwise. If a signal is given, it shall return 0 only if the program is running.

\begin{verbatim}
pidofproc \[-p pidfile\] pathname
\end{verbatim}
The \texttt{pidofproc} function shall return one or more process identifiers for a particular daemon using the algorithm given above. Only process identifiers of running processes should be returned. Multiple process identifiers shall be separated by a single space.

\textbf{Note:} A process may exit between \texttt{pidofproc} discovering its identity and the caller of \texttt{pidofproc} being able to act on that identity. As a result, no test assertion can be made that the process identifiers returned by \texttt{pidofproc} shall be running processes.

The \texttt{pidofproc} function shall return the LSB defined exit status codes for "status". It shall return 0 if the program is running and not 0 otherwise.

\begin{verbatim}
log\_success\_msg message
\end{verbatim}
The \texttt{log\_success\_msg} function shall cause the system to print a success message.

\textbf{Note:} The message should be relatively short; no more than 60 characters is highly desirable.

\begin{verbatim}
log\_failure\_msg message
\end{verbatim}
The \texttt{log\_failure\_msg} function shall cause the system to print a failure message.

\textbf{Note:} The message should be relatively short; no more than 60 characters is highly desirable.
The \texttt{log\_warning\_msg} function shall cause the system to print a warning message.

\textbf{Note:} The message should be relatively short; no more than 60 characters is highly desirable.
21 Users & Groups

21.1 User and Group Database

The format of the User and Group databases is not specified. Programs may only read these databases using the provided API. Changes to these databases should be made using the provided commands.

21.2 User & Group Names

Table 21-1 describes required mnemonic user and group names. This specification makes no attempt to numerically assign user or group identity numbers, with the exception that both the User ID and Group ID for the user root shall be equal to 0.

Table 21-1 Required User & Group Names

<table>
<thead>
<tr>
<th>User</th>
<th>Group</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>root</td>
<td>root</td>
<td>Administrative user with all appropriate privileges</td>
</tr>
<tr>
<td>bin</td>
<td>bin</td>
<td>Legacy User ID/Group ID&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>daemon</td>
<td>daemon</td>
<td>Legacy User ID/Group ID&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

Notes:

a  The bin User ID/Group ID is included for compatibility with legacy applications. New applications should no longer use the bin User ID/Group ID.

b  The daemon User ID/Group ID was used as an unprivileged User ID/Group ID for daemons to execute under in order to limit their access to the system. Generally daemons should now run under individual User ID/Group IDs in order to further partition daemons from one another.

Table 21-2 is a table of optional mnemonic user and group names. This specification makes no attempt to numerically assign uid or gid numbers. If the username exists on a system, then they should be in the suggested corresponding group. These user and group names are for use by distributions, not by applications.

Table 21-2 Optional User & Group Names

<table>
<thead>
<tr>
<th>User</th>
<th>Group</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>adm</td>
<td>adm</td>
<td>Administrative special privileges</td>
</tr>
<tr>
<td>lp</td>
<td>lp</td>
<td>Printer special privileges</td>
</tr>
<tr>
<td>sync</td>
<td>sync</td>
<td>Login to sync the system</td>
</tr>
<tr>
<td>shutdown</td>
<td>shutdown</td>
<td>Login to shutdown the system</td>
</tr>
<tr>
<td>halt</td>
<td>halt</td>
<td>Login to halt the system</td>
</tr>
</tbody>
</table>
Only a minimum working set of "user names" and their corresponding "user groups" are required. Applications cannot assume non system user or group names will be defined.

Applications cannot assume any policy for the default file creation mask (umask) or the default directory permissions a user may have. Applications should enforce user only file permissions on private files such as mailboxes. The location of the users home directory is also not defined by policy other than the recommendations of the Filesystem Hierarchy Standard and should be obtained by the `getpwnam()`, `getpwnam_r()`, `getpwent()`, `getpwuid()`, and `getpwuid_r()` functions.

### 21.3 User ID Ranges

The system User IDs from 0 to 99 should be statically allocated by the system, and shall not be created by applications.

The system User IDs from 100 to 499 should be reserved for dynamic allocation by system administrators and post install scripts using `useradd`.

### 21.4 Rationale

The purpose of specifying optional users and groups is to reduce the potential for name conflicts between applications and distributions.

<table>
<thead>
<tr>
<th>User</th>
<th>Group</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>mail</td>
<td>mail</td>
<td>Mail special privileges</td>
</tr>
<tr>
<td>news</td>
<td>news</td>
<td>News special privileges</td>
</tr>
<tr>
<td>uucp</td>
<td>uucp</td>
<td>UUCP special privileges</td>
</tr>
<tr>
<td>operator</td>
<td>root</td>
<td>Operator special privileges</td>
</tr>
<tr>
<td>man</td>
<td>man</td>
<td>Man special privileges</td>
</tr>
<tr>
<td>nobody</td>
<td>nobody</td>
<td>Used by NFS</td>
</tr>
</tbody>
</table>
22 Software Installation

22.1 Introduction

Applications shall either be packaged in the RPM packaging format as defined in this specification, or supply an installer which is LSB conforming (for example, calls LSB commands and utilities).

**Note:** Supplying an RPM format package is encouraged because it makes systems easier to manage. A future version of the LSB may require RPM, or specify a way for an installer to update a package database.

Applications are also encouraged to uninstall cleanly.

Distributions shall provide a mechanism for installing applications in this packaging format with some restrictions listed below.

**Note:** The distribution itself may use a different packaging format for its own packages, and of course it may use any available mechanism for installing the LSB-conformant packages.

22.2 Package File Format

An RPM format file consists of 4 sections, the Lead, Signature, Header, and the Payload. All values are stored in network byte order.

### Table 22-1 RPM File Format

<table>
<thead>
<tr>
<th>Section</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead</td>
</tr>
<tr>
<td>Signature</td>
</tr>
<tr>
<td>Header</td>
</tr>
<tr>
<td>Payload</td>
</tr>
</tbody>
</table>

These 4 sections shall exist in the order specified.

The lead section is used to identify the package file.

The signature section is used to verify the integrity, and optionally, the authenticity of the majority of the package file.

The header section contains all available information about the package. Entries such as the package's name, version, and file list, are contained in the header.

The payload section holds the files to be installed.

22.2.1 Lead Section

```c
struct rpmlead {
    unsigned char magic[4];
    unsigned char major, minor;
    short type;
    short archnum;
    char name[66];
    short osnum;
    short signature_type;
    char reserved[16];
} ;
```
22 Software Installation

*magic*
Value identifying this file as an RPM format file. This value shall be 
"\355\253\356\333".

*major*
Value indicating the major version number of the file format version. This 
value shall be 3.

*minor*
Value indicating the minor revision number of file format version. This value 
shall be 0.

*type*
Value indicating whether this is a source or binary package. This value shall be 
0 to indicate a binary package.

*archnum*
Value indicating the architecture for which this package is valid. This value is 
specified in the architecture-specific LSB specification.

*name*
A NUL terminated string that provides the package name. This name shall 
conform with the Package Naming section of this specification.

*osnum*
Value indicating the Operating System for which this package is valid. This 
value shall be 1.

*signature_type*
Value indicating the type of the signature used in the Signature part of the file. 
This value shall be 5.

*reserved*
Reserved space. The value is undefined.

### 22.2.2 Header Structure

The Header structure is used for both the Signature and Header Sections. A Header 
Structure consists of 3 parts, a Header record, followed by 1 or more Index records, 
followed by 0 or more bytes of data associated with the Index records. A Header 
structure shall be aligned to an 8 byte boundary.

<table>
<thead>
<tr>
<th>Table 22-2 Signature Format</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Header Record</strong></td>
</tr>
<tr>
<td><strong>Array of Index Records</strong></td>
</tr>
<tr>
<td><strong>Store of Index Values</strong></td>
</tr>
</tbody>
</table>

#### 22.2.2.1 Header Record

```c
struct rpmheader {
    unsigned char magic[4];
```
unsigned char reserved[4];
int nindex;
int hsize;
}

magic
Value identifying this record as an RPM header record. This value shall be 
"\216\255\350\001".

reserved
Reserved space. This value shall be "\000\000\000\000".

nindex
The number of Index Records that follow this Header Record. There should be at least 1 Index Record.

hsize
The size in bytes of the storage area for the data pointed to by the Index Records.

### 22.2.2.2 Index Record

struct rpmhdrindex {
    int tag;
    int type;
    int offset;
    int count;
} ;

tag
Value identifying the purpose of the data associated with this Index Record. The value of this field is dependent on the context in which the Index Record is used, and is defined below and in later sections.

type
Value identifying the type of the data associated with this Index Record. The possible type values are defined below.

offset
Location in the Store of the data associated with this Index Record. This value should between 0 and the value contained in the hsize of the Header Structure.

count
Size of the data associated with this Index Record. The count is the number of elements whose size is defined by the type of this Record.

#### 22.2.2.2.1 Index Type Values

The possible values for the type field are defined in this table.

<table>
<thead>
<tr>
<th>Type</th>
<th>Value</th>
<th>Size (in bytes)</th>
<th>Alignment</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPM_NULL_TYPE</td>
<td>0</td>
<td>Not Implemented.</td>
<td></td>
</tr>
</tbody>
</table>
The string arrays specified for entries of type `RPM_STRING_ARRAY_TYPE` and `RPM_I18NSTRING_TYPE` are vectors of strings in a contiguous block of memory, each element separated from its neighbors by a NUL character.

Index records with type `RPM_I18NSTRING_TYPE` shall always have a `count` of 1. The array entries in an index of type `RPM_I18NSTRING_TYPE` correspond to the locale names contained in the `RPMTAG_HDRI18NTABLE` index.

### 22.2.2.2.2 Index Tag Values

Some values are designated as header private, and may appear in any header structure. These are defined here. Additional values are defined in later sections.

#### Table 22-4 Header Private Tag Values

<table>
<thead>
<tr>
<th>Name</th>
<th>Tag Value</th>
<th>Type</th>
<th>Count</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>RPMTAG_HEADERSIGNATURES</code></td>
<td>62</td>
<td>BIN</td>
<td>16</td>
<td>Optional</td>
</tr>
<tr>
<td><code>RPMTAG_HEADERIMMUTABLE</code></td>
<td>63</td>
<td>BIN</td>
<td>16</td>
<td>Optional</td>
</tr>
<tr>
<td><code>RPMTAG_HDRI18NTABLE</code></td>
<td>100</td>
<td>STRING_ARRAY</td>
<td></td>
<td>Required</td>
</tr>
</tbody>
</table>

`RPMTAG_HEADERSIGNATURES`

The signature tag differentiates a signature header from a metadata header, and identifies the original contents of the signature header.

`RPMTAG_HEADERIMMUTABLE`

This tag contains an index record which specifies the portion of the Header Record which was used for the calculation of a signature. This data shall be preserved or any header-only signature will be invalidated.
RPMTAG_HEADER18NTABLE

Contains a list of locales for which strings are provided in other parts of the package.

Not all Index records defined here will be present in all packages. Each tag value has a status which is defined here.

Required
This Index Record shall be present.

Optional
This Index Record may be present.

Informational
This Index Record may be present, but does not contribute to the processing of the package.

Deprecated
This Index Record should not be present.

Obsolete
This Index Record shall not be present.

Reserved
This Index Record shall not be present.

22.2.2.3 Header Store

The header store contains the values specified by the Index structures. These values are aligned according to their type and padding is used if needed. The store is located immediately following the Index structures.

22.2.3 Signature Section

The Signature section is implemented using the Header structure. The signature section defines the following additional tag values which may be used in the Index structures.

These values exist to provide additional information about the rest of the package.

<table>
<thead>
<tr>
<th>Name</th>
<th>Tag Value</th>
<th>Type</th>
<th>Count</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGTAG_SIGSIZE</td>
<td>1000</td>
<td>INT32</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>SIGTAG_PAYLOAD</td>
<td>1007</td>
<td>INT32</td>
<td>1</td>
<td>Optional</td>
</tr>
</tbody>
</table>

SIGTAG_SIGSIZE
This tag specifies the combined size of the Header and Payload sections.
SIGTAG_PAYLOADSIZE

This tag specifies the uncompressed size of the Payload archive, including the cpio headers.

These values exist to ensure the integrity of the rest of the package.

Table 22-6 Signature Digest Tag Values

<table>
<thead>
<tr>
<th>Name</th>
<th>Tag Value</th>
<th>Type</th>
<th>Count</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGTAG_MD5</td>
<td>1004</td>
<td>BIN</td>
<td>16</td>
<td>Required</td>
</tr>
<tr>
<td>SIGTAG_SHA1 HEADER</td>
<td>1010</td>
<td>STRING</td>
<td>1</td>
<td>Optional</td>
</tr>
</tbody>
</table>

SIGTAG_MD5

This tag specifies the 128-bit MD5 checksum of the combined Header and Archive sections.

SIGTAG_SHA1HEADER

This index contains the SHA1 checksum of the entire Header Section, including the Header Record, Index Records and Header store.

These values exist to provide authentication of the package.

Table 22-7 Signature Signing Tag Values

<table>
<thead>
<tr>
<th>Name</th>
<th>Tag Value</th>
<th>Type</th>
<th>Count</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIGTAG_PGP</td>
<td>1002</td>
<td>BIN</td>
<td>1</td>
<td>Optional</td>
</tr>
<tr>
<td>SIGTAG_GPG</td>
<td>1005</td>
<td>BIN</td>
<td>65</td>
<td>Optional</td>
</tr>
<tr>
<td>SIGTAG_DSAHEADER</td>
<td>1011</td>
<td>BIN</td>
<td>1</td>
<td>Optional</td>
</tr>
<tr>
<td>SIGTAG_RSAHEADER</td>
<td>1012</td>
<td>BIN</td>
<td>1</td>
<td>Optional</td>
</tr>
</tbody>
</table>

SIGTAG_PGP

This tag specifies the RSA signature of the combined Header and Payload sections. The data is formatted as a Version 3 Signature Packet as specified in RFC 2440: OpenPGP Message Format.

SIGTAG_GPG

The tag contains the DSA signature of the combined Header and Payload sections. The data is formatted as a Version 3 Signature Packet as specified in RFC 2440: OpenPGP Message Format.

SIGTAG_DSAHEADER

The tag contains the DSA signature of the Header section. The data is formatted as a Version 3 Signature Packet as specified in RFC 2440: OpenPGP Message Format. If this tag is present, then the SIGTAG_GPG tag shall also be present.
SIGTAG_RSAHEADER

The tag contains the RSA signature of the Header section. The data is formatted as a Version 3 Signature Packet as specified in RFC 2440: OpenPGP Message Format. If this tag is present, then the SIGTAG_PGP shall also be present.

22.2.4 Header Section

The Header section is implemented using the Header structure. The Header section defines the following additional tag values which may be used in the Index structures.

22.2.4.1 Package Information

The following tag values are used to indicate information that describes the package as a whole.

Table 22-8 Package Info Tag Values

<table>
<thead>
<tr>
<th>Name</th>
<th>Tag Value</th>
<th>Type</th>
<th>Count</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPMTAG_NAME</td>
<td>1000</td>
<td>STRING</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_VERSION</td>
<td>1001</td>
<td>STRING</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAGRELEASE</td>
<td>1002</td>
<td>STRING</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_SUMMARY</td>
<td>1004</td>
<td>I18NSTRING</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_DESCRIPTION</td>
<td>1005</td>
<td>I18NSTRING</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_SIZE</td>
<td>1009</td>
<td>INT32</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_DISTRIBUTION</td>
<td>1010</td>
<td>STRING</td>
<td>1</td>
<td>Informational</td>
</tr>
<tr>
<td>RPMTAG_VENDOR</td>
<td>1011</td>
<td>STRING</td>
<td>1</td>
<td>Informational</td>
</tr>
<tr>
<td>RPMTAG_LICENSE</td>
<td>1014</td>
<td>STRING</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_GROUP</td>
<td>1016</td>
<td>I18NSTRING</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_URL</td>
<td>1020</td>
<td>STRING</td>
<td>1</td>
<td>Informational</td>
</tr>
<tr>
<td>RPMTAG_OS</td>
<td>1021</td>
<td>STRING</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_ARCH</td>
<td>1022</td>
<td>STRING</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_SOURCESIZE</td>
<td>1044</td>
<td>STRING</td>
<td>1</td>
<td>Informational</td>
</tr>
<tr>
<td>RPMTAG_RPMVERSION</td>
<td>1064</td>
<td>STRING</td>
<td>1</td>
<td>Informational</td>
</tr>
<tr>
<td>RPMTAG_Cook</td>
<td>1094</td>
<td>STRING</td>
<td>1</td>
<td>Optional</td>
</tr>
</tbody>
</table>
## Software Installation

<table>
<thead>
<tr>
<th>Name</th>
<th>Tag Value</th>
<th>Type</th>
<th>Count</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPMTAG_DISTURL</td>
<td>1123</td>
<td>STRING</td>
<td>1</td>
<td>Informational</td>
</tr>
<tr>
<td>RPMTAG_PAYLOADFORMAT</td>
<td>1124</td>
<td>STRING</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_PAYLOADCOMPRESS</td>
<td>1125</td>
<td>STRING</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_PAYLOADFLAGS</td>
<td>1126</td>
<td>STRING</td>
<td>1</td>
<td>Required</td>
</tr>
</tbody>
</table>

**RPMTAG_NAME**

This tag specifies the name of the package.

**RPMTAG_VERSION**

This tag specifies the version of the package.

**RPMTAG_RELEASE**

This tag specifies the release of the package.

**RPMTAG_SUMMARY**

This tag specifies the summary description of the package. The summary value pointed to by this index record contains a one line description of the package.

**RPMTAG_DESCRIPTION**

This tag specifies the description of the package. The description value pointed to by this index record contains a full description of the package.

**RPMTAG_SIZE**

This tag specifies the sum of the sizes of the regular files in the archive.

**RPMTAG_DISTRIBUTION**

A string containing the name of the distribution on which the package was built.

**RPMTAG_VENDOR**

A string containing the name of the organization that produced the package.

**RPMTAG_LICENSE**

This tag specifies the license which applies to this package.

**RPMTAG_GROUP**

This tag specifies the administrative group to which this package belongs.

**RPMTAG_URL**

Generic package information URL.
RPMTAG_OS

This tag specifies the OS of the package. The OS value pointed to by this index record shall be "linux".

RPMTAG_ARCH

This tag specifies the architecture of the package. The architecture value pointed to by this index record is defined in architecture specific LSB specification.

RPMTAG_SOURCERPM

This tag specifies the name of the source RPM.

RPMTAG_ARCHIVESIZE

This tag specifies the uncompressed size of the Payload archive, including the cpio headers.

RPMTAG_RPMVERSION

This tag indicates the version of RPM tool used to build this package. The value is unused.

RPMTAG_COOKIE

This tag contains an opaque string whose contents are undefined.

RPMTAG_DISTURL

URL for package

RPMTAG_PAYLOADFORMAT

This tag specifies the format of the Archive section. The format value pointed to by this index record shall be 'cpio'.

RPMTAG_PAYLOADCOMPRESSOR

This tag specifies the compression used on the Archive section. The compression value pointed to by this index record shall be 'gzip'.

RPMTAG_PAYLOADFLAGS

This tag indicates the compression level used for the Payload. This value shall always be '9'.

### 22.2.4.2 Installation Information

The following tag values are used to provide information needed during the installation of the package.

**Table 22-9 Installation Tag Values**

<table>
<thead>
<tr>
<th>Name</th>
<th>Tag Value</th>
<th>Type</th>
<th>Count</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPMTAG_PREIN</td>
<td>1023</td>
<td>STRING</td>
<td>1</td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_POSTIN</td>
<td>1024</td>
<td>STRING</td>
<td>1</td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_PREU</td>
<td>1025</td>
<td>STRING</td>
<td>1</td>
<td>Optional</td>
</tr>
<tr>
<td>Name</td>
<td>Tag Value</td>
<td>Type</td>
<td>Count</td>
<td>Status</td>
</tr>
<tr>
<td>--------------</td>
<td>-----------</td>
<td>---------</td>
<td>-------</td>
<td>----------</td>
</tr>
<tr>
<td>RPMTAG_POST</td>
<td>1026</td>
<td>STRING</td>
<td>1</td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_PREIN</td>
<td>1085</td>
<td>STRING</td>
<td>1</td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_POST</td>
<td>1086</td>
<td>STRING</td>
<td>1</td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_PREUN</td>
<td>1087</td>
<td>STRING</td>
<td>1</td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_POST</td>
<td>1088</td>
<td>STRING</td>
<td>1</td>
<td>Optional</td>
</tr>
</tbody>
</table>

**RPMTAG_PREIN**

This tag specifies the preinstall scriptlet. If present, then RPMTAG_PREINPROG shall also be present.

**RPMTAG_POSTIN**

This tag specifies the postinstall scriptlet. If present, then RPMTAG_POSTINPROG shall also be present.

**RPMTAG_PREUN**

This tag specifies the preuninstall scriptlet. If present, then RPMTAG_PREUNPROG shall also be present.

**RPMTAG_POSTUN**

This tag specifies the postuninstall scriptlet. If present, then RPMTAG_POSTUNPROG shall also be present.

**RPMTAG_PREINPROG**

This tag specifies the name of the interpreter to which the preinstall scriptlet will be passed. The interpreter pointed to by this index record shall be `/bin/sh`.

**RPMTAG_POSTINPROG**

This tag specifies the name of the interpreter to which the postinstall scriptlet will be passed. The interpreter pointed to by this index record shall be `/bin/sh`.

**RPMTAG_PREUNPROG**

This tag specifies the name of the interpreter to which the preuninstall scriptlet will be passed. The interpreter pointed to by this index record shall be `/bin/sh`.

**RPMTAG_POSTUNPROG**

This program specifies the name of the interpreter to which the postuninstall scriptlet will be passed. The interpreter pointed to by this index record shall be `/bin/sh`. 
22.2.4.3 File Information

The following tag values are used to provide information about the files in the payload. This information is provided in the header to allow more efficient access of the information.

Table 22-10 File Info Tag Values

<table>
<thead>
<tr>
<th>Name</th>
<th>Tag Value</th>
<th>Type</th>
<th>Count</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPMTAG_OLDilenames</td>
<td>1027</td>
<td>STRING_ARAY</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_FILEsizes</td>
<td>1028</td>
<td>INT32</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_FILEmodes</td>
<td>1030</td>
<td>INT16</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_FILErdevs</td>
<td>1033</td>
<td>INT16</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_FILEmtimes</td>
<td>1034</td>
<td>INT32</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_FILEmd5s</td>
<td>1035</td>
<td>STRING_ARAY</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_FILElinktos</td>
<td>1036</td>
<td>STRING_ARAY</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_FILEflags</td>
<td>1037</td>
<td>INT32</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_FILEusername</td>
<td>1039</td>
<td>STRING_ARAY</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_FILEgroupname</td>
<td>1040</td>
<td>STRING_ARAY</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_FILEdevices</td>
<td>1095</td>
<td>INT32</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_FILEinodes</td>
<td>1096</td>
<td>INT32</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_FILElangs</td>
<td>1097</td>
<td>STRING_ARAY</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_DIRindexes</td>
<td>1116</td>
<td>INT32</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_BASEnames</td>
<td>1117</td>
<td>STRING_ARAY</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_DIRnames</td>
<td>1118</td>
<td>STRING_ARAY</td>
<td></td>
<td>Optional</td>
</tr>
</tbody>
</table>

RPMTAG_OLDilenames

This tag specifies the filenames when not in a compressed format as determined by the absence of rpmlib(CompressedFileNames) in the RPMTAG_REQUIRENAME index.
RPMTAG_FILESIZES
This tag specifies the size of each file in the archive.

RPMTAG_FILEMODES
This tag specifies the mode of each file in the archive.

RPMTAG_FILERDEVS
This tag specifies the device number from which the file was copied.

RPMTAG_FILEMTIMES
This tag specifies the modification time in seconds since the epoch of each file in the archive.

RPMTAG_FILEMD5S
This tag specifies the ASCII representation of the MD5 sum of the corresponding file contents. This value is empty if the corresponding archive entry is not a regular file.

RPMTAG_FILELINKTOS
The target for a symlink, otherwise NULL.

RPMTAG_FILEFLAGS
This tag specifies the bit(s) to classify and control how files are to be installed. See below.

RPMTAG_FILEUSERNAME
This tag specifies the owner of the corresponding file.

RPMTAG_FILEGROUPNAME
This tag specifies the group of the corresponding file.

RPMTAG_FILEDEVICES
This tag specifies the 16 bit device number from which the file was copied.

RPMTAG_FILEINODES
This tag specifies the inode value from the original file on the system on which it was built.

RPMTAG_FILELANGS
This tag specifies a per-file locale marker used to install only locale specific subsets of files when the package is installed.

RPMTAG_DIRINDEXES
This tag specifies the index into the array provided by the RPMTAG_DIRNAMES Index which contains the directory name for the corresponding filename.

RPMTAG_BASENAMES
This tag specifies the base portion of the corresponding filename.
RPMTAG_DIRNAMES

One of RPMTAG_OLDFILENAMES or the tuple RPMTAG_DIRINDEXES, RPMTAG_BASENAMES, RPMTAG_DIRNAMES shall be present, but not both.

22.2.4.3.1 File Flags

The RPMTAG_FILEFLAGS tag value shall identify various characteristics of the file in the payload that it describes. It shall be an INT32 value consisting of either the value RPMFILE_NONE (0) or the bitwise inclusive or of one or more of the following values:

Table 22-11 File Flags

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPMFILE_CONFIG</td>
<td>(1 &lt;&lt; 0)</td>
</tr>
<tr>
<td>RPMFILE_DOC</td>
<td>(1 &lt;&lt; 1)</td>
</tr>
<tr>
<td>RPMFILE_DONOTUSE</td>
<td>(1 &lt;&lt; 2)</td>
</tr>
<tr>
<td>RPMFILE_MISSINGOK</td>
<td>(1 &lt;&lt; 3)</td>
</tr>
<tr>
<td>RPMFILE_NOREPLACE</td>
<td>(1 &lt;&lt; 4)</td>
</tr>
<tr>
<td>RPMFILE_SPECFILE</td>
<td>(1 &lt;&lt; 5)</td>
</tr>
<tr>
<td>RPMFILE_GHOST</td>
<td>(1 &lt;&lt; 6)</td>
</tr>
<tr>
<td>RPMFILE_LICENSE</td>
<td>(1 &lt;&lt; 7)</td>
</tr>
<tr>
<td>RPMFILE_README</td>
<td>(1 &lt;&lt; 8)</td>
</tr>
<tr>
<td>RPMFILE_EXCLUDE</td>
<td>(1 &lt;&lt; 9)</td>
</tr>
</tbody>
</table>

These bits have the following meaning:

RPMTFILE_CONFIG

The file is a configuration file, and an existing file should be saved during a package upgrade operation and not removed during a package removal operation.

RPMTFILE_DOC

The file contains documentation.

RPMTFILE_DONOTUSE

This value is reserved for future use; conforming packages may not use this flag.

RPMTFILE_MISSINGOK

The file need not exist on the installed system.

RPMTFILE_NOREPLACE

Similar to the RPMFILE_CONFIG, this flag indicates that during an upgrade operation the original file on the system should not be altered.
22 Software Installation

RPMFILE_SPECFILE
The file is a package specification.

RPMFILE_GHOST
The file is not actually included in the payload, but should still be considered as a part of the package. For example, a log file generated by the application at run time.

RPMFILE_LICENSE
The file contains the license conditions.

RPMFILE_README
The file contains high level notes about the package.

RPMFILE_EXCLUDE
The corresponding file is not a part of the package, and should not be installed.

22.2.4.4 Dependency Information
The following tag values are used to provide information about interdependencies between packages.

Table 22-12 Package Dependency Tag Values

<table>
<thead>
<tr>
<th>Name</th>
<th>Tag Value</th>
<th>Type</th>
<th>Count</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPMTAG_PROVIDENAME</td>
<td>1047</td>
<td>STRING_ARRAY</td>
<td>1</td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_REQUIREFLAGS</td>
<td>1048</td>
<td>INT32</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_REQUIRENAME</td>
<td>1049</td>
<td>STRING_ARRAY</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_REQUIREVERSION</td>
<td>1050</td>
<td>STRING_ARRAY</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_CONFICTFLAGS</td>
<td>1053</td>
<td>INT32</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_CONFICTNAME</td>
<td>1054</td>
<td>STRING_ARRAY</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_CONFICTVERSION</td>
<td>1055</td>
<td>STRING_ARRAY</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_OBSOLETENAME</td>
<td>1090</td>
<td>STRING_ARRAY</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_PROVIDEFLAGS</td>
<td>1112</td>
<td>INT32</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_PROVIDEVERSION</td>
<td>1113</td>
<td>STRING_ARRAY</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>RPMTAG_OBSOLETEFLAGS</td>
<td>1114</td>
<td>INT32</td>
<td>1</td>
<td>Optional</td>
</tr>
<tr>
<td>Name</td>
<td>Tag Value</td>
<td>Type</td>
<td>Count</td>
<td>Status</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------</td>
<td>---------------</td>
<td>-------</td>
<td>------------</td>
</tr>
<tr>
<td>RPMTAG_OBSLETEVERSION</td>
<td>1115</td>
<td>STRING_ARRAY</td>
<td></td>
<td>Optional</td>
</tr>
</tbody>
</table>

RPMTAG_PROVIDENAME
This tag indicates the name of the dependency provided by this package.

RPMTAG_REQUIREFLAGS
Bits(s) to specify the dependency range and context.

RPMTAG_REQUIRENAME
This tag indicates the dependencies for this package.

RPMTAG_REQUIREVERSION
This tag indicates the versions associated with the values found in the RPMTAG_REQUIRENAME Index.

RPMTAG_CONFLICTFLAGS
Bits(s) to specify the conflict range and context.

RPMTAG_CONFLICTNAME
This tag indicates the conflicting dependencies for this package.

RPMTAG_CONFLICTVERSION
This tag indicates the versions associated with the values found in the RPMTAG_CONFLICTNAME Index.

RPMTAG_OBSOLETENAME
This tag indicates the obsoleted dependencies for this package.

RPMTAG_PROVIDEFLAGS
Bits(s) to specify the conflict range and context.

RPMTAG_PROVIDEVERSION
This tag indicates the versions associated with the values found in the RPMTAG_PROVIDENAME Index.

RPMTAG_OBSOLETEFLAGS
Bits(s) to specify the conflict range and context.

RPMTAG_OBSOLETEVERSION
This tag indicates the versions associated with the values found in the RPMTAG_OBSOLETENAME Index.

22.2.4.4.1 Package Dependency Values
The package dependencies are stored in the RPMTAG_REQUIRENAME and RPMTAG_REQUIREVERSION index records. The following values may be used.
Table 22-13 Index Type values

<table>
<thead>
<tr>
<th>Name</th>
<th>Version</th>
<th>Meaning</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>rpmlib(Versioned Dependencies)</td>
<td>3.0.3-1</td>
<td>Indicates that the package contains RPMTAG_PROVIDENAME, RPMTAG_OBSOLETENAME or RPMTAG_PREREQ records that have a version associated with them.</td>
<td>Optional</td>
</tr>
<tr>
<td>rpmlib(PayloadFilesHavePrefix)</td>
<td>4.0-1</td>
<td>Indicates the filenames in the Archive have had &quot;.&quot; prepended to them.</td>
<td>Optional</td>
</tr>
<tr>
<td>rpmlib(CompressedFileNames)</td>
<td>3.0.4-1</td>
<td>Indicates that the filenames in the Payload are represented in the RPMTAG_DIRINDEXES, RPMTAG_DIRNAME and RPMTAG_BASENAME indexes.</td>
<td>Optional</td>
</tr>
<tr>
<td>/bin/sh</td>
<td></td>
<td>Interpreter usually required for installation scripts.</td>
<td>Optional</td>
</tr>
</tbody>
</table>

Additional dependencies are specified in the Package Dependencies section of this document, and the architecture specific documents.

22.2.4.4.2 Package Dependencies Attributes

The package dependency attributes are stored in the RPMTAG_REQUIREFLAGS, RPMTAG_PROVIDEFLAGS and RPMTAG_OBSOLETEFLAGS index records. The following values may be used.

Table 22-14 Package Dependency Attributes

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPMSENSE_LESS</td>
<td>0x02</td>
<td></td>
</tr>
<tr>
<td>RPMSENSE_GREATER</td>
<td>0x04</td>
<td></td>
</tr>
<tr>
<td>RPMSENSE_EQUAL</td>
<td>0x08</td>
<td></td>
</tr>
<tr>
<td>RPMSENSE_PREREQ</td>
<td>0x40</td>
<td></td>
</tr>
</tbody>
</table>
### 22 Software Installation

#### 22.2.4.5 Other Information

The following tag values are also found in the Header section.

<table>
<thead>
<tr>
<th>Name</th>
<th>Value</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPMSENSE_INTERP</td>
<td>0x100</td>
<td></td>
</tr>
<tr>
<td>RPMSENSE_SCRIPT_PRE</td>
<td>0x200</td>
<td></td>
</tr>
<tr>
<td>RPMSENSE_SCRIPT_POST</td>
<td>0x400</td>
<td></td>
</tr>
<tr>
<td>RPMSENSE_SCRIPT_PREUN</td>
<td>0x800</td>
<td></td>
</tr>
<tr>
<td>RPMSENSE_SCRIPT_POSTUN</td>
<td>0x1000</td>
<td></td>
</tr>
<tr>
<td>RPMSENSE_RPMLIB</td>
<td>0x1000000</td>
<td></td>
</tr>
</tbody>
</table>

#### Table 22-15 Other Tag Values

<table>
<thead>
<tr>
<th>Name</th>
<th>Tag Value</th>
<th>Type</th>
<th>Count</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPMTAG_BUILDTIME</td>
<td>1006</td>
<td>INT32</td>
<td>1</td>
<td>Informational</td>
</tr>
<tr>
<td>RPMTAG_BUILDDHOST</td>
<td>1007</td>
<td>STRING</td>
<td>1</td>
<td>Informational</td>
</tr>
<tr>
<td>RPMTAG_FILEVERIFYFLAGS</td>
<td>1045</td>
<td>INT32</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_CHANGELOGTIME</td>
<td>1080</td>
<td>INT32</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_CHANGELOGNAME</td>
<td>1081</td>
<td>STRING_AR</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_CHANGELOGTEXT</td>
<td>1082</td>
<td>STRING_AR</td>
<td></td>
<td>Optional</td>
</tr>
<tr>
<td>RPMTAG_OPTIFLAGS</td>
<td>1122</td>
<td>STRING</td>
<td>1</td>
<td>Informational</td>
</tr>
<tr>
<td>RPMTAG_RHNPLATFORM</td>
<td>1131</td>
<td>STRING</td>
<td>1</td>
<td>Deprecated</td>
</tr>
<tr>
<td>RPMTAG_PLATFORM</td>
<td>1132</td>
<td>STRING</td>
<td>1</td>
<td>Informational</td>
</tr>
</tbody>
</table>

**RPMTAG_BUILDTIME**

This tag specifies the time as seconds since the epoch at which the package was built.

**RPMTAG_BUILDDHOST**

This tag specifies the hostname of the system on which which the package was built.

**RPMTAG_FILEVERIFYFLAGS**

This tag specifies the bit(s) to control how files are to be verified after install, specifying which checks should be performed.
RPMTAG_CHANGELOGTIME
This tag specifies the Unix time in seconds since the epoch associated with each entry in the Changelog file.

RPMTAG_CHANGELOGNAME
This tag specifies the name of who made a change to this package.

RPMTAG_CHANGELOGTEXT
This tag specifies the changes associated with a changelog entry.

RPMTAG_OPTFLAGS
This tag indicates additional flags which may have been passed to the compiler when building this package.

RPMTAG_RHNPLATFORM
This tag contains an opaque string whose contents are undefined.

RPMTAG_PLATFORM
This tag contains an opaque string whose contents are undefined.

22.2.5 Payload Section
The Payload section contains a compressed cpio archive. The format of this section is defined by RFC 1952: GZIP File Format Specification.

When uncompressed, the cpio archive contains a sequence of records for each file. Each record contains a CPIO Header, Filename, Padding, and File Data.

Table 22-16 CPIO File Format

<table>
<thead>
<tr>
<th>CPIO Header</th>
<th>Header structure as defined below.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filename</td>
<td>NUL terminated ASCII string containing the name of the file.</td>
</tr>
<tr>
<td>Padding</td>
<td>0-3 bytes as needed to align the file stream to a 4 byte boundary.</td>
</tr>
<tr>
<td>File data</td>
<td>The contents of the file.</td>
</tr>
<tr>
<td>Padding</td>
<td>0-3 bytes as needed to align the file stream to a 4 byte boundary.</td>
</tr>
</tbody>
</table>

The CPIO Header uses the following header structure (sometimes referred to as "new ASCII" or "SVR4 cpio"). All numbers are stored as ASCII representations of their hexadecimal value with leading zeros as needed to fill the field. With the exception of c_namesize and the corresponding name string, and c_checksum, all information contained in the CPIO Header is also represented in the Header Section. The values in the CPIO Header shall match the values contained in the Header Section.

struct {
    char      c_magic[6];
    char      c_ino[8];
    char      c_mode[8];
    char      c_uid[8];

c_magic

Value identifying this cpio format. This value shall be "070701".

c_ino

This field contains the inode number from the filesystem from which the file was read. This field is ignored when installing a package. This field shall match the corresponding value in the RPMTAG_FILEINODES index in the Header section.

c_mode

Permission bits of the file. This is an ascii representation of the hexadecimal number representing the bit as defined for the st_mode field of the stat structure defined for the stat function. This field shall match the corresponding value in the RPMTAG_FILEMODES index in the Header section.

c_uid

Value identifying this owner of this file. This value matches the uid value of the corresponding user in the RPMTAG_FILEUSERNAME as found on the system where this package was built. The username specified in RPMTAG_FILEUSERNAME should take precedence when installing the package.

c_gid

Value identifying this group of this file. This value matches the gid value of the corresponding user in the RPMTAG_FILEGROUPNAME as found on the system where this package was built. The groupname specified in RPMTAG_FILEGROUPNAME should take precedence when installing the package.

c_nlink

Value identifying the number of links associated with this file. If the value is greater than 1, then this filename will be linked to 1 or more files in this archive that has a matching value for the c_ino, c_devmajor and c_devminor fields.

c_mtime

Value identifying the modification time of the file when it was read. This field shall match the corresponding value in the RPMTAG_FILEMTIMES index in the Header section.

c_filesize

Value identifying the size of the file. This field shall match the corresponding value in the RPMTAG_FILESIZES index in the Header section.
22.3 Package Script Restrictions

Scripts used as part of the package install and uninstall shall only use commands and interfaces that are specified by the LSB. All other commands are not guaranteed to be present, or to behave in expected ways.

Packages shall not use RPM triggers.

Packages shall not depend on the order in which scripts are executed (pre-install, pre-uninstall, etc), when doing an upgrade.

22.4 Package Tools

The LSB does not specify the interface to the tools used to manipulate LSB-conformant packages. Each conforming distribution shall provide documentation for installing LSB packages.
22.5 Package Naming

Packages supplied by distributions and applications must follow the following rules for the name field within the package. These rules are not required for the filename of the package file itself.¹

1 For example, there are discrepancies among distributions concerning whether the name might be frobnicator-1.7-21-ppc32.rpm or frobnicator-1.7-21-powerpc32.rpm. The architecture aside, recommended practice is for the filename of the package file to match the name within the package.

The following rules apply to the name field alone, not including any release or version.²

2 For example, if the name with the release and version is frobnicator-1.7-21, the name part is frobnicator and falls under the rules for a name with no hyphens.

• If the name begins with "lsb-" and contains no other hyphens, the name shall be assigned by the Linux Assigned Names and Numbers Authority (http://www.lanana.org) (LANANA), which shall maintain a registry of LSB names. The name may be registered by either a distribution or an application.

• If the package name begins with "lsb-" and contains more than one hyphen (for example "lsb-distro.example.com-database" or "lsb-gnome-gnumeric"), then the portion of the package name between first and second hyphens shall either be an LSB provider name assigned by the LANANA, or it may be one of the owners' fully-qualified domain names in lower case (e.g., "debian.org", "staroffice.sun.com"). The LSB provider name assigned by LANANA shall only consist of the ASCII characters [a-z0-9]. The provider name or domain name may be either that of a distribution or an application.

• Package names containing no hyphens are reserved for use by distributions. Applications must not use such names.³

3 For example, "frobnicator".

• Package names which do not start with "lsb-" and which contain a hyphen are open to both distributions and applications. Distributions may name packages in any part of this namespace. They are encouraged to use names from one of the other namespaces available to them, but this is not required due to the large amount of current practice to the contrary.⁴

4 For example, ssh-common, ssh-client, kernel-pcmcia, and the like. Possible alternative names include sshcommon, foolinux-ssh-common (where foolinux is registered to the distribution), or lsb-foolinux-ssh-common.

Applications may name their packages this way, but only if the portion of the name before the first hyphen is a provider name or registered domain name as described above.⁵

5 For example, if an application vendor has domain name visicalc.example.com and has registered visicalc as a provider name, they might name packages visicalc-base, visicalc.example.com-charting, and the like.

Note that package names in this namespace are available to both the distribution and an application. Distributions and applications will need to consider this potential for conflicts when deciding to use these names rather than the alternatives (such as names starting with "lsb-").

22.6 Package Dependencies

Packages shall have a dependency that indicates which LSB modules are required. LSB module descriptions are dash seperated tuples containing the name 'lsb', the
module name, and the architecture name. The following dependencies may be used.

**lsb-core-arch**

This dependency is used to indicate that the application is dependent on features contained in the LSB-Core specification.

**lsb-core-noarch**

This dependency is used to indicate that the application is dependent on features contained in the LSB-Core specification and that the package does not contain any architecture specific files.

These dependencies shall have a version of 3.0.

Packages shall not depend on other system-provided dependencies. They shall not depend on non-system-provided dependencies unless those dependencies are fulfilled by packages which are part of the same application. A package may only provide a virtual package name which is registered to that application.

Other modules in the LSB may supplement this list. The architecture specific dependencies are described in the relevant architecture specific LSB.

### 22.7 Package Architecture Considerations

Packages which do not contain any architecture specific files must specify an architecture of noarch. An LSB runtime environment must accept values noarch, or the value specified in the architecture specific supplement.

Additional specifications or restrictions may be found in the architecture specific LSB specification.
Annex A Alphabetical Listing of Interfaces

A.1 libc

The behavior of the interfaces in this library is specified by the following Standards.

Large File Support
this specification
SUSv2
SVID Issue 3
SVID Issue 4

Table A-1 libc Function Interfaces

<table>
<thead>
<tr>
<th>Function</th>
<th>Specification</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>_Exit(GLIBC_2.1.1)[1]</td>
<td>getpwuid_r(GLIBC_2.1.1)[1]</td>
<td>sigaddset(GLIBC_2.1.1)[1]</td>
</tr>
<tr>
<td>_IO_feof(GLIBC_2.0)[1]</td>
<td>getrlimit(GLIBC_2.0)[1]</td>
<td>sigaltstack(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>_IO_getc(GLIBC_2.0)[1]</td>
<td>getrlimit64(GLIBC_2.0)[1]</td>
<td>sigandset(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>_IO_putc(GLIBC_2.0)[1]</td>
<td>getusage(GLIBC_2.0)[1]</td>
<td>sigdelset(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>__assert_fail(GLIBC_2.0)[1]</td>
<td>getservbyname(GLIBC_2.0)[1]</td>
<td>sigemptyset(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>__ctype_b_loc[1]</td>
<td>getservbyport(GLIBC_2.0)[1]</td>
<td>sigfillset(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>__ctype_get_mb_cur_max(GLIBC_2.0)[1]</td>
<td>getsid(GLIBC_2.0)[1]</td>
<td>sigignore(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>__ctype_tolower_loc[1]</td>
<td>getsockname()[1]</td>
<td>siginterrupt()[1]</td>
</tr>
<tr>
<td>__ctype_toupper_loc[1]</td>
<td>getsockopt()[1]</td>
<td>sigisemptyset()[1]</td>
</tr>
<tr>
<td>__fpending(GLIBC_2.2)[1]</td>
<td>getsb Joanna(GLIBC_2.1.3)[1]</td>
<td>sigismember(GLIBC_2.1.3)[1]</td>
</tr>
<tr>
<td>__h_errno_location[1]</td>
<td>gettext(GLIBC_2.0)[1]</td>
<td>siglongjmp(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>__ftime(GlIBC_2.2)[1]</td>
<td>gettimeofday(GLIBC_2.2)[1]</td>
<td>signal(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__ftime64(GLIBC_2.2)[1]</td>
<td>getuid(GLIBC_2.0)[1]</td>
<td>sigorset(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>__fxstat(GLIBC_2.0)[1]</td>
<td>getutent(GLIBC_2.0)[1]</td>
<td>sigpause(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__fxstat64(GLIBC_2.2)[1]</td>
<td>getutxent_r(GLIBC_2.0)[1]</td>
<td>sigpending(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>__getpagesize(GLIBC_2.0)[1]</td>
<td>getutxent(GLIBC_2.0)[1]</td>
<td>sigprocmask(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>__getpgid(GLIBC_2.0)[1]</td>
<td>getutxid()[1]</td>
<td>sigqueue()[1]</td>
</tr>
<tr>
<td>Function</td>
<td>Function</td>
<td>Function</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
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</tr>
<tr>
<td>__isinf[1]</td>
<td>getutxline()[1]</td>
<td>sigrelse()[1]</td>
</tr>
<tr>
<td>__isinff[1]</td>
<td>getw()[1]</td>
<td>sigreturn()[1]</td>
</tr>
<tr>
<td>__isinfl[1]</td>
<td>getwc()[1]</td>
<td>sigset()[1]</td>
</tr>
<tr>
<td>__isnan[1]</td>
<td>getwchar()[1]</td>
<td>sigsuspend()[1]</td>
</tr>
<tr>
<td>__isnanf[1]</td>
<td>getwd()[1]</td>
<td>sigtimedwait()[1]</td>
</tr>
<tr>
<td>__isnanl[1]</td>
<td>glob()[1]</td>
<td>sigwait()[1]</td>
</tr>
<tr>
<td>__libc_current_sigrtmax(GLIBC_2.1)[1]</td>
<td>glob64(GLIBC_2.1)[1]</td>
<td>sigwaitinfo(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__libc_current_sigrtmin(GLIBC_2.1)[1]</td>
<td>globfree(GLIBC_2.1)[1]</td>
<td>sleep(GLIBC_2.1)[1]</td>
</tr>
<tr>
<td>__libc_start_main(GLIBC_2.0)[1]</td>
<td>globfree64(GLIBC_2.0)[1]</td>
<td>snprintf(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__lxstat(GLIBC_2.0)[1]</td>
<td>gmtime(GLIBC_2.0)[1]</td>
<td>sockatmark()[1]</td>
</tr>
<tr>
<td>__lxstat64(GLIBC_2.2)[1]</td>
<td>gmtime_r(GLIBC_2.2)[1]</td>
<td>socket(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__mempcpy(GLIBC_2.0)[1]</td>
<td>grantpt(GLIBC_2.0)[1]</td>
<td>socketpair(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__rawmemchr(GLIBC_2.1)[1]</td>
<td>hcreate(GLIBC_2.1)[1]</td>
<td>sprintf(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__register_atfork[1]</td>
<td>hdestroy()[1]</td>
<td>srand()[1]</td>
</tr>
<tr>
<td>__sigsetjmp(GLIBC_2.0)[1]</td>
<td>hsearch(GLIBC_2.0)[1]</td>
<td>srand48(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__stpcpy(GLIBC_2.0)[1]</td>
<td>htonl(GLIBC_2.0)[1]</td>
<td>srandom(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__strdup(GLIBC_2.0)[1]</td>
<td>htons(GLIBC_2.0)[1]</td>
<td>sscanf(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__strtod_internal(GLIBC_2.0)[1]</td>
<td>iconv(GLIBC_2.0)[1]</td>
<td>statvfs(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__strtof_internal(GLIBC_2.0)[1]</td>
<td>iconv_close(GLIBC_2.0)[1]</td>
<td>statvfs64[1]</td>
</tr>
<tr>
<td>__strtok_r(GLIBC_2.0)[1]</td>
<td>iconv_open(GLIBC_2.0)[1]</td>
<td>stime(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>__strtold_internal(GLIBC_2.0)[1]</td>
<td>if_freenameln[1]</td>
<td>stpcpy(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__strtold_internal(GLIBC_2.0)[1]</td>
<td>if_indexoname[1]</td>
<td>stpncpy(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__strtoll_internal(GLIBC_2.0)[1]</td>
<td>if_nameln[1]</td>
<td>strcasecmp(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>__strtoull_internal(GLIBC_2.0)[1]</td>
<td>if_nametoiname[1]</td>
<td>strcascmp(GLIBC_2.2)[1]</td>
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<td>if_nameinjl[1]</td>
<td>strcasestr(GLIBC_2.2)[1]</td>
</tr>
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<td>imaxabs(GLIBC_2.0)[1]</td>
<td>strcat(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>Function</td>
<td>GLIBC_2.0</td>
<td>GLIBC_2.2</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>__sysconf</td>
<td>imaxdiv</td>
<td>strchr</td>
</tr>
<tr>
<td>__sysv_signal</td>
<td>index</td>
<td>strcmp</td>
</tr>
<tr>
<td>__wcstod_internal</td>
<td>inet_addr</td>
<td>strcoll</td>
</tr>
<tr>
<td>__wcstof_internal</td>
<td>inet_ntoa</td>
<td>strnscopy</td>
</tr>
<tr>
<td>__wcstol_internal</td>
<td>inet_ntop</td>
<td>strcspn</td>
</tr>
<tr>
<td>_initgroups</td>
<td>strdup</td>
<td></td>
</tr>
<tr>
<td>__xmknod</td>
<td>initstate</td>
<td>strerror</td>
</tr>
<tr>
<td>__xstat</td>
<td>insque</td>
<td>strftime</td>
</tr>
<tr>
<td>__xstat64</td>
<td>ioctl</td>
<td></td>
</tr>
<tr>
<td>_exit</td>
<td>isalnum</td>
<td>strncasec</td>
</tr>
<tr>
<td>longjmp</td>
<td>isalpha</td>
<td>strncasec</td>
</tr>
<tr>
<td>_setjmp</td>
<td>isascii</td>
<td>strncat</td>
</tr>
<tr>
<td>_tolower</td>
<td>isatty</td>
<td>strncmp</td>
</tr>
<tr>
<td>_toupper</td>
<td>isblank</td>
<td>strncmp</td>
</tr>
<tr>
<td>atoi</td>
<td>iscntrl</td>
<td>strndup</td>
</tr>
<tr>
<td>accept</td>
<td>isgraph</td>
<td>strlen</td>
</tr>
<tr>
<td>access</td>
<td>islower</td>
<td>strndup</td>
</tr>
<tr>
<td>acct</td>
<td>iswalpha</td>
<td>strndup</td>
</tr>
<tr>
<td>adjtime</td>
<td>isspace</td>
<td>strsep</td>
</tr>
<tr>
<td>alarm</td>
<td>isupper</td>
<td>strsep</td>
</tr>
<tr>
<td>asctime</td>
<td>iswalnum</td>
<td>strsep</td>
</tr>
<tr>
<td>asctime_r</td>
<td>iswalpha</td>
<td>strsep</td>
</tr>
<tr>
<td>asprintf</td>
<td>iswblank</td>
<td>strtof</td>
</tr>
<tr>
<td>atof</td>
<td>iswcntrl</td>
<td>strtoimax</td>
</tr>
</tbody>
</table>
### Annex A Alphabetical Listing of Interfaces

<table>
<thead>
<tr>
<th>Function</th>
<th>Function</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>atoi(GLIBC_2.0)[1]</td>
<td>iswctype(GLIBC_2.0)[1]</td>
<td>strtok(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>atol(GLIBC_2.0)[1]</td>
<td>iswdigit(GLIBC_2.0)[1]</td>
<td>strtok_r(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>atoll[1]</td>
<td>iswgraph()[1]</td>
<td>strtol()[1]</td>
</tr>
<tr>
<td>authnone_create(GLIBC_2.0)[1]</td>
<td>iswlower(GLIBC_2.0)[1]</td>
<td>strtold(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>basename(GLIBC_2.0)[1]</td>
<td>iswprint(GLIBC_2.0)[1]</td>
<td>strto1l(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>bcmp(GLIBC_2.0)[1]</td>
<td>iswpunct(GLIBC_2.0)[1]</td>
<td>strtoq(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>bcopy(GLIBC_2.0)[1]</td>
<td>iswspace(GLIBC_2.0)[1]</td>
<td>strtoull(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>bind(GLIBC_2.0)[1]</td>
<td>iswupper(GLIBC_2.0)[1]</td>
<td>strtoull(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>bind_textdomain_codest[1]</td>
<td>iswxdigit()[1]</td>
<td>strtoumax()[1]</td>
</tr>
<tr>
<td>bindresvport(GLIBC_2.0)[1]</td>
<td>isxdigit(GLIBC_2.0)[1]</td>
<td>strtoq(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>bindtextdomain(GLIBC_2.0)[1]</td>
<td>jrand48(GLIBC_2.0)[1]</td>
<td>strxfrm(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>brk(GLIBC_2.0)[1]</td>
<td>key_decryptsession(GLIBC_2.0)[1]</td>
<td>svc_getreqset(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>bsd_signal(GLIBC_2.0)[1]</td>
<td>kill(GLIBC_2.0)[1]</td>
<td>svc_register(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>bsearch(GLIBC_2.0)[1]</td>
<td>killpg(GLIBC_2.0)[1]</td>
<td>svc_run(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>btowc(GLIBC_2.0)[1]</td>
<td>l64a(GLIBC_2.0)[1]</td>
<td>svc_sendreply(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>bzero(GLIBC_2.0)[1]</td>
<td>labs(GLIBC_2.0)[1]</td>
<td>svcerr_auth(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>calloc(GLIBC_2.0)[1]</td>
<td>lchown(GLIBC_2.0)[1]</td>
<td>svcerr_decode(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>catclose(GLIBC_2.0)[1]</td>
<td>lcong48(GLIBC_2.0)[1]</td>
<td>svcerr_noproc(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>catgets(GLIBC_2.0)[1]</td>
<td>ld16(GLIBC_2.0)[1]</td>
<td>svcerr_noprog(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>catopen(GLIBC_2.0)[1]</td>
<td>lfind(GLIBC_2.0)[1]</td>
<td>svcerr_progvers(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>cfgetispeed(GLIBC_2.0)[1]</td>
<td>link(GLIBC_2.0)[1]</td>
<td>svcerr_systemerr(GLIBC_2.0)[1]</td>
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<td>link(GLIBC_2.0)[1]</td>
<td>svcerr_systemerr(GLIBC_2.0)[1]</td>
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<td>llabs(GLIBC_2.0)[1]</td>
<td>svctcp_create(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>cfsetispeed(GLIBC_2.0)[1]</td>
<td>llldiv(GLIBC_2.0)[1]</td>
<td>svcudp_create(GLIBC_2.0)</td>
</tr>
</tbody>
</table>
### Annex A Alphabetical Listing of Interfaces

<table>
<thead>
<tr>
<th>Function (LIBINT_2.0)</th>
<th>Function (LIBINT_2.0)</th>
<th>Function (LIBINT_2.0)</th>
</tr>
</thead>
<tbody>
<tr>
<td>cfsetospeed(GLIBC_2.0)[1]</td>
<td>localeconv(GLIBC_2.0)[1]</td>
<td>swab(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>cfsetospeed(GLIBC_2.0)[1]</td>
<td>localtime(GLIBC_2.0)[1]</td>
<td>swapcontext(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>chdir(GLIBC_2.0)[1]</td>
<td>localtime_r(GLIBC_2.0)[1]</td>
<td>swprintf(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>chmod(GLIBC_2.0)[1]</td>
<td>lockf(GLIBC_2.0)[1]</td>
<td>swscanf(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>chown(GLIBC_2.1)[1]</td>
<td>lockf64(GLIBC_2.1)[1]</td>
<td>symlink(GLIBC_2.1)[1]</td>
</tr>
<tr>
<td>chroot(GLIBC_2.0)[1]</td>
<td>longjmp(GLIBC_2.0)[1]</td>
<td>sync(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>clearerr(GLIBC_2.0)[1]</td>
<td>lrand48(GLIBC_2.0)[1]</td>
<td>sysconf(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>clnt_create(GLIBC_2.0)[1]</td>
<td>lsearch(GLIBC_2.0)[1]</td>
<td>syslog(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>clnt_pcreateerror(GLIBC_2.0)[1]</td>
<td>lseek(GLIBC_2.0)[1]</td>
<td>system(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>clnt_perror(GLIBC_2.0)[1]</td>
<td>makecontext(GLIBC_2.0)[1]</td>
<td>tcdrain(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>clnt_sperror(GLIBC_2.0)[1]</td>
<td>malloc(GLIBC_2.0)[1]</td>
<td>tcflow(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>clnt_sperror(GLIBC_2.0)[1]</td>
<td>mbhang(GLIBC_2.0)[1]</td>
<td>tcflush(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>clnt_sperror(GLIBC_2.0)[1]</td>
<td>mbrlen(GLIBC_2.0)[1]</td>
<td>tcsetattr(GLIBC_2.0)[1]</td>
</tr>
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<td>clnt_sperror(GLIBC_2.0)[1]</td>
<td>mbstowcs(GLIBC_2.0)[1]</td>
<td>tctgetpgrp(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>clock(GLIBC_2.0)[1]</td>
<td>mbsinit(GLIBC_2.0)[1]</td>
<td>tcgetpgrp(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>close(GLIBC_2.0)[1]</td>
<td>mbsnrtowcs(GLIBC_2.0)[1]</td>
<td>tcgetpgrp(GLIBC_2.0)[1]</td>
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### Annex A Alphabetical Listing of Interfaces

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<thead>
<tr>
<th>Function</th>
<th>Function</th>
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<td>tmpnam(GLIBC_2.0)</td>
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<td>tolower()</td>
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## Annex A Alphabetical Listing of Interfaces

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<th>Function</th>
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### Annex A Alphabetical Listing of Interfaces

<table>
<thead>
<tr>
<th>Function</th>
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Annex A Alphabetical Listing of Interfaces

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<tr>
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<th>shmat(GLIBC_2.0)[1]</th>
<th>xdr_void(GLIBC_2.0)[1]</th>
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A.2 libcrypt

The behavior of the interfaces in this library is specified by the following Standards.

Table A-3 libcrypt Function Interfaces

| crypt(GLIBC_2.0)[1] | encrypt(GLIBC_2.0)[1] | setkey(GLIBC_2.0)[1] |

A.3 libdl

The behavior of the interfaces in this library is specified by the following Standards.
this specification

Table A-4 libdl Function Interfaces

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A.4 libm

The behavior of the interfaces in this library is specified by the following Standards.
ISO C (1999)
this specification
SUSv2

Table A-5 libm Function Interfaces

| __finite[1] | csinhf()[1] | log10()[1] |

421
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Annex A Alphabetical Listing of Interfaces

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### Annex A Alphabetical Listing of Interfaces

<table>
<thead>
<tr>
<th>Function</th>
<th>Function</th>
<th>Function</th>
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<tbody>
<tr>
<td>cprojf(GLIBC_2.1)</td>
<td>lgammal_r(GLIBC_2.1)</td>
<td>y0l(GLIBC_2.1)</td>
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**Table A-6 libm Data Interfaces**

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### A.5 libncurses

The behavior of the interfaces in this library is specified by the following Standards.

**X/Open Curses**

**Table A-7 libncurses Function Interfaces**

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### Annex A Alphabetical Listing of Interfaces

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<td><code>mvwaddchstr</code></td>
<td><code>tigetstr</code></td>
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<td><code>mvwaddnstr</code></td>
<td><code>timeout</code></td>
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<td><code>mvwaddstr</code></td>
<td><code>touchline</code></td>
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<td><code>mvwchgat</code></td>
<td><code>touchwin</code></td>
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<td><code>mvwdelch</code></td>
<td><code>tparm</code></td>
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Annex A Alphabetical Listing of Interfaces

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Table A-8 libncurses Data Interfaces

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A.6 libpam

The behavior of the interfaces in this library is specified by the following Standards. this specification

Table A-9 libpam Function Interfaces

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A.7 libpthread

The behavior of the interfaces in this library is specified by the following Standards. Large File Support

Table A-10 libpthread Function Interfaces

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<tr>
<td>pthread_attr_setschedpolicy(GLIBC_2.0)[1]</td>
<td>pthread_mutexattr_destroy(GLIBC_2.0)[1]</td>
<td>sem_destroy(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>pthread_attr_setscope(GLIBC_2.0)[1]</td>
<td>pthread_mutexattr_getpshared(GLIBC_2.0)[1]</td>
<td>sem_getvalue(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>pthread_attr_setstack[1]</td>
<td>pthread_mutexattr_gettype()[1]</td>
<td>sem_init()[1]</td>
</tr>
</tbody>
</table>
Annex A Alphabetical Listing of Interfaces

<table>
<thead>
<tr>
<th>pthread_attr_setstackaddr(GLIBC_2.1)[1]</th>
<th>pthread_mutexattr_init(GLIBC_2.1)[1]</th>
<th>sem_open(GLIBC_2.1)[1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>pthread_attr_setstacksize(GLIBC_2.1)[1]</td>
<td>pthread_mutexattr_setpshared(GLIBC_2.1)[1]</td>
<td>sem_post(GLIBC_2.1)[1]</td>
</tr>
<tr>
<td>pthread_cancel(GLIBC_2.0)[1]</td>
<td>pthread_mutexattr_settype(GLIBC_2.0)[1]</td>
<td>sem_timedwait(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>pthread_cond_broadcast(GLIBC_2.0)[1]</td>
<td>pthread_once(GLIBC_2.0)[1]</td>
<td>sem_trywait(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>pthread_cond_destroy(GLIBC_2.0)[1]</td>
<td>pthread_rwlock_destroy(GLIBC_2.0)[1]</td>
<td>sem_unlink(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>pthread_cond_init(GLIBC_2.0)[1]</td>
<td>pthread_rwlock_init(GLIBC_2.0)[1]</td>
<td>sem_wait(GLIBC_2.0)[1]</td>
</tr>
<tr>
<td>pthread_cond_signal(GLIBC_2.0)[1]</td>
<td>pthread_rwlock_rdlock(GLIBC_2.0)[1]</td>
<td></td>
</tr>
<tr>
<td>pthread_cond_timedwait(GLIBC_2.0)[1]</td>
<td>pthread_rwlock_timedrdlock(GLIBC_2.0)[1]</td>
<td></td>
</tr>
</tbody>
</table>

A.8 librt

The behavior of the interfaces in this library is specified by the following Standards.

Table A-11 librt Function Interfaces

<table>
<thead>
<tr>
<th>clock_getcpuclockid(GLIBC_2.2)[1]</th>
<th>clock_settime(GLIBC_2.2)[1]</th>
<th>timer_delete(GLIBC_2.2)[1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>clock_getres(GLIBC_2.2)[1]</td>
<td>shm_open(GLIBC_2.2)[1]</td>
<td>timer_getoverrun(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>clock_gettime(GLIBC_2.2)[1]</td>
<td>shm_unlink(GLIBC_2.2)[1]</td>
<td>timer_gettime(GLIBC_2.2)[1]</td>
</tr>
<tr>
<td>clock_nanosleep(GLIBC_2.2)[1]</td>
<td>timer_create(GLIBC_2.2)[1]</td>
<td>timer_settime(GLIBC_2.2)[1]</td>
</tr>
</tbody>
</table>

A.9 libutil

The behavior of the interfaces in this library is specified by the following Standards.

Table A-12 libutil Function Interfaces

<table>
<thead>
<tr>
<th>forkpty(GLIBC_2.0)[1]</th>
<th>login_tty(GLIBC_2.0)[1]</th>
<th>logwtmp(GLIBC_2.0)[1]</th>
</tr>
</thead>
<tbody>
<tr>
<td>login(GLIBC_2.0)[1]</td>
<td>logout(GLIBC_2.0)[1]</td>
<td>openpty(GLIBC_2.0)[1]</td>
</tr>
</tbody>
</table>

A.10 libz

The behavior of the interfaces in this library is specified by the following Standards.
Table A-13 libz Function Interfaces

<table>
<thead>
<tr>
<th>Function</th>
<th>Function</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>get_crc_table[1]</td>
<td>gzsetparams[1]</td>
<td></td>
</tr>
</tbody>
</table>
Annex B Future Directions (Informative)

B.1 Introduction

This appendix describes interfaces that are under development and aimed at future releases of this specification. At this stage, such interfaces are at best recommended practice, and do not constitute normative requirements of this specification. Applications may not assume that any system provides these interfaces.

We encourage system implementors and ISVs to provide these interfaces, and to provide feedback on their specification to lsbspec@freestandards.org (mailto://lsb-spec@freestandards.org). These interfaces may well be further modified during the development process, and may be withdrawn if consensus cannot be reached.
B.2 Commands And Utilities

lsbinstall

Name
lsbinstall — installation tool for various types of data

Synopsis
/usr/lib/lsb/lsbinstall [-c | --check | -r | --remove] { -t type | --
type=type } [ -p package | --package=package] operand...

Description
The lsbinstall utility may be used to install certain types of files into system specific locations, repositories, or databases. This command may be used during a package post installation script to add package specific data to system wide repositories. A user may need appropriate privilege to invoke lsbinstall.

The operand (or operands) name an object of type type (see below) that belongs to a package named package. The combination of package name, object type and object name should be unique amongst all objects installed by lsbinstall. The lsbinstall utility may rename an object if another package already owns an object of the same type with the same name.

Note: If a namespace collision is detected by lsbinstall, it is unspecified how the object is renamed, although typical implementations may prepend the package name to the object in some way (e.g. package.obj-name). The lsbinstall utility may maintain a database of the mappings it has performed during installation in order to ensure that the correct object is removed during a subsequent removal operation.

Scripts installed by lsbinstall should not make use of the script name in order to decide on their functionality.

Note: It is appropriate for such a script to use the script name in error messages, usage statements, etc. The only guarantee made by lsbinstall is the effect that an installation (or removal) should have, not where a script is installed, or how it is named.

The -p pkg or --package=pkg is required for all object types unless explicitly noted below.

If the -c or --check option is specified, lsbinstall should test to see if there is an existing object of the type specified already installed. If there is, lsbinstall should print a message to its standard output and immediately exit with a status of zero. If there is no object of the type and name specified already installed, lsbinstall should exit with a non-zero status and take no further action.

If the -r or --remove is specified, the named object of the specified type should be removed or disabled from the system, except as noted below. The behavior is unspecified if the named object was not previously installed by lsbinstall.

Note: lsbinstall may rename objects during installation in order to prevent name collisions where another package has already installed an object with the given name. Using lsbinstall --remove will remove only the object belonging to the named package, and not the object belonging to another package.
Annex B Future Directions (Informative)

Also note that the intent of the --remove option is to prevent the effect of the installed object; it should be sufficient to disable or comment out the addition in some way, while leaving the content behind. It is not intended that --remove be required to be the exact reverse of installation.

Object Types

The -t type or --type=type option should support at least the following types:

profile

install a profile script into a system specific location. There should be one operand, that names a profile shell script. The behavior is unspecified if this name does not have the suffix .sh.

The sh utility should read and execute commands in its current execution environment from all such installed profile shell scripts when invoked as an interactive login shell, or if the -l (the letter ell) is specified (see Shell Invocation).

service

ensure a service name and number pair is known to the system service database. When installing, there must be at least two operands. The first operand should have the format %d/%s with the port number and protocol values (e.g. 22/tcp), and the second operand should be the name of the service. Any subsequent operands provide aliases for this service. The -p pkg or --package=pkg option is not required for service objects, and is ignored if specified. If any of the -r, --remove, -c or --check options are specified, there should be a single operand identifying the port and protocol values (with the same format as above).

It should not be an error to attempt to add a service name to the system service database if that service name already exists for the same port and protocol combination. If the port and protocol combination was already present, but the name unknown, the name should be added as an alias to the existing entry. It should be an error to attempt to add a second entry for a given service name and protocol, but where the port number differs from an existing entry.

If the -r or --remove is specified, the system service database need not be updated to remove or disable the named service.

inet

add an entry to the system's network super daemon configuration. If none of the -r, --remove, -c or --check options are specified, the first operand should have the format:

"%s:%s:%s:%s:%s:%s"

Otherwise, the first operand should have the format

"%s:%s"

The fields in the first operand have the following meaning, in order:

svc_name

The name of this service. If the name does not contain a /, this should match the name of an already installed service (see also getservbyname()). If the name contains a / character, the behavior is unspecified.
**Rationale:** This version of the LSB does not specify `getrpcbyname()` nor the existence or format of the `/etc/rpc` file. Therefore, installation of RPC based services is not specified at this point. A future version of this specification may require names containing a `/` character to be Remote Procedure Call-based services.

**Protocol**

The name of a protocol. The name should be one of those listed in `/etc/protocols`. If this attribute is not specified (i.e. a null value is passed), the system should use an implementation defined default protocol.

**socket_type**

One of the following values:

- **stream**
  
  the service will use a stream type socket.

- **dgram**
  
  the service will use a datagram type socket.

- **seqpacket**
  
  the service will use a sequenced packet type socket.

This field is not required for the `-c`, `--check`, `-r`, or `--remove` options.

**wait_flag**

If the value of this attribute is `wait`, once the service is started, no further requests for that service will be handled until the service exits. If the value is `nowait`, the network super daemon should continue to handle further requests for the given service while that service is running.

**Note:** If the service has the `socket_type` attribute set to `dgram`, the `wait_flag` attribute should be set to `wait`, since such services do not have any distinction between the socket used for listening and that used for accepting.

This field is not required for the `-c`, `--check`, `-r`, or `--remove` options.

**user[.group]**

The name of a user from the user login database, optionally followed by the name of a group from the group database. The service started to handle this request should run with the privileges of the specified user and group. This field is not required for the `-c`, `--check`, `-r`, or `--remove` options.

**server [arg ...]**

The name of a program to run to handle the request, optionally followed by any arguments required. The server name and each of its arguments is separated by whitespace. This field is not required for the `-c`, `--check`, `-r`, or `--remove` options.

If the implementation supports additional controls over services started through the inet super daemon, there may be additional, implementation-defined, operands.

435
Rationale: Systems that use the xinetd super daemon may support additional controls such as IP address restrictions, logging requirements, etc. The LSB does not require these additional controls. However, it was believed to be of sufficient benefit that implementations are granted permission to extend this interface as required.

Examples

```bash
lsbinstall --package=myapp --type=profile myco.com-prod.sh
```

Install the profile shell script for myco.com-prod.sh, part of the myapp package.

```bash
lsbinstall --package=myapp --check --type=profile myco.com-prod.sh
```

Test to see if the profile shell script for myco.com-prod.sh, as part of the myapp package, is installed correctly.

Exit Status

If the -c or --check option is specified, lsbinstall should exit with a zero status if an object of the specified type and name is already installed, or non-zero otherwise. Otherwise, lsbinstall should exit with a zero status if the object with the specified type and name was successfully installed (or removed if the -r or --remove option was specified), and non-zero if the installation (or removal) failed. On failure, a diagnostic message should be printed to the standard error file descriptor.
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Version 1.1, March 2000

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