
Linux Standard Base (LSB) —
Part 4-2:
Core specification for AMD64 (X86-64) architecture

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO/IEC PRF 23360-4-2](https://standards.iteh.ai/catalog/standards/sist/e111f345-0b6f-4b87-bdf0-03ac94945ee5/iso-iec-prf-23360-4-2)

<https://standards.iteh.ai/catalog/standards/sist/e111f345-0b6f-4b87-bdf0-03ac94945ee5/iso-iec-prf-23360-4-2>



iTeh STANDARD PREVIEW (standards.iteh.ai)

[ISO/IEC PRF 23360-4-2](https://standards.iteh.ai/catalog/standards/sist/e111f345-0b6f-4b87-bdf0-03ac94945ee5/iso-iec-prf-23360-4-2)

<https://standards.iteh.ai/catalog/standards/sist/e111f345-0b6f-4b87-bdf0-03ac94945ee5/iso-iec-prf-23360-4-2>



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2021

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see patents.iec.ch).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by the Linux Foundation [as Linux Standard Base (LSB): Core specification for AMD64 (X86-64) architecture] and drafted in accordance with its editorial rules. It was assigned to Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 22, *Programming languages, their environments and system software interfaces*, and adopted by National Bodies.

This first edition of ISO/IEC 23360-4-2 cancels and replaces ISO/IEC 23360-4:2006, which has been technically revised.

A list of all parts in the ISO/IEC 23660 series can be found on the ISO and IEC websites.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Contents

Foreword	iii
Introduction	vi
I Introductory Elements	1
1 Scope.....	2
2 References.....	3
2.1 Normative References	3
2.2 Informative References/Bibliography.....	5
3 Requirements	8
3.1 Relevant Libraries	8
3.2 LSB Implementation Conformance.....	8
3.3 LSB Application Conformance	9
4 Terms and Definitions.....	11
5 Documentation Conventions	13
II Executable and Linking Format (ELF)	14
6 Introduction	15
7 Low Level System Information	16
7.1 Machine Interface.....	16
7.2 Function Calling Sequence	17
7.3 Operating System Interface.....	18
7.4 Process Initialization	18
7.5 Coding Examples.....	19
7.6 C Stack Frame.....	19
7.7 Debug Information.....	19
8 Object Format	20
8.1 Introduction.....	20
8.2 ELF Header.....	20
8.3 Sections.....	20
8.4 Symbol Table	21
8.5 Relocation	21
9 Program Loading and Dynamic Linking	22
9.1 Introduction.....	22
9.2 Program Header	22
9.3 Program Loading	22
9.4 Dynamic Linking.....	22
III Base Libraries	24
10 Libraries	25
10.1 Program Interpreter/Dynamic Linker	25
10.2 Interfaces for libc	25
10.3 Data Definitions for libc.....	45
10.4 Interface Definitions for libc	65
10.5 Interfaces for libm	66
10.6 Data Definitions for libm	71
10.7 Interface Definitions for libm	72
10.8 Interfaces for libpthread.....	73
10.9 Data Definitions for libpthread.....	79
10.10 Interfaces for libgcc_s.....	80
10.11 Data Definitions for libgcc_s.....	81
10.12 Interface Definitions for libgcc_s.....	81

10.13 Interfaces for libdl	82
10.14 Data Definitions for libdl.....	83
10.15 Interfaces for libcrypt	83
10.16 Data Definitions for libcrypt.....	84
IV Utility Libraries	85
11 Libraries	86
11.1 Interfaces for libz	86
11.2 Data Definitions for libz.....	86
11.3 Interfaces for libncurses	87
11.4 Data Definitions for libncurses	87
11.5 Interfaces for libncursesw	87
11.6 Data Definitions for libncursesw	88
11.7 Interfaces for libutil	88
V Base Libraries.....	90
12 Libraries	91
12.1 Interfaces for libstdcxx.....	91
12.2 Interface Definitions for libstdcxx.....	202
VI Package Format and Installation	203
13 Software Installation.....	204
13.1 Package Dependencies	204
13.2 Package Architecture Considerations	204
Annex A Alphabetical Listing of Interfaces by Library.....	205
A.1 libc	205
A.2 libcrypt	220
A.3 libdl	220
A.4 libgcc_s.....	221
A.5 libm	221
A.6 libpthread.....	226
A.7 librt.....	229
A.8 libutil	230

iTeh STANDARD PREVIEW

(standards.iteh.ai)

ISO/IEC PRF 23360-4-2

<https://standards.iteh.ai/catalog/standards/sist/e111f345-0b6f-4b87-bd10-03ac94945cc5/iso-iec-prf-23360-4-2>

03ac94945cc5/iso-iec-prf-23360-4-2

Introduction

The LSB defines a binary interface for application programs that are compiled and packaged for LSB-conforming implementations on many different hardware architectures. A binary specification must include information specific to the computer processor architecture for which it is intended. To avoid the complexity of conditional descriptions, the specification has instead been divided into generic parts which are augmented by one of several architecture-specific parts, depending on the target processor architecture; the generic part will indicate when reference must be made to the architecture part, and vice versa.

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:

1. The first number (x) is the major version number. Versions sharing the same major version number shall be compatible in a backwards direction; that is, a newer version shall be compatible with an older version. Any deletion of a library results in a new major version number. Interfaces marked as deprecated may be removed from the specification at a major version change.
2. The second number (y) is the minor version number. Libraries and individual interfaces may be added, but not removed. Interfaces may be marked as deprecated at a minor version change. Other minor changes may be permitted at the discretion of the LSB workgroup.
3. The third number (z), if present, is the editorial level. Only editorial changes should be included in such versions.

Since this specification is a descriptive Application Binary Interface, and not a source level API specification, it is not possible to make a guarantee of 100% backward compatibility between major releases. However, it is the intent that those parts of the binary interface that are visible in the source level API will remain backward compatible from version to version, except where a feature marked as "Deprecated" in one release may be removed from a future release. Implementors are strongly encouraged to make use of symbol versioning to permit simultaneous support of applications conforming to different releases of this specification.

LSB is a trademark of the Linux Foundation. Developers of applications or implementations interested in using the trademark should see the Linux Foundation Certification Policy for details.

I Introductory Elements

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[ISO/IEC PRF 23360-4-2](https://standards.iteh.ai/catalog/standards/sist/e111f345-0b6f-4b87-bdf0-03ac94945ee5/iso-iec-prf-23360-4-2)

<https://standards.iteh.ai/catalog/standards/sist/e111f345-0b6f-4b87-bdf0-03ac94945ee5/iso-iec-prf-23360-4-2>

1 Scope

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 part describing those parts of the interface that remain constant across all implementations of the LSB, and an architecture-specific part describing the parts of the interface that vary by processor architecture. Together, the common part and the relevant architecture-specific part for a single hardware architecture provide a complete interface specification for compiled application programs on systems that share a common hardware architecture.

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 provides 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.

This is the X86-64 architecture specific part of the Core module of the Linux Standard Base (LSB). This part supplements the common part of the LSB Core module with those interfaces that differ between architectures.

This part should be used in conjunction with LSB Core - Generic, the common part. Whenever a section of the common part is supplemented by architecture-specific information, the common part includes a reference to the architecture-specific part. This part may also contain additional information that is not referenced in the common part.

Interfaces described in this part of the LSB Core Specification are mandatory except where explicitly listed otherwise. Interfaces described in the LSB Core module are supplemented by other LSB modules. All other modules depend on the presence of LSB Core.

2 References

2.1 Normative References

The following specifications are incorporated by reference into this specification. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced specification (including any amendments) applies.

Note: Where copies of a referenced specification are available on the World Wide Web, a Uniform Resource Locator (URL) is given, for informative purposes only. Such URL might at any given time resolve to a more recent copy of the specification, or be out of date (not resolve). Reference copies of specifications at the revision level indicated may be found at the Linux Foundation's Reference Specifications (<http://refspecs.linuxbase.org>) site.

Table 2-1 Normative References

Name	Title	URL
LSB Core - Generic	Linux Standard Base - Core Specification - Generic	http://www.linuxbase.org/spec/
AMD64 Architecture Programmer's Manual, Volume 1	AMD64 Architecture Programmer's Manual, Volume 1: Application Programming 24592 3.08	http://www.amd.com/us-en/Processors/DevelopWithAMD/
AMD64 Architecture Programmer's Manual, Volume 2	AMD64 Architecture Programmer's Manual, Volume 2: System Programming 24593 3.08 https://standards.iteh.ai/catalog/standards/sist/e111f345-0b6f-4b87-bd10-03ac94945cc5/iso-iec-prf-23360-4-2	http://www.amd.com/us-en/Processors/DevelopWithAMD/
AMD64 Architecture Programmer's Manual, Volume 3	AMD64 Architecture Programmer's Manual, Volume 3: General Purpose and System Instructions 24594 3.03	http://www.amd.com/us-en/Processors/DevelopWithAMD/
AMD64 Architecture Programmer's Manual, Volume 4	AMD64 Architecture Programmer's Manual, Volume 4: 128-bit Media Instructions 26568 3.04	http://www.amd.com/us-en/Processors/DevelopWithAMD/
AMD64 Architecture Programmer's Manual, Volume 5	AMD64 Architecture Programmer's Manual, Volume 5: 64-bit Media and x87 Floating-Point Instructions 26569 3.03	http://www.amd.com/us-en/Processors/DevelopWithAMD/
Filesystem Hierarchy Standard	Filesystem Hierarchy Standard (FHS) 3.0	http://refspecs.linuxbase.org/fhs
ISO C (1999)	ISO/IEC 9899:1999 - Programming Languages -- C	

Name	Title	URL
ISO/IEC 14882: 2003 C++ Language	ISO/IEC 14882: 2003 Programming languages --C++	
Itanium™ C++ ABI	Itanium™ C++ ABI (Revision 1.86)	http://refspecs.linuxfoundation.org/cxxabi-1.86.html
Large File Support	Large File Support	http://www.UNIX-systems.org/version2/whatsnew/lfs20mar.html
Libncursesw API	Libncursesw API	http://invisible-island.net/ncurses/man/ncurses.3x.html
Libncursesw Placeholder	Libncursesw Specification Placeholder	http://refspecs.linuxfoundation.org/libncursesw/libncursesw.html
POSIX 1003.1-2001 (ISO/IEC 9945-2003)	ISO/IEC 9945-1:2003 Information technology -- Portable Operating System Interface (POSIX) -- Part 1: Base Definitions ISO/IEC 9945-2:2003 Information technology -- Portable Operating System Interface (POSIX) -- Part 2: System Interfaces ISO/IEC 9945-3:2003 Information technology -- Portable Operating System Interface (POSIX) -- Part 3: Shell and Utilities ISO/IEC 9945-4:2003 Information technology -- Portable Operating System Interface (POSIX) -- Part 4: Rationale Including Technical Cor. 1: 2004	http://www.unix.org/version3/
POSIX 1003.1-2008 (ISO/IEC 9945-2009)	Portable Operating System Interface (POSIX®) 2008 Edition / The Open Group Technical Standard	http://www.unix.org/version4/

Name	Title	URL
	Base Specifications, Issue 7	
SUSv2	CAE Specification, January 1997, System Interfaces and Headers (XSH), Issue 5 (ISBN: 1- 85912-181-0, C606)	http://www.opengroup.org/publications/catalog/un.htm
SVID Issue 3	American Telephone and Telegraph Company, System V Interface Definition, Issue 3; Morristown, NJ, UNIX Press, 1989. (ISBN 0201566524)	
SVID Issue 4	System V Interface Definition, Fourth Edition	http://refspecs.linuxfoundation.org/svid4/
System V ABI	System V Application Binary Interface, Edition 4.1	http://www.sco.com/developers/devspecs/gabi41.pdf
System V ABI Update	System V Application Binary Interface - DRAFT - 17 December 2003	http://www.sco.com/developers/gabi/2003-12-17/contents.html
System V Application Binary Interface AMD64 Architecture Processor Supplement	System V Application Binary Interface AMD64 Architecture Processor Supplement, Draft Version 0.95	http://refspecs.linuxfoundation.org/elf/x86_64-abi-0.95.pdf
X/Open Curses, Issue 7	X/Open Curses, Issue 7 (ISBN: 1-931624-83-6, The Open Group, November 2009)	https://www2.opengroup.org/ogsys/catalog/C094

2.2 Informative References/Bibliography

The documents listed below provide essential background information to implementors of this specification. These references are included for information only, and do not represent normative parts of this specification.

Table 2-2 Other References

Name	Title	URL
DWARF Debugging Information Format, Version 4	DWARF Debugging Information Format, Version 4 (June 10, 2010)	http://www.dwarfstd.org/doc/DWARF4.pdf

Name	Title	URL
IEC 60559/IEEE 754 Floating Point	IEC 60559:1989 Binary floating-point arithmetic for microprocessor systems	http://www.ieee.org/
ISO/IEC TR14652	ISO/IEC Technical Report 14652:2002 Specification method for cultural conventions	
ITU-T V.42	International Telecommunication Union Recommendation V.42 (2002): Error-correcting procedures for DCEs using asynchronous-to-synchronous conversion ITUV	http://www.itu.int/rec/recommendation.asp?type=folders&lang=e&parent=T-REC-V.42
Li18nux Globalization Specification	LI18NUX 2000 Globalization Specification, Version 1.0 with Amendment 4	http://www.openi18n.org/docs/html/LI18NUX-2000-amd4.htm
Linux Allocated Device Registry	LINUX ALLOCATED DEVICES	http://www.lanana.org/docs/device-list/devices-2.6+.txt
Linux Assigned Names And Numbers Authority	Linux Assigned Names And Numbers Authority	http://www.lanana.org/
Mozilla's NSS SSL Reference	Mozilla's NSS SSL Reference	http://www.mozilla.org/projects/security/pki/nss/ref/ssl/
NSPR Reference	Mozilla's NSPR Reference	http://refspecs.linuxfoundation.org/NSPR_API_Reference/NSPR_API.html
PAM	Open Software Foundation, Request For Comments: 86.0 , October 1995, V. Samar & R.Schemers (SunSoft)	http://www.opengroup.org/tech/rfc/mirror-rfc/rfc86.0.txt
RFC 1321: The MD5 Message-Digest Algorithm	IETF RFC 1321: The MD5 Message-Digest Algorithm	http://www.ietf.org/rfc/rfc1321.txt
RFC 1833: Binding Protocols for ONC RPC Version 2	IETF RFC 1833: Binding Protocols for ONC RPC Version 2	http://www.ietf.org/rfc/rfc1833.txt

Name	Title	URL
RFC 1950: ZLIB Compressed Data Format Specification	IETF RFC 1950: ZLIB Compressed Data Format Specification	http://www.ietf.org/rfc/rfc1950.txt
RFC 1951: DEFLATE Compressed Data Format Specification	IETF RFC 1951: DEFLATE Compressed Data Format Specification version 1.3	http://www.ietf.org/rfc/rfc1951.txt
RFC 1952: GZIP File Format Specification	IETF RFC 1952: GZIP file format specification version 4.3	http://www.ietf.org/rfc/rfc1952.txt
RFC 2440: OpenPGP Message Format	IETF RFC 2440: OpenPGP Message Format	http://www.ietf.org/rfc/rfc2440.txt
RFC 2821: Simple Mail Transfer Protocol	IETF RFC 2821: Simple Mail Transfer Protocol	http://www.ietf.org/rfc/rfc2821.txt
RFC 2822: Internet Message Format	IETF RFC 2822: Internet Message Format	http://www.ietf.org/rfc/rfc2822.txt
RFC 5531/4506 RPC & XDR	IETF RFC 5531 & 4506	http://www.ietf.org/
RFC 791: Internet Protocol	IETF RFC 791: Internet Protocol Specification	http://www.ietf.org/rfc/rfc791.txt
RPM Package Format	RPM Package Format V3.0 https://standards.iteh.ai/catalog/standards/sist/e111f345-0b6e-4b87-bd1e-03ac94925ee5/iso-iec-prf-23360-4-2 See 5/iso-iec-prf-23360-4-2	http://www.rpm.org/max-rpm/s1-rpm-file-format-rpm-file-format.html
zlib Manual	zlib 1.2 Manual	http://www.gzip.org/zlib/

3 Requirements

3.1 Relevant Libraries

The libraries listed in Table 3-1 shall be available on x86-64 Linux Standard Base systems, with the specified runtime names. These names override or supplement the names specified in the generic LSB (LSB Core - Generic) specification. The specified program interpreter, referred to as `proginterp` in this table, shall be used to load the shared libraries specified by `DT_NEEDED` entries at run time.

Table 3-1 Standard Library Names

Library	Runtime Name
libc	libc.so.6
libcrypt	libcrypt.so.1
libdl	libdl.so.2
libgcc_s	libgcc_s.so.1
libm	libm.so.6
libncurses	libncurses.so.5
libncursesw	libncursesw.so.5
libpthread	libpthread.so.0
libstdc++	libstdc++.so.6
libutil	libutil.so.1
libz	libz.so.1
proginterp	/lib64/ld-linux-x86-64.so.3

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 is necessarily architecture specific, and must provide the interfaces specified by both the generic LSB Core specification (LSB Core - Generic) and the relevant architecture specific part of the LSB Core Specification.

Rationale: An implementation must provide *at least* the interfaces specified in these specifications. It may also provide additional interfaces.

A conforming implementation shall satisfy the following requirements:

- A processor architecture represents a family of related processors which may not have identical feature sets. The architecture specific parts of the LSB Core Specification that supplement this specification for a given target processor architecture describe a minimum acceptable processor. The implementation shall provide all features of this processor, whether in hardware or through emulation transparent to the application.

- The implementation shall be capable of executing compiled applications having the format and using the system interfaces described in this specification.
- The implementation shall provide libraries containing the interfaces specified by this specification, 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 specification.
- The map of virtual memory provided by the implementation shall conform to the requirements of this specification.
- 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 specification.
- 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 specification in the format defined here and in other documents normatively included by reference. All commands and utilities shall behave as required by this specification. The implementation shall also provide all mandatory components of an application's runtime environment that are included or referenced in this specification.
- 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 containing object files is necessarily architecture specific, and must conform to both the generic LSB Core specification (LSB Core - Generic) and the relevant architecture specific part of the LSB Core Specification. A conforming application which contains no object files may be architecture neutral. Architecture neutral applications shall conform only to the requirements of the generic LSB Core specification (LSB Core - Generic).

A conforming application shall satisfy the following requirements:

- Executable files shall be either object files in the format defined in the Object Format section of this specification, or script files in a scripting language where the interpreter is required by this specification.
- Object files shall participate in dynamic linking as defined in the Program Loading and Linking section of this specification.
- Object files shall employ only the instructions, traps, and other low-level facilities defined as being for use by applications in the Low-Level System Information section of this specification