

IEEE Standard for Information Technology—POSIX[®]-Based Supercomputing Application Environment Profile

Sponsor

**Portable Application Standards Committee
of the
IEEE Computer Society**

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Abstract: This standard is related to the POSIX[®] series of standards for applications and user interfaces to open systems. It specifies the set of standards and the requirements needed for portability of supercomputing applications, users, and system administrators.

Keywords: AEP, application portability, applications, batch, portability, portable application, profile, queue, resource, supercomputer, supercomputing, user portability

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Foreword

This profile is being developed and maintained by the P1003.10 Supercomputing working groups within the IEEE Computer Society Portable Applications Standards Committee as part of the POSIX Open Systems Environment. The Supercomputing working group includes members from both user and vendor organizations.

No existing profiles are superseded by this work. This is the first version of this profile.

The normative sections and annexes are:

1, 2, 3, 4, 5, 6, A.

The informative annexes are:

B, C, D, E, F, G.

Introduction

This Introduction is not a normative part of IEEE Std 1003.10-1995, but is included for information only.

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Robert Bismuth
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IEEE Standard for Information Technology—POSIX[®]-Based Supercomputing Application Environment Profile

1. General

1.1 Scope

The purpose of this standard profile is

- To define a supercomputing application environment profile, based on the POSIX suite of standards, in order to provide application and user portability in a supercomputing environment.
- To identify additional supercomputing requirements not currently met by formal standards.

This profile specifies standards, options, and additional requirements needed by supercomputing applications and users in a POSIX environment.

This profile focuses on the portability of supercomputing applications and the users of supercomputers. Supercomputing applications differ from other computing applications in the scale of the compute task. The massive scale of supercomputing applications creates the need for some services that are frequently missing or inadequate in smaller systems. The goal of this profile is to detail an environment that provides these services.

This profile uses the model of the traditional supercomputer environment: a centralized compute and data serve entity with access from other compute and data serve entities of varying capability. While the centralized entity could be one physical machine, there is nothing in this profile to preclude that entity being a collection of workstations or a massively parallel machine that is seen by the user as one entity.

The audience of this profile includes supercomputer procurers, supercomputer vendors, and application developers. By specifying a list of required standards and any corresponding options, this profile benefits each of the targeted groups.

This profile provides a basis for a standards based environment that can be used to target system implementation and application development. It also provides guidance to users in the acquisition of systems and applications. Focusing on

a specific set of standards and options provides a greater level of application portability and consistency of user interaction. This allows users to acquire and make effective use of both new systems and new applications when these are designed for conformance to this profile.

This profile does not address other types of systems such as realtime, transaction processing, fault tolerant, etc.

This profile does not address any unique requirements of massively parallel or distributed supercomputer environments. These modes of delivering compute power for supercomputing applications are likely to be even more important in the future, but standardization at this time is premature. The scope of this standard may be expanded to include these areas at some future time.

1.2 Scenario and Supercomputing Model

A typical supercomputer system is self contained; it includes both the application development environment and the execution environment. Such a system may actually be composed of multiple processing engines but appears to the user as a single system. Such a system may also include network connections, but those are explicitly visible to the user.

1.2.1 Typical Supercomputing Applications

The particular requirements and characteristics of supercomputers and supercomputing applications include

- Massive amounts of data
- Large physical resource requirements
- Long runtimes (several days or more)
- Job suspension and continuation
- Numerically intensive
- Timely turnaround
- Expensive resources

Refer to Annex E for examples.

1.2.2 Supercomputing Model

The traditional concept of a POSIX system assumes that the application and utility processes are being controlled by an interactive user who may initiate a shell script.

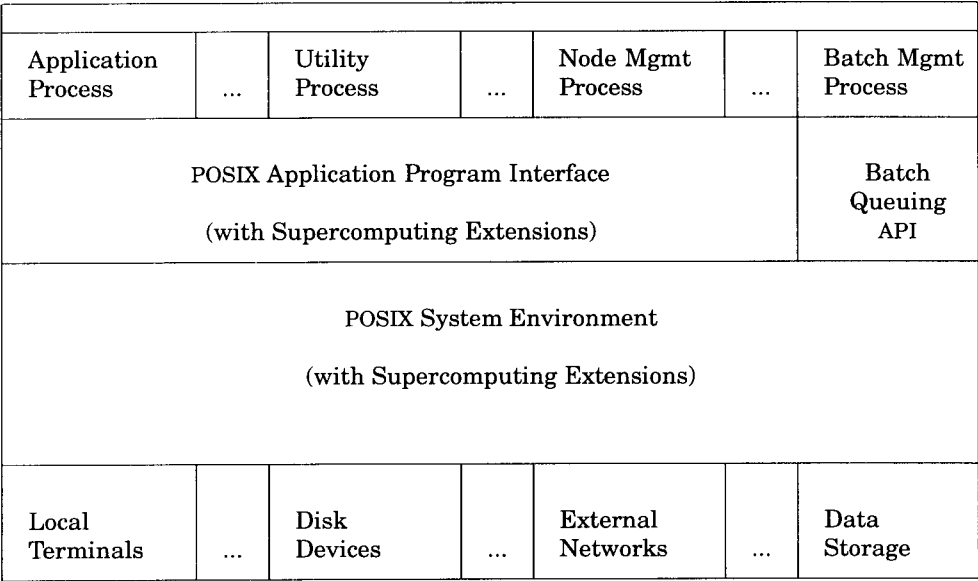


Figure 1.1—POSIX Supercomputing Model

The POSIX supercomputing model is shown in Figure 1.1. The primary new feature is the addition of a batch management process. The batch manager provides control over the system resources necessary for long runs of supercomputer applications.

The supercomputing model illustrates that extensions to the POSIX API and system environment are required for a supercomputing applications environment. Also, the need for networks and data storage is expressed in this model.

There are two primary modes of use in the supercomputing environment:

- Batch Mode
Since many supercomputing applications take a significant percentage of the system resources, batch processing is necessary to maximize throughput and manage the use of system resources.
- Interactive Mode
Interactive use typically includes application development, pre-processing and post-processing of batch runs, and system administration. Online visualization with user interaction is an important technique for increasing productivity when dealing with large amounts of data.

2. References

2.1 Normative References

The following documents contain provisions which, through reference in this text, constitute provisions of this standardized profile. At the time of publication, the editions indicated were valid. All documents are subject to revision, and parties to agreements based on this standardized profile are warned against automatically applying more recent editions of the documents listed below, since the nature of references made by standardized profiles to such documents is that they may be specific to a particular edition.

The reference numbers in the following list are used in this profile when citing one of the base standards.

Compliance with all or some part of each base standard listed below is either required or optional for conformance to this standardized profile.

[1] ISO 1001: 1986, *Information processing—File structure and labeling of magnetic tapes for information interchange*.¹

[2] ISO/IEC 1539: 1991, *Information technology—Programming languages—FORTRAN*.

[3] ISO 8652: 1987, (ANSI/MIL 1815A-1983), *Programming languages—Ada*.²

[4] ISO/IEC 9899: 1990 (ANSI X3-159), *Programming languages—C*.

[5] ISO/IEC 9945-1: 1990 (IEEE Std 1003.1-1990), *Information Technology—Portable Operating System Interface (POSIX®)—Part 1: System Application Program Interface (API) [C Language]*.³

[6] ISO/IEC 9945-2: 1993 (IEEE Std 1003.2-1992), *Information Technology—Portable Operating System Interface (POSIX)—Part 2: Shell and Utilities*.

[7] IEEE Std 1003.1b-1993, *IEEE Standard for Information Technology—Portable Operating System Interface (POSIX)—Part 1: Application Program Interface (API) [C Language]—Amendment: Realtime Extensions*.

[8] IEEE Std 1003.2d-1994, *IEEE Standard for Information Technology—Portable Operating System Interface (POSIX)—Part 2: Shell and Utilities—Batch Extensions*.

[9] IEEE Std 1003.5-1992, *IEEE Standard for Information Technology—POSIX Ada Language Interfaces—Part 1: Binding for System Application Program Interface (API)*.

[10] IEEE Std 1003.9-1992, *IEEE Standard for Information Technology—POSIX FORTRAN 77 Language Interfaces—Part 1: Binding for System Application Program Interface (API)*.

[11] IEEE Std 1224.2-1993, *IEEE Standard for Information Technology—Directory Services—Application Program Interface (API) [Language Independent]*.

[12] ANSI X3.9-1978 (Reaff. 1989), *Programming Language FORTRAN*.

2.2 Additional References

The standards listed below contain additional information which could be useful to a user of this standardized profile.

[13] IEEE Std 1003.0-1995, *IEEE Guide to POSIX-Based Open System Environment (OSE)*.

[14] IEEE P1003.18/D12, *Draft POSIX Standardized Profile—POSIX Interactive Systems AEP*.

[15] IEEE Std 1003.3-1991, *IEEE Standard for Information Technology—Test Methods for Measuring Conformance to POSIX*.

¹ISO documents can be obtained from the ISO office, 1, rue de Varembe, Case Postale 56, CH-1211, Genève 20, Switzerland/Suisse. ISO documents are available in the United States from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

²ANSI publications are available from the Sales Department, American National Standards Institute, 11 West 42nd Street, 13th Floor, New York, NY 10036, USA.

³IEEE publications are available from the Institute of Electrical and Electronics Engineers, Service Center, 445 Hoes Lane, P.O. Box 1331, Piscataway, NJ 08855-1331, USA.

[16] IEEE Std 2003.1-1992, *IEEE Standard for Information Technology—Test Methods for Measuring Conformance to POSIX—Part 1: System Integration*.

[17] IEEE P2003.2/D10, *Draft Standard for Information Technology—Test Methods for Measuring Conformance to POSIX—Part 2: Shell and Utilities*.

NOTE — References to defacto and emerging standards are listed in Annex F.

3. Definitions

3.1 General Terms

For the purposes of this standardized profile, the following general terms apply.

Other general terms used in this standardized profile are defined in the referenced base standards.

3.1.1 base standard: A standard or specification that is recognized as appropriate for normative reference in a profile by the body adopting the profile.

3.1.2 POSIX locale: A particular locale which identifies a portable character set as described in POSIX.2 {6} 2.5.1.

3.2 Definitions

For the purposes of this standardized profile, the following definitions apply.

Other terms used in this standardized profile are defined in the referenced base standards.

3.2.1 test method: The software, procedures, or other means specified by a standard to measure conformance.

4. Conventions and Abbreviations

4.1 Conventions

The conventions used in this standardized profile are the same in those for POSIX.2 Shell and Utilities {6}.

4.2 General Abbreviations

For the purposes of this standardized profile, the following abbreviations apply.

Other abbreviations used in this standardized profile are defined in the referenced base standards.

4.2.1 AEP: Application Environment Profile.

4.2.2 API: Application Program Interface.

4.2.3 FDDI: Fibre Distributed Data Interface.

4.2.4 FTAM: File Transfer Access Method.

FTAM is part of the OSI suite of protocols.

4.2.5 GKS: Graphical Kernel System.

4.2.6 HIPPI: High Performance Parallel Interface.

4.2.7 IP: Internet Protocol.

IP is a packet-based protocol for passing data from one system to another.

4.2.8 ISPICS: International Standardized Profile Implementation Conformance Statement.

4.2.9 MSS: Mass Storage System.

4.2.10 OSI: Open Systems Interconnect.

OSI is a suite of protocols and standards for interconnection and communication between systems.

4.2.11 PCTS: POSIX Conformance Test Suite.

4.2.12 PEX: PHIGS Extended X11.

4.2.13 PHIGS: Programmer's Hierarchical Interactive Graphics System.

4.2.14 TCP: Transport Control Protocol.

TCP is a reliable, sequenced, end-to-end, connection-based, stream protocol that runs on top of the Internet Protocol.

4.2.15 TFA: Transparent File Access.

4.2.16 UDP: User Datagram Protocol.

UDP is an unreliable, message-based protocol that runs on top of the Internet Protocol.

4.2.17 UPE: User Portability Extension.

4.2.18 VTP: Virtual Terminal Protocol.

VTP is part of the OSI suite of protocols.

4.2.19 X11: The X Window System, version 11, distributed by the MIT X Consortium.

4.2.20 X.400: Electronic messaging protocol.

X.400 is part of the OSI suite of protocols.

4.2.21 X.500: Directory Services.

X.500 is part of the OSI suite of protocols.

4.3 Abbreviations for Base Standards

For the purposes of this standardized profile, the following abbreviations are used to reference the base standards. An abbreviation may include multiple base standards which form a complete set.

4.3.1 Ada Standard: *Programming language Ada.*

See Normative References {3}.

4.3.2 C Standard: *Programming language C.*

See Normative References {4}.

4.3.3 FORTRAN 77 Standard: *Programming language FORTRAN 77.*

See Normative References {12}.

4.3.4 Fortran 90 Standard: *Programming language Fortran 90.*

See Normative References {2}.

4.3.5 Labeled Tape Standard: *Information processing—File structure and labeling of magnetic tapes for information interchange.*

See Normative References {1}.

4.3.6 POSIX.1: *Portable Operating System Interface (POSIX)—Part 1: System Application Program Interface.*

See Normative References {5}.

4.3.7 POSIX.1a: *Portable Operating System Interface (POSIX)—Part 1: System API—Amendment: System API Extensions.*

4.3.8 POSIX.2: *Portable Operating System Interface (POSIX)—Part 2: Shell and Utilities.*

See Normative References {6}.

4.3.9 4.3.9 POSIX.4: *Realtime Extension for Portable Operating Systems.*

See Normative References {7}.

4.3.10 POSIX.5: *POSIX Ada Language Interfaces—Part 1: Binding for System API.*

See Normative References {9}.

4.3.11 POSIX.8: *Portable Operating System Interface (POSIX)—Part 1: System API—Amendment: Network-Transparent File Access (TFA).*

4.3.12 POSIX.9: *POSIX FORTRAN 77 Language Interfaces—Part 1: Binding System API.*

See Normative References {10}.

4.3.13 POSIX.10: This profile.

4.3.14 POSIX.15: *Portable Operating System Interface (POSIX)—Batch Extensions.*

See Normative References {8}.

4.3.15 P1224.2: *Directory Services, OSI/API—X.500 LIS.*

See Normative References {11}.

5. Conformance

5.1 Implementation Requirements

A conforming implementation shall meet all of the following criteria:

- The system shall support all required interfaces and limits specified within Section 6 of this standard including requirements set by the normatively referenced specifications in Section 6. These interfaces shall meet the conformance requirements of the referenced standards and their associated test methods, if any.
- The system may support optional interfaces referenced within Section 6. If an option is implemented, the interfaces shall meet the conformance requirements of the referenced standards and their associated test methods, if any.
- The system may provide functions or facilities in addition to those specified in Section 6. Nonstandard extensions should be identified as such in the system documentation. Nonstandard extensions, when used, may change the behavior of functions or facilities referenced in Section 6. The conformance documents for the referenced standards plus the conformance document for this standard shall define an environment in which an application can be run with the behavior specified by this standard. In no case shall an environment require modification of a strictly conforming POSIX.10 application. See 5.4.1

5.2 Implementation Conformance Document

A conformance document with the following information shall be available for an implementation claiming conformance to the POSIX.10 profile. The conformance document shall have the same structure as this document, with the information presented in the appropriately numbered subclauses. The conformance document shall not contain information about extended facilities or capabilities outside the scope of this standard. The conformance document shall also include a completed version of the conformance template specified in 5.3.

The conformance document shall contain a statement that indicates, the full name, number, and date of the standard that applies. The conformance document shall give references to the conformance documents of the referenced standards.

The conformance document shall describe the behavior of the implementation for all implementation-defined features defined in Section 6 of this profile. This requirement shall be met by listing these features and providing either a specific reference to the system documentation or by providing a description of these features. The conformance document may specify the behavior of the implementation for those features where Section 6 states that implementation may vary or where features are identified as undefined or unspecified.

The phrases “shall document” or “shall be documented” in this standard mean that documentation of the feature shall appear in the conformance document, as described previously, unless the system documentation is explicitly mentioned.

The system documentation should also contain the information found in the conformance document.

5.3 Implementation Conformance Template

The conformance document shall include the items specified in this template with actual values and options specified for the implementation.

5.3.1 Base Standards

The following languages are required:

- C Language {4}
- FORTRAN 77 Language {12}

Conformance to the following standards is required:

- POSIX.1 System API {5}
- POSIX.2 Shell and Utilities {6}
- POSIX.4 Realtime Extension
(Asynchronous I/O option) {7}
- POSIX.9 FORTRAN 77 Bindings {10}
- POSIX.15 Shell and Utilities—Batch Extensions {8}