IEEE P1003.0 Draft 13 – September 1991

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IEEE Standards Department
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445 Hoes Lane, P.O. Box 1331
Piscataway, NJ 08855-1331, USA
+1 (908) 562-3800
+1 (908) 562-1571 [FAX]

Section 7: POSIX SP Profiling Efforts

Responsibility: Wendy Rauch

7.1 Introduction

This section maintains the list of currently known POSIX Standardized Profiles (POSIX SPs). This list is a factual record of which POSIX SPs exist, or are in preparation, together with a summary description of the scope, scenario, and model for each profile. These POSIX SPs might be useful as building blocks for other profiles.

7.1.1 Approved POSIX Standardized Profiles

There are currently no approved POSIX SPs.

7.1.2 POSIX Standardized Profiles In-Progress

The current efforts to develop POSIX SPs are summarized in Table 7-1. They are all being done by IEEE 1003 POSIX working groups. A brief summary of each effort is given in clauses 6.4 and 6.5.

7.2 General Purpose POSIX SPs

7.2.1 POSIX Platform Environment Profile (PEP)

7.2.1.1 Rationale and Overview

The POSIX Platform Environment Profile (PEP), IEEE POSIX.18, is a platform profile based on POSIX.1 {2} and related standards. It defines the functionality and standards needed for a system that is as similar as possible to the traditional UNIX operating system's interactive, multiuser development and run-time environment.

The PEP is valuable for many users, vendors, programmers, and procurement officers who do not have the time or desire to analyze and specify all the individual interfaces for a system they need. The PEP obviates this analysis by

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Table 7-1 – POSIX SPs In Progress

Project Name	Taxonomy	Profile Name	Profile Type
IEEE P1003.10		Supercomputing	Application profile
IEEE P1003.11		Transaction Processing	Application profile
IEEE P1003.13		Realtime Full Function	Application-oriented profile
IEEE P1003.13		Realtime Embedded Control System	Application-oriented profile
IEEE P1003.13		Realtime Intermediate	Application-oriented profile
IEEE P1003.14		Multiprocessing Application Support	Platform profile
IEEE P1003.18	USI-P001	POSIX Platform Environment Profile	Platform profile

NOTES:

(1) At this time it is not known whether the three realtime profiles will be contained within a single multipart POSIX SP, or separate single-part POSIX SPs.

(2) While the issue of a taxonomy for POSIX SPs has not been decided, a placeholder has been provided and a proposed taxonomical name for one profile has been listed.

enabling the users to point to a single document that specifies exactly what they should order to obtain a system that looks like traditional UNIX systems, except that the PEP will be totally based on formal standards.

7.2.1.2 Content of the Platform Environment Profile

The POSIX Platform Environment Profile consists of:

— All of POSIX.1 {2} along with options that correspond to the US Government's Application Portability Profile (APP) (FIPS 151-1);

— All of the POSIX.2 {*ref*} (Shell and Utilities) and POSIX.2a (User Portability Extension); and

— All of ANSI X3.159 C.

To reflect the goals and intent of the POSIX.18 working group, the PEP document also commits to specifying additional specifications in the future, when those specifications are completed and approved as standards. These specifications include system administration, secure/trusted systems extensions, realtime facilities, verification testing facilities, Ada and FORTRAN language bindings, graphical user interfaces, and network interface facilities.

The PEP is expected to be the pioneer Application Environment Profile submitted to ISO for international approval. The concept of Application Environment Profiles and Platform Profiles is new. How ISO handles the international standardization of the PEP, and the profile issues resolved, will likely set a precedent followed in the development of other profile standards.

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7.2.2 Multiprocessing Systems Platform Profiles

7.2.2.1 Rationale and Overview

The POSIX Multiprocessing Systems Profile (IEEE POSIX. 14) is a platform profile. Like the POSIX PEP (POSIX. 18), the Multiprocessing Systems profile defines the functionality, standards, and options within standards that are needed for development and execution on a multiprocessing platform.

The Multiprocessing Systems profile is intended for use by multiprocessor vendors, application developers, users, and system administrators. It is important because it is designed to support portability of multiprocessing applications, as well as users and system administrators in multiprocessing environments.

The Multiprocessing Systems Profile has two major goals. The first one is to make POSIX safe for multiprocessing. This goal requires the POSIX. 14 working group to identify and address the caveats, problems, and failings of POSIX base standards for multiprocessing platforms. Examples of these failings range from reentrant-function problems to potential problems with threads.

The second goal is to make POSIX useful for multiprocessing. This goal requires the POSIX. 14 working group to ensure that POSIX supports the functionality needed by multiprocessing platforms. An example of this is ensuring that POSIX has capabilities to allow vendors to parallelize software functions. In the absence of parallelizing standards, the details of what happens when the same software functions are used on different multiprocessor system vary.

7.2.2.2 Content of the Multiprocessing Systems Profile

The Multiprocessing Systems platform profile identifies standards, options, and gaps in the standards relevant to multiprocessing. It also identifies additional requirements not satisfied by existing standards and, in an informative annex, suggests interfaces to extended services that can satisfy some of these requirements. In addition, the POSIX. 14 Multiprocessing Systems Group will propose changes and amendments to a variety of relevant standards in order to encourage the specifiers of these standards to add functions and options that accommodate multiprocessing requirements.

Standards particularly relevant to the Multiprocessing System Profile include the POSIX Pthreads extension (IEEE POSIX. 4a), the supercomputing batch scheduling standard (IEEE POSIX. 15), and the supercomputing proposed checkpoint and restart facilities (IEEE POSIX. 10). Since checkpoint and restart facilities will be added to the POSIX .1 {2} standard, POSIX .1 {2} is also of concern to the Multiprocessing Profile.

The Multiprocessing Systems profile will specify both general-purpose-computing and multiprocessor-specific standards. General-purpose standards planned or under consideration for the Multiprocessing Systems profile include:

— The IEEE POSIX. 1 core POSIX system, POSIX. 2 POSIX Shell and Utilities, and POSIX. 2a User Portability Extension;

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— The IEEE POSIX.4 realtime extension;

— The IEEE POSIX.4a: POSIX Pthreads extension;

— The IEEE POSIX.6 POSIX security standard and POSIX.7 system administration standard;

— The Ada language bindings (IEEE POSIX.5) and FORTRAN language bindings (IEEE POSIX.9) to POSIX;

— The IEEE POSIX.10 Supercomputing Profile, POSIX.11 Transaction Processing Profile, and POSIX.13 Realtime Applications Profiles.

As other standards emerge, they too will be incorporated in the Multiprocessing Systems profile. An annex of this document will deal with, and list, relevant emerging standards to provide an idea of the Multiprocessing Systems profile's direction.

Multiprocessing-specific requirements identified by the POSIX.14 Multiprocessing working group include:

— System administration tools for multiprocessors;

— Parallelizing compilers;

— Explicit parallelism;

— Threads;

— Thread-safe libraries;

— Message-passing IPC;

— Parallel utilities (e.g., `find`, `grep`, `make`, etc.);

— Scheduler controls;

— Processor allocation: mandatory/advisory;

— Processor binding;

— Degree of symmetry: I/O, computation, memory.

Standards will be needed for many of these requirements. Many of these requirements will, therefore, become the subject of a POSIX.14 working group proposal for a new standardized function or an option in other standards.

7.2.3 Supercomputing

7.2.3.1 Rationale and Overview

The Supercomputing Applications Environment Profile (IEEE POSIX.10) is a profile designed to support application and programmer portability in POSIX-based supercomputer environments. The profile's goal is to allow supercomputer application code to be ported to other sites, reduce the learning curve of users, and encourage production of timely third-party applications.

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The need exists for such a profile because of the differences between supercomputing environments and traditional application environments. One difference is that supercomputing jobs are computationally intensive, very long running, and very demanding of resources. Another is that the cost of the supercomputer CPU and many of its peripheral resources is extremely high.

Ordinary POSIX standards are not applicable in their entirety to supercomputer environments because the traditional UNIX-based POSIX functions are not adequate to meaningfully manage the use of, and accounting for, a supercomputer or its resources. Furthermore, supercomputers need much better tape handling, multiprocessing, and other capabilities than POSIX or UNIX specifications presently support.

7.2.3.2 Content of the Supercomputing Profile

The Supercomputing Application Environment Profile identifies POSIX base standards and other relevant standards that support supercomputing requirements. Where none exist, the POSIX.10 working group will define the functionality itself, or instigate the formation of a new group to define it. In addition, the POSIX.10 working group is taking some of the traditional modifications built to allow UNIX systems to run on supercomputers, and making those modifications both consistent across supercomputers and portable to users, system administrators, and applications.

Base computing standards specified by the supercomputing profile (or planned for specification when the standards are completed) include:

— The IEEE POSIX.1 {2} core POSIX system, POSIX.2 POSIX Shell and Tools, and POSIX.2a User Portability Extensions (and the corresponding FIPS standards);

— The IEEE POSIX.4 realtime work (particularly the use of its asynchronous I/O facility);

— The IEEE POSIX.6 POSIX security standard and POSIX.7 system administration standard;

— Several graphics standards, including ISO GKS, PHIGS, and CGM, ANSI IGES, and the X Consortium's PEX.

— X3H2.6 (also called X11) for windowing;

— Several programming languages, including ISO, ANSI, and the NIST's FIPS for C, FORTRAN-77, Pascal, Ada, Common LISP, and COBOL.

— TCP/IP protocol stacks and network applications (e.g., file transfer and messaging) now and OSI in the long-term;

— The IEEE POSIX.8 Transparent File Access standard for distributed file management;

- The X3T5.5 Remote Procedure Call (RPC).

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The nonstandardized and nonavailable supercomputing functions identified in the POSIX. 10 profile include:

— Batch system scheduling, administration, and network definition;

— Checkpoint recovery;

— A resource manager;

— A better tape management facility;

— Better mass storage/archiving facilities.

There are no existing standards for batch scheduling and administration facilities. Batch scheduling and administration extensions to POSIX base standards are currently being defined by the IEEE POSIX. 15 working group—a group spawned by the Supercomputing profile working group.

To meet recovery and archiving requirements, the POSIX. 10 working group defined system interfaces for functions that perform ‘‘checkpoint,’’ ‘‘restart,’’ and better magnetic tape handling (e.g., to rewind a tape under program control). These interfaces have been submitted to the POSIX. 1 working group for inclusion in the next POSIX .1 {2}revision.

7.2.4 Transaction Processing

7.2.4.1 Rationale and Overview

The Transaction Processing Applications Environment Profile (IEEE 1003.11) is intended to support the development of portable online transaction processing (OLTP) applications in POSIX environments. This profile is targeted at application developers and open system services suppliers. It is important because transaction processing is a major area of business for most large computer vendors and it plays a major role in the daily operations of most users. There are currently no existing POSIX functions that specifically address OLTP needs.

7.2.4.2 Content of the Transaction Processing Profile

The Transaction Processing profile’s goal is to identify the interfaces and standards relevant to OLTP , and optional functions in existing standards that must be made mandatory for OLTP applications. The profile will specify general-purpose standards, as well as standards unique to OLTP.

The Transaction Processing Profile’s specifications include or plan the following generic and transaction processing-specific standards:

— The ISO /IEC 9945-1: 1990 (POSIX 1003.1) core POSIX system interfaces (including required options, minimum values for certain variables, and particular environment variables needed for OLTP applications);

— The IEEE 1003.2 Shell and Utilities’ software development utilities option, C language development utilities option, and C language bindings option;

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— The IEEE 1003.2 `getconf` utility;

— The realtime files and asynchronous input and output features from the IEEE 1003.4 Realtime POSIX Extensions;

— The IEEE 1003.6 POSIX security standard;

— The ISO/IEC, ANSI, and FIPS C and COBOL programming languages;

— TCP/IP networking in the short term and OSI in the long-term;

— The X3T5.5 Remote Procedure Call (RPC)

— The ISO SQL database language;

— The ISO Distributed Transaction Processing 10026.1, .2, and .3 for communication of transaction information.

The Transaction Processing profile also identifies extensions needed to existing standards to support distributed transaction processing. Important extensions that need to be defined include those related to the two-phase commit, as well as others related to making RPCs robust.

The P1003.11 working group is working with the ISO RPC Group to add transaction semantics to the Networking working group's RPC specifications. These extensions will be incorporated in the Transaction Processing profile. Plans are also for the 1003.11 profile to draw on the transaction processing work being produced by the X/Open consortium, particularly on the XA interfaces (the interface between a Transaction Manager and a Resource Manager).

7.2.5 Realtime Application Profiles

7.2.5.1 Rationale and Overview

Different types of realtime applications have different characteristics and diverse requirements. For example, embedded systems generally do not need the full functionality of an operating system, nor do they require all the IEEE POSIX.4 realtime extensions. Compliance with the entire realtime standard and/or POSIX operating system interfaces could reduce the embedded system's responsiveness and increase the amount of memory needed for systems that need to be embedded in limited space. High-end realtime systems, on the other hand, have softer realtime requirements. However, they need the full operating system and realtime functionality.

Therefore, the POSIX.13 working group was formed to define profiles for various types of realtime applications. The realtime profiles defined will determine which interfaces must be implemented for a given type of realtime system to claim conformance to the realtime standard.

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7.2.5.2 Content of the Realtime Application Profiles

The POSIX. 13 working group is defining three different realtime application profiles:

— Low-end, embedded systems (often known as ‘‘hard’’ realtime systems);

— Mid-range realtime systems with medium-level critical realtime constraints;

— High-end realtime systems.

7.2.5.2.1 Minimal Embedded Realtime Profiles

Embedded realtime systems are typically standalone systems used for robot controllers, automated systems controllers, instrumentation, high-speed data acquisition, satellite subsystem control, some process control, and some testing. Time-critical responsiveness is a key requirement of embedded systems. In the absence of a standard, the realtime functionality required for embedded systems is generally provided by a proprietary realtime kernel or a simple home-grown monitor using memory mapped I/O.

Since low-end embedded systems need only minimal functionality, the POSIX. 13 working group will select a relatively small number of POSIX. 4 and POSIX .1 {2} functions that will be required for portable realtime embedded systems. These functions will be selected for three types of embedded applications, each of which comprise a sort of embedded system ‘‘subprofile.’’ One type of embedded application has no requirements for a file system or multiple processes. The second type of embedded application requires a file system, but not multiple processes. The third type of application requires multiple processes, but no file system.

7.2.5.2.2 Mid-Range Realtime Profiles

The mid-range, or intermediate-level realtime systems profile is designed to support distributed realtime applications. These applications are distributed across multiple processors sharing a high-speed communication channel (e.g., a backplane) or across a local network. Mid-range realtime applications typically are used in a controller for a group of robots, to control a subsystem on the factory floor, or in a relatively small simulation system.

Distributed realtime control systems have many of the same needs as embedded systems. However, mid-range realtime systems require more functionality than do systems used for embedded realtime control. At a minimum, distributed realtime systems require support for transparent, external processor-to-processor communications to support connectivity between the realtime system and other types of applications, as well as support for multiple flows of control (via multiprocessing or multithreading).

To satisfy the requirements of distributed realtime systems, the mid-range application environment profile is specifying most of the POSIX. 4 functionality, along with the relevant options from the POSIX. 4 and POSIX .1 {2} standards. This profile is applicable to either a process or a thread model.

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7.2.5.2.3 High-End Realtime Profiles

The high-end realtime application profile is applicable to complex realtime systems. Such high-end realtime systems are typically used in military command and control, in space station control systems, in systems that control robot or factory subsystems, and as the operating system for a high-end simulation system.

Because of the great complexity of high-end realtime applications and the large number of users typically involved, high-end realtime applications require a number of realtime and nonrealtime capabilities. For example, besides realtime responsiveness and reliability, high-end realtime systems must support many languages, distributed processing, distributed file systems, and system security. Also, realtime support is often required for fault tolerance, distributed database management, networking, graphics facilities, and possibly parallel processing or multiprocessing. The level of realtime response that must be supported varies with the application.

Since high-end realtime systems have a greater design complexity than embedded or mid-range systems, and need much greater functionality, they will most likely require all or most of the POSIX.4 and POSIX.1 {2} specifications. The POSIX.4a Threads extension is optionally required, particularly to support Ada programs which are multithreaded.

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Annex A
(informative)
Considerations for Developers of POSIX SPs

A.1 Introduction

Responsibility: Bob Gambrel

The contents of this Annex are illustrative of rules that might be developed for the submitters of POSIX Standardized Profiles (SPs).

This Annex contains modifications and comments relating to the use of the *TCOS-SSC POSIX Standards Style Guide* {B6} in POSIX SPs.

A.2 Scope

While Section 6 addressed profiles generally, this Annex addresses considerations for developers of formal POSIX Standardized Profiles. It builds directly upon the concepts, principles, and guidance of Section 6.

RJG: This Annex is not complete, in that more work is required in the domain of POSIX profiles.

Future work in the area of profiling will be done by IEEE and the standards community. This document, and the guidance it provides, will be updated as appropriate. The major areas expected to be addressed are:

- *International standardization considerations*
- *Conformance issues*
- *Taxonomy of POSIX SPs*
- *Registration of POSIX SPs*
- *Delegation of authority to call something a POSIX SP (Note: Currently, this document does not prohibit another group beside IEEE from calling their document a POSIX SP.)*
- *Clarification of base standards referencing issues such as subsetting and the handling of options*
- *Editorial issues such as guidance on the correct level of detail*

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