




## **Networking Services (XNS) Issue 5**

*The Open Group*



© February 1997, The Open Group

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the copyright owners.

Portions of this document are extracted from IEEE Std 1003.1-1990, copyright © 1990 by the Institute of Electrical and Electronics Engineers, Inc. with the permission of the IEEE.

Portions of this document were extracted from IEEE Draft Standard P1003.2/D12, copyright © 1992 by the Institute of Electrical and Electronics Engineers, Inc. with the permission of the IEEE. No further reproduction of this material is permitted without the written permission of the publisher. IEEE Std 1003.2-1992, copyright © 1992 by the Institute of Electrical and Electronics Engineers, Inc., and ISO/IEC 9945-2:1993, Information Technology — Portable Operating System (POSIX) — Part 2: Shell and Utilities, are technically identical to IEEE Draft Standard P1003.2/D12 in these areas.

Portions of this document are derived from copyrighted material owned by Hewlett-Packard Company, International Business Machines Corporation, Novell Inc., The Open Software Foundation, and Sun Microsystems, Inc.

CAE Specification

Networking Services (XNS) Issue 5

ISBN: 1-85912-165-9

Document Number: C523

Published in the U.K. by The Open Group, February 1997.

Any comments relating to the material contained in this document may be submitted to:

The Open Group  
Apex Plaza  
Forbury Road  
Reading  
Berkshire, RG1 1AX  
United Kingdom

or by Electronic Mail to:

OGSpecs@opengroup.org

# Contents

<b>Chapter</b>	<b>1</b>	<b>Common Information.....</b>	<b>1</b>
	1.1	Terminology .....	1
	1.2	Use and Implementation of Interfaces .....	2
	1.2.1	C Language Definition.....	2
	1.3	The Compilation Environment.....	3
	1.3.1	The Name Space.....	3
	1.4	Relationship to the XSH Specification.....	6
	1.4.1	Error Numbers.....	6
	1.5	Thread Safety .....	6
	1.6	Thread Cancellation Points.....	6
	1.7	Relationship to Emerging Formal Standards.....	7
<b>Chapter</b>	<b>2</b>	<b>General Introduction to the XTI .....</b>	<b>9</b>
<b>Chapter</b>	<b>3</b>	<b>Explanatory Notes for XTI.....</b>	<b>11</b>
	3.1	Transport Endpoints.....	11
	3.2	Transport Providers.....	11
	3.3	Association of a UNIX Process to an Endpoint .....	12
	3.4	Use of the Same Protocol Address .....	12
	3.5	Modes of Service .....	13
	3.6	Error Handling .....	13
	3.7	Synchronous and Asynchronous Execution Modes.....	14
	3.8	Effect of Signals .....	16
	3.9	Event Management.....	16
<b>Chapter</b>	<b>4</b>	<b>XTI Overview .....</b>	<b>19</b>
	4.1	Overview of Connection-oriented Mode.....	19
	4.1.1	Initialisation/De-initialisation Phase .....	20
	4.1.2	Overview of Connection Establishment .....	21
	4.1.3	Overview of Data Transfer .....	22
	4.1.4	Overview of Connection Release .....	24
	4.2	Overview of Connectionless Mode.....	26
	4.2.1	Initialisation/De-initialisation Phase .....	26
	4.2.2	Overview of Data Transfer .....	26
	4.3	XTI Features .....	28
	4.3.1	XTI Functions versus Protocols .....	29
<b>Chapter</b>	<b>5</b>	<b>States and Events in XTI.....</b>	<b>31</b>
	5.1	Transport Interfaces States.....	32
	5.2	Outgoing Events .....	33
	5.3	Incoming Events .....	34
	5.4	Transport User Actions.....	35

5.5	State Tables.....	36
5.6	Events and TLOOK Error Indication.....	38
<b>Chapter 6</b>	<b>The Use of Options in XTI .....</b>	<b>39</b>
6.1	Generalities .....	39
6.2	The Format of Options.....	40
6.3	The Elements of Negotiation.....	41
6.3.1	Multiple Options and Options Levels.....	41
6.3.2	Illegal Options .....	41
6.3.3	Initiating an Option Negotiation .....	42
6.3.4	Responding to a Negotiation Proposal .....	43
6.3.5	Retrieving Information about Options.....	44
6.3.6	Privileged and Read-only Options.....	45
6.4	Option Management of a Transport Endpoint .....	46
6.5	Supplements .....	48
6.5.1	The Option Value T_UNSPEC .....	48
6.5.2	The info Argument .....	48
6.5.3	Summary .....	48
6.6	Portability Aspects.....	50
<b>Chapter 7</b>	<b>XTI Library Functions and Parameters .....</b>	<b>51</b>
7.1	How to Prepare XTI Applications.....	51
7.2	Key for Parameter Arrays .....	51
7.3	Return of TLOOK Error.....	52
7.4	Use of “struct netbuf” .....	53
	<i>t_accept()</i> .....	54
	<i>t_alloc()</i> .....	57
	<i>t_bind()</i> .....	59
	<i>t_close()</i> .....	62
	<i>t_connect()</i> .....	63
	<i>t_error()</i> .....	66
	<i>t_errno</i> .....	68
	<i>t_free()</i> .....	69
	<i>t_getinfo()</i> .....	71
	<i>t_getprotaddr()</i> .....	74
	<i>t_getstate()</i> .....	76
	<i>t_listen()</i> .....	77
	<i>t_look()</i> .....	79
	<i>t_open()</i> .....	81
	<i>t_optmgmt()</i> .....	84
	<i>t_rcv()</i> .....	91
	<i>t_rcvconnect()</i> .....	93
	<i>t_rcvdis()</i> .....	95
	<i>t_rcvrel()</i> .....	97
	<i>t_rcvreldata()</i> .....	98
	<i>t_rcvudata()</i> .....	100
	<i>t_rcvuderr()</i> .....	102
	<i>t_rcvv()</i> .....	104

	<i>t_rcvvudata()</i> .....	106
	<i>t_snd()</i> .....	108
	<i>t_snddis()</i> .....	111
	<i>t_sndrel()</i> .....	113
	<i>t_sndreldata()</i> .....	114
	<i>t_sndudata()</i> .....	116
	<i>t_sndv()</i> .....	118
	<i>t_sndvudata()</i> .....	121
	<i>t_strerror()</i> .....	124
	<i>t_sync()</i> .....	125
	<i>t_sysconf()</i> .....	127
	<i>t_unbind()</i> .....	128
<b>Chapter 8</b>	<b>Sockets Interfaces .....</b>	<b>129</b>
8.1	Sockets Overview .....	129
	<i>accept()</i> .....	130
	<i>bind()</i> .....	132
	<i>close()</i> .....	134
	<i>connect()</i> .....	135
	<i>fcntl()</i> .....	138
	<i>fgetpos()</i> .....	139
	<i>fsetpos()</i> .....	140
	<i>ftell()</i> .....	141
	<i>getpeername()</i> .....	142
	<i>getsockname()</i> .....	143
	<i>getsockopt()</i> .....	144
	<i>listen()</i> .....	147
	<i>lseek()</i> .....	148
	<i>poll()</i> .....	149
	<i>read()</i> .....	150
	<i>recv()</i> .....	151
	<i>recvfrom()</i> .....	153
	<i>recvmsg()</i> .....	156
	<i>select()</i> .....	159
	<i>send()</i> .....	160
	<i>sendmsg()</i> .....	162
	<i>sendto()</i> .....	165
	<i>setsockopt()</i> .....	168
	<i>shutdown()</i> .....	171
	<i>socket()</i> .....	172
	<i>socketpair()</i> .....	174
	<i>write()</i> .....	176
<b>Chapter 9</b>	<b>Sockets Headers .....</b>	<b>177</b>
	<fcntl.h> .....	178
	<sys/socket.h> .....	179
	<sys/stat.h> .....	183
	<sys/uio.h> .....	184

	<code>&lt;sys/un.h&gt;</code> .....	185
<b>Chapter 10</b>	<b>IP Address Resolution Interfaces.....</b>	<b>187</b>
	<code>endhostent()</code> .....	188
	<code>endnetent()</code> .....	190
	<code>endprotoent()</code> .....	191
	<code>endservent()</code> .....	192
	<code>gethostbyaddr()</code> .....	194
	<code>gethostname()</code> .....	195
	<code>getnetbyaddr()</code> .....	196
	<code>getprotobynumber()</code> .....	197
	<code>getservbyport()</code> .....	198
	<code>h_errno</code> .....	199
	<code>htonl()</code> .....	200
	<code>inet_addr()</code> .....	201
	<code>ntohl()</code> .....	203
	<code>sethostent()</code> .....	204
	<code>setnetent()</code> .....	205
	<code>setprotoent()</code> .....	206
	<code>setservent()</code> .....	207
<b>Chapter 11</b>	<b>IP Address Resolution Headers .....</b>	<b>209</b>
	<code>&lt;arpa/inet.h&gt;</code> .....	210
	<code>&lt;netdb.h&gt;</code> .....	211
	<code>&lt;netinet/in.h&gt;</code> .....	213
	<code>&lt;unistd.h&gt;</code> .....	214
<b>Appendix A</b>	<b>ISO Transport Protocol Information.....</b>	<b>215</b>
A.1	General .....	215
A.2	Options .....	216
A.2.1	Connection-mode Service .....	216
A.2.1.1	Options for Quality of Service and Expedited Data .....	216
A.2.1.2	Management Options .....	218
A.2.2	Connectionless-mode Service .....	220
A.2.2.1	Options for Quality of Service .....	220
A.2.2.2	Management Options .....	221
A.3	Functions .....	222
A.4	The <code>&lt;xti_osi.h&gt;</code> Header File .....	225
<b>Appendix B</b>	<b>Internet Protocol-specific Information.....</b>	<b>229</b>
B.1	General .....	229
B.2	Options .....	230
B.2.1	TCP-level Options .....	230
B.2.2	T_UDP-level Options .....	231
B.2.3	T_IP-level Options .....	232
B.3	Functions .....	235
B.4	The <code>&lt;xti_inet.h&gt;</code> Header File .....	238

<b>Appendix C</b>	<b>Guidelines for Use of XTI.....</b>	<b>241</b>
C.1	Transport Service Interface Sequence of Functions.....	241
C.2	Example in Connection-oriented Mode.....	242
C.3	Example in Connectionless Mode.....	244
C.4	Writing Protocol-independent Software.....	245
C.5	Event Management.....	246
C.5.1	Short-term Solution.....	246
C.5.2	XTI Events.....	247
C.6	The Poll Function.....	248
C.6.1	Example of Use of Poll.....	248
C.7	The Select Function.....	257
C.7.1	Example of Use of Select.....	257
<b>Appendix D</b>	<b>Use of XTI to Access NetBIOS.....</b>	<b>266</b>
D.1	Introduction.....	266
D.2	Objectives.....	266
D.3	Scope.....	267
D.4	Issues.....	268
D.5	NetBIOS Names and Addresses.....	269
D.6	NetBIOS Connection Release.....	271
D.7	Options.....	272
D.8	XTI Functions.....	273
<b>Appendix E</b>	<b>XTI and TLI.....</b>	<b>279</b>
E.1	Restrictions Concerning the Use of XTI.....	279
E.2	Relationship between XTI and TLI.....	280
<b>Appendix F</b>	<b>Headers and Definitions for XTI.....</b>	<b>281</b>
<b>Appendix G</b>	<b>Abbreviations.....</b>	<b>295</b>
<b>Appendix H</b>	<b>Minimum OSI Functionality (CAE Specification).....</b>	<b>297</b>
H.1	General.....	297
H.1.1	Rationale for using XTI-mOSI.....	297
H.1.2	Migrant Applications.....	297
H.1.3	OSI Functionality.....	297
H.1.4	mOSI API versus XAP.....	298
H.1.5	Upper Layers Functionality Exposed via mOSI.....	298
H.1.5.1	Naming and Addressing Information used by mOSI.....	298
H.1.5.2	XTI Options Specific to mOSI.....	298
H.2	Options.....	300
H.2.1	ACSE/Presentation Connection-mode Service.....	300
H.2.2	ACSE/Presentation Connectionless-mode Service.....	301
H.2.3	Transport Service Options.....	302
H.3	Functions.....	303
H.4	Implementors) Notes.....	307
H.4.1	Upper Layers FUs, Versions and Protocol Mechanisms.....	307
H.4.2	Mandatory and Optional Parameters.....	307

H.4.3	Mapping XTI Functions to ACSE/Presentation Services.....	308
H.4.3.1	Connection-mode Services .....	308
H.4.3.2	Connectionless-mode Services .....	312
H.5	Option Data Types and Structures.....	313
H.6	<xti_mosi.h> Header File.....	317
<b>Appendix I</b>	<b>SNA Transport Provider.....</b>	<b>319</b>
I.1	Introduction .....	319
I.2	SNA Transport Protocol Information .....	320
I.2.1	General.....	320
I.2.2	SNA Addresses .....	321
I.2.3	Options.....	322
I.2.3.1	Connection-Mode Service Options .....	322
I.2.4	Functions .....	324
I.3	Mapping XTI to SNA Transport Provider .....	327
I.3.1	General Guidelines.....	328
I.3.2	Flows Illustrating Full Duplex Mapping .....	329
I.3.3	Full Duplex Mapping.....	338
I.3.3.1	Parameter Mappings.....	340
I.3.4	Half Duplex Mapping.....	350
I.3.5	Return Code to Event Mapping.....	351
<b>Appendix J</b>	<b>The Internet Protocols .....</b>	<b>353</b>
<b>Appendix K</b>	<b>IPX/SPX Transport Provider .....</b>	<b>355</b>
K.1	General.....	355
K.2	Namespace .....	355
K.2.1	IPX.....	355
K.2.2	SPX.....	356
K.3	Options.....	356
K.3.1	IPX-level Options.....	356
K.3.2	SPX-level Options.....	357
K.4	Functions .....	359
<b>Appendix L</b>	<b>ATM Transport Protocol Information for XTI.....</b>	<b>363</b>
L.1	General.....	363
L.2	ATM Addresses .....	364
L.2.1	ATM Network Address .....	364
L.2.2	ATM Protocol Address .....	364
L.2.3	t_atm_sap Structure .....	365
L.3	Options.....	369
L.3.1	Signalling-level Options .....	369
L.3.2	Absolute Requirements .....	370
L.3.3	Further Remarks.....	370
L.4	Existing Functions .....	381
L.5	New Functions .....	384
	t_addleaf() .....	385
	t_removeleaf() .....	387



	<i>t_rcvleafchange()</i> .....	389
L.6	Implementation Notes.....	391
<b>Appendix M</b>	<b>ATM Transport Protocol Information for Sockets .....</b>	<b>395</b>
M.1	General .....	395
M.2	Existing Functions .....	396
M.3	Point-to-Multipoint Connections .....	399
M.3.1	Adding a Leaf .....	399
M.3.2	Removing a Leaf .....	400
M.3.3	Receiving Indication of a Change in Leaf Status.....	400
M.4	Implementation Notes.....	402
<b>Appendix N</b>	<b>ATM Transport Headers .....</b>	<b>405</b>
N.1	Proposed Additions to <xti.h>.....	405
N.2	Proposed Additions to <sys/socket.h>.....	405
N.3	<xti_atm.h> .....	405
N.4	<netatm/atm.h> .....	406
N.5	<_atm_common.h> .....	407
	<b>Glossary .....</b>	<b>415</b>
	<b>Index.....</b>	<b>419</b>
 <b>List of Figures</b>		
I-1	Active Connection Establishment, Blocking Version (1 of 2) .....	329
I-2	Active Connection Establishment, Non-blocking Version (2 of 2) .....	330
I-3	Passive Connection Establishment, Instantiation Version (1 of 3) .....	331
I-4	Passive Connection Establishment, Blocking Version (2 of 3).....	332
I-5	Passive Connection Establishment, Non-blocking Version (3 of 3) ....	333
I-6	XTI Function to LU 6.2 Verb Mapping: Blocking t_snd .....	334
I-7	XTI Function to LU 6.2 Verb Mapping: Non-blocking t_snd.....	335
I-8	XTI Function to LU 6.2 Verb Mapping: Blocking t_rcv .....	336
I-9	Mapping from XTI Calls to LU 6.2 Verbs (Passive side).....	337
 <b>List of Tables</b>		
3-1	Events and <i>t_look()</i> .....	15
4-1	Classification of the XTI Functions .....	29
5-1	Transport Interface States .....	32
5-2	Transport Interface Outgoing Events .....	33
5-3	Transport Interface Incoming Events .....	34
5-4	Transport Interface User Actions.....	35
5-5	Initialisation/De-initialisation States .....	36
5-6	Data Transfer States: Connectionless-mode.....	36
5-7	Connection/Release/Data Transfer States: Connection-mode .....	37
7-1	XTI-level Options.....	88
A-1	Options for Quality of Service and Expedited Data.....	216

A-2	Management Options .....	218
A-3	Options for Quality of Service .....	220
A-4	Management Option .....	221
B-1	TCP-level Options .....	230
B-2	T_UDP-level Option.....	231
B-3	T_IP-level Options.....	232
C-1	Sequence of Transport Functions in Connection-oriented Mode .....	243
C-2	Sequence of Transport Functions in Connectionless Mode .....	244
H-1	APCO-level Options .....	300
H-2	APCL-level Options .....	301
H-3	Association Establishment.....	309
H-4	Data Transfer.....	310
H-5	Association Release .....	311
H-6	Connectionless-mode ACSE Service .....	312
I-1	SNA Options.....	323
I-2	Fields for <i>info</i> Parameter.....	324
I-3	Default Characteristics returned by <i>t_open()</i> .....	325
I-4	FDX LU 6.2 Verb Definitions .....	328
I-5	XTI Mapping to LU 6.2 Full Duplex Verbs .....	338
I-6	Relation Symbol Description.....	340
I-7	<i>t_accept</i> <--> FDX Verbs and Parameters .....	340
I-8	<i>t_bind</i> <--> FDX Verbs and Parameters .....	341
I-9	<i>t_close</i> <--> FDX Verbs and Parameters.....	341
I-10	<i>t_connect</i> <--> FDX Verbs and Parameters .....	342
I-11	<i>t_getprocaddr</i> <--> FDX Verbs and Parameters.....	344
I-12	<i>t_listen</i> <--> FDX Verbs and Parameters.....	345
I-13	<i>t_optmgmt</i> <--> FDX Verbs and Parameters.....	345
I-14	<i>t_rcv</i> <--> FDX Verbs and Parameters .....	346
I-15	<i>t_rcvconnect</i> <--> FDX Verbs and Parameters.....	347
I-16	<i>t_snd</i> <--> FDX Verbs and Parameters.....	348
I-17	<i>t_snddis</i> (Existing Connection) <--> FDX Verbs and Parameters.....	349
I-18	<i>t_snddis</i> (Incoming Connect Req.) <--> FDX Verbs and Parameters...	349
I-19	<i>t_sndrel</i> <--> FDX Verbs and Parameters .....	349
I-20	Mapping of XTI Events to SNA Events.....	351
L-1	Signaling-level Options .....	369

# *Preface*

## **The Open Group**

The Open Group is an international open systems organisation that is leading the way in creating the infrastructure needed for the development of network-centric computing and the information superhighway. Formed in 1996 by the merger of the X/Open Company and the Open Software Foundation, The Open Group is supported by most of the world's largest user organisations, information systems vendors and software suppliers. By combining the strengths of open systems specifications and a proven branding scheme with collaborative technology development and advanced research, The Open Group is well positioned to assist user organisations, vendors and suppliers in the development and implementation of products supporting the adoption and proliferation of open systems.

With more than 300 member companies, The Open Group helps the IT industry to advance technologically while managing the change caused by innovation. It does this by:

- consolidating, prioritising and communicating customer requirements to vendors
- conducting research and development with industry, academia and government agencies to deliver innovation and economy through projects associated with its Research Institute
- managing cost-effective development efforts that accelerate consistent multi-vendor deployment of technology in response to customer requirements
- adopting, integrating and publishing industry standard specifications that provide an essential set of blueprints for building open information systems and integrating new technology as it becomes available
- licensing and promoting the X/Open brand that designates vendor products which conform to X/Open Product Standards
- promoting the benefits of open systems to customers, vendors and the public.

The Open Group operates in all phases of the open systems technology lifecycle including innovation, market adoption, product development and proliferation. Presently, it focuses on seven strategic areas: open systems application platform development, architecture, distributed systems management, interoperability, distributed computing environment, security, and the information superhighway. The Open Group is also responsible for the management of the UNIX trade mark on behalf of the industry.

## **The X/Open Process**

This description is used to cover the whole Process developed and evolved by X/Open. It includes the identification of requirements for open systems, development of CAE and Preliminary Specifications through an industry consensus review and adoption procedure (in parallel with formal standards work), and the development of tests and conformance criteria.

This leads to the preparation of a Product Standard which is the name used for the documentation that records the conformance requirements (and other information) to which a vendor may register a product. There are currently two forms of Product Standard, namely the Profile Definition and the Component Definition, although these will eventually be merged into one.

The X/Open brand logo is used by vendors to demonstrate that their products conform to the relevant Product Standard. By use of the X/Open brand they guarantee, through the X/Open Trade Mark Licence Agreement (TMLA), to maintain their products in conformance with the Product Standard so that the product works, will continue to work, and that any problems will be fixed by the vendor.

### Open Group Publications

The Open Group publishes a wide range of technical literature, the main part of which is focused on specification development and product documentation, but which also includes Guides, Snapshots, Technical Studies, Branding and Testing documentation, industry surveys and business titles.

There are several types of specification:

- *CAE Specifications*

CAE (Common Applications Environment) Specifications are the stable specifications that form the basis for our product standards, which are used to develop X/Open branded systems. These specifications are intended to be used widely within the industry for product development and procurement purposes.

Anyone developing products that implement a CAE Specification can enjoy the benefits of a single, widely supported industry standard. In addition, they can demonstrate product compliance through the X/Open brand. CAE Specifications are published as soon as they are developed, so enabling vendors to proceed with development of conformant products without delay.

- *Preliminary Specifications*

Preliminary Specifications usually address an emerging area of technology and consequently are not yet supported by multiple sources of stable conformant implementations. They are published for the purpose of validation through implementation of products. A Preliminary Specification is not a draft specification; rather, it is as stable as can be achieved, through applying The Open Group's rigorous development and review procedures.

Preliminary Specifications are analogous to the *trial-use* standards issued by formal standards organisations, and developers are encouraged to develop products on the basis of them. However, experience through implementation work may result in significant (possibly upwardly incompatible) changes before its progression to becoming a CAE Specification. While the intent is to progress Preliminary Specifications to corresponding CAE Specifications, the ability to do so depends on consensus among Open Group members.

- *Consortium and Technology Specifications*

The Open Group publishes specifications on behalf of industry consortia. For example, it publishes the NMF SPIRIT procurement specifications on behalf of the Network Management Forum. It also publishes Technology Specifications relating to OSF/1, DCE, OSF/Motif and CDE.

Technology Specifications (formerly AES Specifications) are often candidates for consensus review, and may be adopted as CAE Specifications, in which case the relevant Technology Specification is superseded by a CAE Specification.

In addition, The Open Group publishes:

- *Product Documentation*

This includes product documentation — programmer's guides, user manuals, and so on — relating to the Pre-structured Technology Projects (PSTs), such as DCE and CDE. It also includes the Single UNIX Documentation, designed for use as common product documentation for the whole industry.

- *Guides*

These provide information that is useful in the evaluation, procurement, development or management of open systems, particularly those that relate to the CAE Specifications. The Open Group Guides are advisory, not normative, and should not be referenced for purposes of specifying or claiming conformance to a Product Standard.

- *Technical Studies*

Technical Studies present results of analyses performed on subjects of interest in areas relevant to The Open Group's Technical Programme. They are intended to communicate the findings to the outside world so as to stimulate discussion and activity in other bodies and the industry in general.

- *Snapshots*

These provide a mechanism to disseminate information on its current direction and thinking, in advance of possible development of a Specification, Guide or Technical Study. The intention is to stimulate industry debate and prototyping, and solicit feedback. A Snapshot represents the interim results of a technical activity.

### **Versions and Issues of Specifications**

As with all *live* documents, CAE Specifications require revision to align with new developments and associated international standards. To distinguish between revised specifications which are fully backwards compatible and those which are not:

- A new *Version* indicates there is no change to the definitive information contained in the previous publication of that title, but additions/extensions are included. As such, it *replaces* the previous publication.
- A new *Issue* indicates there is substantive change to the definitive information contained in the previous publication of that title, and there may also be additions/extensions. As such, both previous and new documents are maintained as current publications.

### **Corrigenda**

Readers should note that Corrigenda may apply to any publication. Corrigenda information is published on the World-Wide Web at <http://www.opengroup.org/public/pubs>.

### **Ordering Information**

Full catalogue and ordering information on all Open Group publications is available on the World-Wide Web at <http://www.opengroup.org/public/pubs>.

## This Document

This document is a CAE Specification, although it includes some appendices which are classed as Preliminary Specifications. The introductory section in each appendix clearly identifies its status.

The Networking Services (XNS) specification describes the industry-standard Open Systems interfaces to communications services. These include two APIs to transport-level process-to-process communications: Sockets and XTI. Both Sockets and XTI are specified for use over Internet protocols (TCP, UDP and IP) and ISO Transport protocols. They also include a set of Internet address resolution interfaces which are commonly used in conjunction with Sockets. XTI support for many other protocols is described in appendices to XNS.

This XNS Issue 5 is one of the UNIX98 specifications. Branded UNIX98 systems support the Sockets, XTI and Address Resolution interfaces described in XNS Issue 5. Sockets and Address Resolution must be supported over the Internet protocols. XTI may be supported over either the Internet or ISO Transport protocols. Other protocols may also be provided, but this is not required for the Brand.

XNS Issue 5 contains a number of new features over the previous publication<sup>1</sup>. The most important new feature is the removal of implicit data length assumptions (for example, that an item of type *int* is 32 bits long). This enables the XNS APIs to be used effectively on new computer architectures with 64-bit (or larger) word lengths. Other new features include:

- taking account of realtime threads
- support for scatter/gather
- XTI can now be used in a way that takes less of the application's name space
- use of XTI over IPX/SPX is now specified
- use of Sockets and XTI with the broadband Asynchronous Transfer Mode (ATM) protocol is now specified.

XNS Issue 5 includes revisions to align with the IEEE Standard 1003.1: 1990 (Portable Operating System Interface). At the time of publication, the IEEE project P1003.1g is considering draft extensions, and their current draft includes some aspects with which XNS can not align (for example, it still makes implicit data length assumptions). Attempts are being made in P1003.1g to seek alignment with XNS Issue 5.

## Structure

- Chapter 1 contains information comparable to that in the **XSH** specification. It applies to the Sockets and Address Resolution interfaces (see below) if the UNIX compilation environment is in effect.
- Chapter 2 is a general introduction to the Transport Interface (XTI).
- Chapter 3 provides explanatory notes.
- Chapter 4 gives an overview for XTI.
- Chapter 5 describes the states and events in XTI.
- Chapter 6 describes the use of options.

---

1. The previous XNS publication was CAE Specification, September 1994, Networking Services, Issue 4, (ISBN: 1-85912-049-0, C438).

- Chapter 7 contains reference manual pages for the XTI functions and parameters.
- Chapter 8 gives an overview and interfaces for Sockets.
- Chapter 9 defines the headers for Sockets.
- Chapter 10 gives an overview and interfaces for IP Address Resolution.
- Chapter 11 defines the headers for IP Address Resolution.
- Appendix A describes the protocol-specific information that is relevant for ISO transport providers, including for ISO-over-TCP (RFC 1006).
- Appendix B describes the protocol-specific information that is relevant for TCP and UDP transport providers.
- Appendix C gives guidelines for the use of XTI.
- Appendix D specifies a standard programming interface to NetBIOS transport providers in systems compliant to XTI.
- Appendix E describes how XTI provides refinement of the Transport Level Interface (TLI).
- Appendix F presents a summary of the contents of the `<xti.h>` header file.
- Appendix G lists abbreviations used in this document.
- Appendix H provides a simple API exposing a minimum set of OSI Upper Layers functionality (mOSI).
- Appendix I describes the protocol-specific information and mapping to XTI functions that is relevant for Systems Network Architecture (SNA) transport providers.
- Appendix J contains a brief explanation of the Internet Protocols.
- Appendix K describes the protocol-specific information and mapping to XTI functions that is relevant for an IPX/SPX transport provider.
- Appendix L describes the protocol-specific information for XTI that is relevant for ATM transport providers.
- Appendix M describes the protocol-specific information for Sockets that is relevant for ATM transport providers.
- Appendix N presents header files information required for ATM transport providers.

### Typographical Conventions

The following typographical conventions are used throughout this document:

- **Bold** font is used in text for options to commands, filenames, keywords, type names, data structures and their members.
- *Italic* strings are used for emphasis or to identify the first instance of a word requiring definition. Italics in text also denote:
  - command operands, command option-arguments or variable names, for example, substitutable argument prototypes
  - environment variables, which are also shown in capitals
  - utility names
  - external variables, such as *errno*

- functions; these are shown as follows: *name()*. Names without parentheses are C external variables, C function family names, utility names, command operands or command option-arguments.
- Normal font is used for the names of constants and literals.
- The notation **<file.h>** indicates a header file.
- Names surrounded by braces, for example, {ARG\_MAX}, represent symbolic limits or configuration values which may be declared in appropriate headers by means of the C **#define** construct.
- The notation [ABCD] is used to identify a return value ABCD, including if this is an error value.
- Syntax, code examples and user input in interactive examples are shown in fixed width font. Brackets shown in this font, [ ], are part of the syntax and do *not* indicate optional items. In syntax the | symbol is used to separate alternatives, and ellipses ( . . . ) are used to show that additional arguments are optional.



## *Trade Marks*

AT&T<sup>®</sup> is a registered trade mark of AT&T in the U.S.A. and other countries.

HP<sup>®</sup> is a registered trade mark of Hewlett-Packard.

Motif<sup>®</sup>, OSF/1<sup>®</sup> and UNIX<sup>®</sup> are registered trade marks and the “X Device”<sup>™</sup> and The Open Group<sup>™</sup> are trade marks of The Open Group.

SNA is a product of International Business Machines Corporation.

/usr/group<sup>®</sup> is a registered trade mark of UniForum, the International Network of UNIX System Users.

# Acknowledgements

- AT&T for permission to reproduce portions of its copyrighted System V Interface Definition (SVID) and material from the UNIX System V Release 2.0 documentation.
- The Institution of Electrical and Electronics Engineers, Inc. for permission to reproduce portions of its copyrighted material.
- The IEEE Computer Society's Portable Applications Standards Committee (PASC), whose Standards contributed to our work.
- The UniForum (formerly /usr/group) Technical Committee's Internationalization Subcommittee for work on internationalised regular expressions.
- The ANSI X3J11 Committees.
- The Open Group gratefully acknowledges the valued contribution of the following people in the development of this specification, along with their corporate affiliation at the time of their contribution:

Josee Auber	Hewlett-Packard	Lori Mickelson	Unisys
Kathryn Britton	IBM	Laura Micks	IBM
Philippe Camus	Groupe Bull	Finnbarr Murphy	DIGITAL
Andrew Chandler	ICL	Alagu Periyannan	Apple
Andre Cohen	Groupe Bull	George Preoteasa	Hewlett-Packard
Paul Comstock	Hewlett-Packard	John Ronciak	Unisys
Andrew Gollan	Sun	Seth Rosenthal	Novell
Michel Habert	Groupe Bull	Eric Scoredos	Hewlett-Packard
Torez Hiley	USL	Maria Stanley	DIGITAL
Martin Jess	NCR	Lutz Temme	SNI
Mukesh Kacker	Sun	Roger Turner	IBM
Gerhard Kieselmann	SNI	Keith Weir	ICL
David Laight	Fujitsu/ICL	Robert Weirick	Unisys
Jack McCann	DIGITAL	Greg Wiley	SFC (SCO)
Hiroshi Maruta	Hitachi	Isaac Wong	Hewlett-Packard

# *Referenced Documents*

The following documents are referenced in this specification:

## **ACSE**

### **ISO 8649**

ISO 8649: 1988, Information Processing Systems — Open Systems Interconnection — Service Definition for the Association Control Service Element, together with:

Technical Corrigendum 1: 1990 to ISO 8649: 1988

Amendment 1: 1990 to ISO 8649: 1988

Authentication during association establishment.

Amendment 2: 1991 to ISO 8649: 1988

Connectionless-mode ACSE Service.

### **ISO 8650**

ISO 8650: 1988, Information Processing Systems — Open Systems Interconnection — Protocol specification for the Association Control Service Element, together with:

Technical Corrigendum 1: 1990 to ISO 8650: 1988

Amendment 1: 1990 to ISO 8650: 1988

Authentication during association establishment.

### **ISO/IEC 10035**

ISO/IEC 10035: 1991, Information Technology — Open Systems Interconnection — Connectionless ACSE Protocol Specification.

## **Presentation**

### **ISO 8822**

ISO 8822: 1988, Information Processing Systems — Open Systems Interconnection — Connection-oriented Presentation Service Definition.

### **ISO 8823**

ISO 8823: 1988, Information Processing Systems — Open Systems Interconnection — Connection-oriented Presentation Protocol Specification.

### **ISO 8824**

ISO 8824: 1990, Information Technology — Open Systems Interconnection — Specification of Abstract Syntax Notation One (ASN.1).

### **BER**

ISO/IEC 8825: 1990 (ITU-T Recommendation X.209 (1988)), Information Technology — Open Systems Interconnection — Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1).

### **ISO/IEC 9576**

ISO/IEC 9576: 1991, Information Technology — Open Systems Interconnection — Connectionless Presentation Protocol Specification.

## Session

### ISO 8326

ISO 8326: 1987, Information Processing Systems — Open Systems Interconnection — Basic Connection-oriented Session Service Definition.

### ISO 8327

ISO 8327: 1987, Information Processing Systems — Open Systems Interconnection — Basic Connection-oriented Session Protocol Specification.

Amendment 3: 1992 to ISO 8327: 1987 — Additional Synchronization Functionality.

## ATM

ATMNAS ATM Forum: “Native ATM services: Semantic Description, Version 1”, obtainable via anonymous ftp from Internet address ftp.atmforum.com, in directory /pub/approved-specs, files af-saa-0048.000.doc (Word 6.0) or af-saa-0048.000.ps (postscript).

UNIATM Forum: “ATM User-Network Interface (UNI) Specification, Version 3.1”, published by Prentice Hall. Also obtainable electronically via anonymous ftp from Internet address ftp.atmforum.com, in directory /pub/UNI/ver3.1.

## Other References

### Minimal OSI

ISO/IEC DISP 11188-3, International Standardized Profile — Common Upper Layer Requirements — Part 3: Minimal OSI Upper Layers Facilities, Version 6, 1994-04-14.

### ISO 7498

ISO 7498: 1984, Information Processing Systems — Open Systems Interconnection — Basic Reference Model.

### ISO Transport

	Connection-Oriented	Connectionless
Protocol Definition	IS 8073-1986	IS 8602
Service Definition	IS 8072-1986	IS 8072/Add.1-1986

### TCP

Transmission Control Protocol, RFC 793 (Defense Communication Agency, DDN Protocol Handbook, Volume II, DARPA Internet Protocols, (December 1985).

Also see TCP, Transmission Control Protocol, Military Standard, Mil-std-1778, Defense Communication Agency, DDN Protocol Handbook, Volume I, DOD Military Standard Protocols (December 1985).

### UDP

User Datagram Protocol, RFC 768 (Defense Communication Agency, DDN Protocol Handbook, Volume II, DARPA Internet Protocols, December 1985).

### TLI Specifications

Networking Services Extension, draft version of SVID Issue 2, Volume III, 1986.

### NetBIOS

Mappings of NetBIOS services to OSI and IPS transport protocols are provided in the CAE Specification, October 1992, Protocols for PC Interworking: SMB, Version 2 (ISBN: 1-872630-45-6, C209).

## *Referenced Documents*

### SNA

SNA National Registry, IBM document G325-6025-0.

### CURL

Common Upper Layer Requirements, Part 3: Minimal OSI Upper Layer Facilities — OIW/EWOS working document.

### XSH, Issue 5

CAE Specification, January 1997, System Interfaces and Headers, Issue 5 (ISBN: 1-85912-181-0, C606).

### XCU, Issue 5

CAE Specification, January 1997, Commands and Utilities, Issue 5 (ISBN: 1-85912-191-8, C604).

### XBD, Issue 5

CAE Specification, January 1997, System Interface Definitions, Issue 5 (ISBN: 1-85912-186-1, C605).

