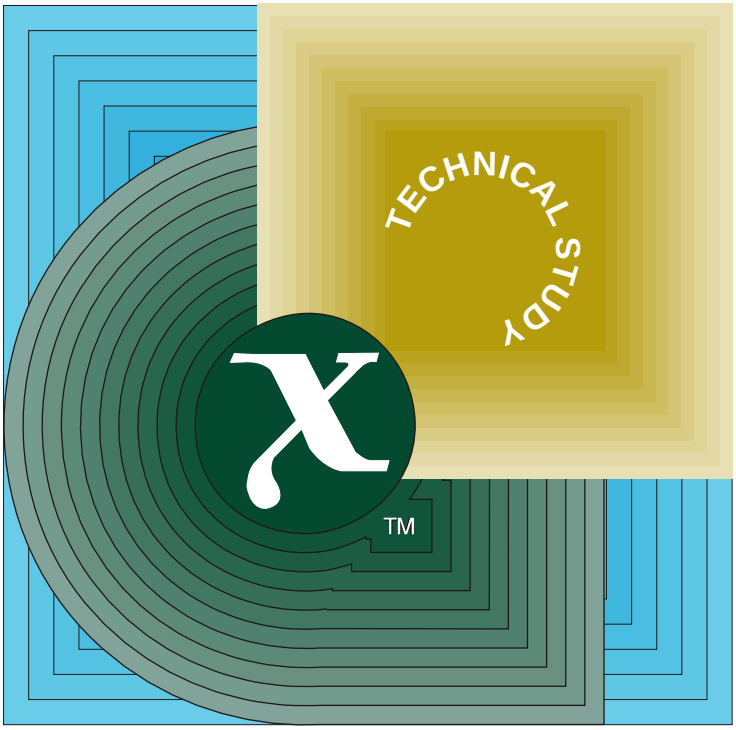
Technical Study

Manageability of Interworking Specifications



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X/Open Technical Study

Manageability of Interworking Specifications

X/Open Company Ltd.

X/Open Technical Study

Manageability of Interworking Specifications

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Preface

X/Open

X/Open is an independent, worldwide, open systems organisation supported by most of the world's largest information systems suppliers, user organisations and software companies. Its mission is to bring to users greater value from computing, through the practical implementation of open systems.

X/Open's strategy for achieving this goal is to combine existing and emerging standards into a comprehensive, integrated, high-value and usable open system environment, called the Common Applications Environment (CAE). This environment covers the standards, above the hardware level, that are needed to support open systems. It provides for portability and interoperability of applications, and so protects investment in existing software while enabling additions and enhancements. It also allows users to move between systems with a minimum of retraining.

X/Open defines this CAE in a set of specifications which include an evolving portfolio of application programming interfaces (APIs) which significantly enhance portability of application programs at the source code level, along with definitions of and references to protocols and protocol profiles which significantly enhance the interoperability of applications and systems.

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- *Preliminary Specifications*

  These specifications, which often address an emerging area of technology and consequently are not yet supported by multiple sources of stable conformant implementations, are released in a controlled manner for the purpose of validation through implementation of products. A Preliminary specification is not a draft specification. In fact, it is as stable as X/Open can make it, and on publication has gone through the same rigorous X/Open development and review procedures as a CAE specification.

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- *Guides*

  These provide information that X/Open believes is useful in the evaluation, procurement, development or management of open systems, particularly those that are X/Open-compliant. X/Open Guides are advisory, not normative, and should not be referenced for purposes of specifying or claiming X/Open conformance.

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  X/Open Technical Studies present results of analyses performed by X/Open on subjects of interest in areas relevant to X/Open's Technical Programme. They are intended to communicate the findings to the outside world and, where appropriate, stimulate discussion and actions by other bodies and the industry in general.

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Corrigenda

Most X/Open publications deal with technology at the leading edge of open systems development. Feedback from implementation experience gained from using these publications occasionally uncovers errors or inconsistencies. Significant errors or recommended solutions to reported problems are communicated by means of Corrigenda.

The reader of this document is advised to check periodically if any Corrigenda apply to this publication. This may be done either by email to the X/Open info-server or by checking the Corrigenda list in the latest X/Open Publications Price List.

To request Corrigenda information by email, send a message to info-server@xopen.co.uk with the following in the Subject line:

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request corrigenda; topic index
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This will return the index of publications for which Corrigenda exist.

This Document

This document is a Technical Study of the implications of manageability requirements on X/Open interworking specifications.

The X/Open interworking specifications considered are those that, at the time of publication, are already or are expected shortly to become, CAE specifications.

The **Manageability Guidelines** X/Open snapshot discusses issues associated with introducing *manageability* into the definition of Application Programming Interfaces (APIs). Rather than discussing these issues separately for each interworking specification, this technical study addresses all these specifications, under the headings Management Tasks, Resources, and Services. The description of the manageability issues arising follows the form of the template that is defined in the **Manageability Guidelines** X/Open snapshot. In addition, the final chapter presents conclusions on the manageability of X/Open interworking specifications, and recommends actions to ensure that the manageability aspects of interworking specifications are addressed.

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Referenced Documents

The list of documents referenced here is incomplete. Most of the OSI systems management standards, Internet management RFCs and X/Open systems management specifications are potentially relevant. The most important specifications in each of these categories at the time of publication are referenced in this list.

X/Open Interworking Specifications

BSFT

X/Open CAE Specification - Byte Stream File Transfer (BSFT), C194, X/Open Co. Ltd, December 1991.

IPC SMB

X/Open CAE Specification - IPC Mechanisms for SMB, C195, X/Open Co. Ltd, February 1992.

MPTN Access Node

X/Open Preliminary Specification - XMPTN Access Node, P408, X/Open Co. Ltd, September 1994.

MPTN Address Mapper

X/Open Preliminary Specification - XMPTN Address Mapper, P407, X/Open Co. Ltd, September 1994.

(PC)NFS

X/Open Developers' Specification - (PC)NFS, D030, X/Open Co. Ltd, August 1990.

SMB

X/Open CAE Specification - Protocols for X/Open PC Interworking: SMB, Version 2, The X/Open Co. Ltd, 1992

XAP

X/Open CAE Specification - ACSE/Presentation Services API, C209, X/Open Co. Ltd, September 1993.

XAP-ROSE

X/Open Preliminary Specification - Remote Operations Service Element (XAP-ROSE) API, C408, X/Open Co. Ltd, February 1995.

XAP-TP

X/Open Preliminary Specification - ACSE/Presentation: Transaction Processing API (XAP-TP), C409, X/Open Co. Ltd, April 1995.

XDS

X/Open CAE Specification - API to Directory Services (XDS), Issue 2, C317, X/Open Co. Ltd., May 1994.

XFTAM

X/Open CAE Specification - FTAM High-Level API (XFTAM), C502, X/Open Co. Ltd, October 1995.

XMHS

X/Open CAE Specification - API to Electronic Mail (X.400), Issue 2, C316, X/Open Co. Ltd., May 1994.

XMS
X/Open CAE Specification - Message Store API (XMS), C305, X/Open Co. Ltd., June 1993.

XNFS
X/Open CAE Specification - Protocols for X/Open Interworking: XNFS, Issue 4, C218, X/Open Co. Ltd, October 1992.

XOM
X/Open CAE Specification - OSI-Abstract-Data Manipulation API (XOM), Issue 2, C315, X/Open Co. Ltd., May 1994.

XTI
X/Open CAE Specification - X/Open Networking Services (Transport Interface, XTI), C438, X/Open Co. Ltd, May 1994.

X/Open Systems Management Specifications

Manageability Guidelines
Draft X/Open Snapshot - Manageability Guidelines, S438, X/Open Co. Ltd, November 1994.

UMA DCI
X/Open Preliminary Specification - Systems Management: UMA Data Capture Interface, P434, X/Open Co. Ltd, April 1995.

UMA DPD
X/Open Preliminary Specification - Systems Management: UMA Data Pool Definitions, P435, X/Open Co. Ltd, April 1995.

UMA Guide
X/Open Guide - Guide to Universal Measurement Architecture (UMA), G414, X/Open Co. Ltd, April 1995.

UMA MLI
X/Open Preliminary Specification - Systems Management: UMA Measurement Layer Interface, P426, X/Open Co. Ltd, April 1995.

XBSA
X/Open Preliminary Specification - Systems Management: Backup Services API (XBSA), P424, X/Open Co. Ltd, July 1995.

XGDMO
X/Open Preliminary Specification - Systems Management: GDMO to XOM Translation Algorithm, P319, X/Open Co. Ltd, March 1994.

XMP
X/Open CAE Specification - Systems Management: Management Protocols API (XMP), C306, X/Open Co. Ltd, March 1994.

XMPP
X/Open CAE Specification - Systems Management: Management Protocol Profiles (XMPP), C206, X/Open Co. Ltd, November 1993.

XMSO
X/Open Preliminary Specification - Systems Management: Common Management Facilities, P421, X/Open Co. Ltd, July 1995.

XRM
X/Open Guide - Systems Management: Reference Model, G207, X/Open Co. Ltd, September 1993.

Other X/Open Publications

Security in Interworking Specifications
X/Open Technical Study - Security in Interworking Specifications. X/Open Co. Ltd, E403, ISBN 1-85912-051-2, December 1994.

OSI Management Standards

CMISP
ISO/IEC 9596-1: 1991, Common Management Information Service Protocol

GDMO
ISO/IEC 10165-4 (1991), Information Technology - Open Systems Interconnection - Structure of Management Information - Part 4: Guidelines for the Definition of Managed Objects

Other relevant OSI management standards are to be added to the above list.

Internet Management RFCs

SNMP
Internet RFC 1157, The Simple Network Management Protocol

RFC 1567
Internet RFC 1567, X.500 Directory Monitoring MIB.

RFC 1566
Internet RFC 1566, Mail Monitoring MIB.

RFC 1565
Internet RFC 1565, Network Services Monitoring MIB.

RFC 1461
Internet RFC 1461, SNMP MIB extension for Multiprotocol Interconnect over X.25.

RFC 1382
Internet RFC 1382, SNMP MIB Extension for the X.25 Packet Layer.

RFC 1381
Internet RFC 1381, SNMP MIB Extension for X.25 LAPB.

RFC 1213
Internet RFC 1213, Management Information Base for network management of TCP/IP-based internets:MIB-II.

RFC 1238
Internet RFC 1238, CLNS MIB for use with Connectionless Network Protocol (ISO 8473) and End System to Intermediate System (ISO 9542).

Other Standards

POSIX 1387.x

1387-2:
Draft Standard - POSIX - System Administration Part 2 - System Software Administration

1387-3
Draft Standard - POSIX - System Administrator Part 3 - User Group Account Management

1387-4
Draft Standard - POSIX - System Administration Part 4 - Printing Interfaces.

Chapter 1

Management Requirements Overview

1.1 Scope and Purpose

This document is a Technical Study of the implications of manageability requirements on X/Open interworking specifications.

The X/Open interworking specifications considered are those that, at the time of publication, are already or are expected shortly to become, CAE specifications. These consist of the following documents (full details are given in the list of references).

- XTI
- XMPTN (Access Node and Address Mapper)
- XAP, XAP-TP and XAP-ROSE
- XOM
- XFTAM
- BSFT
- X.400 API
- XMS
- XDS
- XNFS
- (PC)NFS
- SMB Protocols
- IPC Mechanisms for SMB.

The **Manageability Guidelines** X/Open snapshot discusses issues associated with introducing *manageability* into the definition of Application Programming Interfaces (APIs). It states the requirement for doing this in a consistent way, so that management applications can operate uniformly in a system that includes interfaces conforming to several X/Open specifications. It provides guidance to the writers of new API specifications, with the goal that the resources made available by new APIs are treated in a way that is compatible with the management of other resources. It also applies to existing API specifications that do not include any material addressing management issues, and provides guidance for how management concerns can be introduced either into an update of the specification or into a new, separate document dealing with management issues.

This technical study addresses manageability considerations for all of the interworking specifications listed above. It follows the template that is defined in the **Manageability Guidelines** X/Open snapshot for a manageability chapter in a new API specification. Each of the sections or subsections defined in the template is present in this technical study, but written for the interworking specifications in general, rather than for one specification in particular.

All of the specifications listed above are or include API specifications, except for the **BSFT** X/Open CAE specification, the **XMPTN Access Node** X/Open preliminary specification, the **XMPTN Address Mapper** X/Open preliminary specification and the **SMB** X/Open CAE specification. The **Manageability Guidelines** X/Open snapshot is particularly oriented towards API specifications, but also applies to the other specifications listed above.

1.2 Management Goals

The **Manageability Guidelines** X/Open snapshot states that each specification should clearly identify the goals that it seeks to achieve in identifying its management requirements. These goals may be in the following areas:

- Access Control
- Configuration Management
- Performance Management
- Fault Management
- Accounting Management.

This subsection addresses what these goals should be for interworking specifications in general.

A further important goal is the ability to define and manage policy. While it should clearly be possible to operate interworking interfaces in accordance with the management policy of each user enterprise, there is no requirement for interworking interface subsystems to include policy management facilities. The question of management policy goals is not addressed explicitly in this subsection.

1.2.1 Security Management

Access control is an important aspect of overall system security. Other aspects include identification, authentication, data integrity, confidentiality, non-repudiation, security event reporting and audit trail. Interworking interfaces play a significant role in all of these aspects, but security features are not in general defined in detail in X/Open interworking specifications. A discussion of security and X/Open interworking specifications can be found in the referenced **Security in Interworking Specifications**, X/Open technical study.

There are two classes of threat that should be considered separately in relation to an interworking interface in a system:

- the threat of misuse of network resources by users of the system
- the threat of misuse of system resources by users of the network.

Threats of the first of these types apply to all of the X/Open interworking specifications. Access control is perhaps the most important countermeasure to them.

Threats of the second type apply to most of the X/Open interworking specifications (the exceptions are those such as XDS and BSFT that do not include facilities for network users to access the system). For these threats, identification and authentication are countermeasures that are at least as important as access control.

All of these countermeasures have aspects that require management. For example, many access control schemes rely on access control lists (ACLs) to determine whether any particular request for access to a resource can be granted. These ACLs must be set up initially and maintained as the user population of an enterprise changes. Similarly, authentication often requires lists of users and passwords, or other secret information, to be maintained.

It should be a goal that, where security countermeasures are provided by an interworking interface implementation, those countermeasures can be managed effectively.

1.2.2 Configuration Management

Most interworking interfaces have configuration information associated with them. This can include:

- protocol selection (some interfaces, for example the XTI, can be implemented over several different communications protocols)
- device driver selection (some interface software can be configured with any of a number of device drivers, and the appropriate ones must be installed on each system)
- protocol parameters (packet sizes, etc.)
- local and remote addresses.

Generally, this information can be supplied through the interface (for example, in the case of XTI, using the option management facilities). However, the implementation often supplies defaults which can be set by system managers.

It should be a goal that, where configuration information can not be supplied through the interface specified by X/Open, or where system defaults can be used, there is effective provision for values to be supplied through configuration management.

1.2.3 Performance Management

Systems managers will want to measure, and to optimise, the performance of interface software. More importantly, they will also want to measure and optimise the performance of their networks, and the interface software can help them to do this.

Performance management of networks and of interface software is most concerned with *throughput* and *transit delay* of data across the interface and over the network.

Performance management is partly dependant on configuration management, since many of the parameters that are set though configuration management affect performance.

It should be a goal that performance management facilities associated with an interface should enable the throughput and transit delay of data across the interface and over the network to be measured and optimised.

1.2.4 Fault Management

As with performance management, there is a requirement to manage, through the network interface component, detection and correction of faults in the network, as well as detection and correction of faults in the communications component itself.

Faults are in fact much more likely to occur in the network than in the network interface component. Some of these faults can be detected by the interface software. Good fault management requires that the interface software should detect faults where possible, and should be able to report them.

It would also be possible for interface software to assist with fault repair by re-routing traffic to avoid faulty network components while they are replaced or repaired. Configuration management facilities should enable system managers to reconfigure the software for this purpose.

It should be a goal that interworking interfaces should detect and report faults, and should re-route traffic to avoid them, where possible.

1.2.5 Accounting Management

Any accounting that is required of the computer resources used by the interworking interface implementation is likely to be provided by the operating system platform. However, accounting of use of network resources will also be required in some installations. This can appropriately be provided by the interworking interface implementations.

It should be a goal that interworking interfaces can provide accounting information about use of network resources.

1.3 Management Requirements

The **Manageability Guidelines** X/Open snapshot states that the management requirements should be analysed with regard to the different classes of user requiring access to management interfaces. These can include

- computer system administrators
- management application developers
- system service providers
- computer system resource planners.

Interworking interfaces fall into the intersection of two management domains: computer systems and communications networks. Systems and networks can be, and often are, managed together, but they are sometimes managed separately and by different groups of people.

Each of the above classes of user can be divided into two subclasses: computer and network. This should be borne in mind when the management requirements for interworking interfaces are considered.

From the point of view of management of access control and other aspects of security, of configuration management and of accounting management, the interface components are primarily the concern of the computer manager. From the point of view of performance management and fault management, the information generated by interface components is more of interest to the network manager.

In either case, an interworking interface component is only a part of a larger entity (computer or network), and must be managed together with the other components of that entity. Management requirements must be considered in relation to other system management requirements, to other network management requirements, and to the whole set of requirements for management of distributed systems that include both computers and networks.

1.4 Standards

1.4.1 Existing Standards

The existing standards that could be used to support the management of interworking interfaces include:

- the OSI systems management standards listed as Referenced Documents
- the Internet management RFCs listed as Referenced Documents
- the X/Open systems management specifications listed as Referenced Documents.

1.4.2 Emerging Standards

Emerging standards in the categories listed in Section 1.4.1 are potentially relevant to the management of interworking interfaces.

Chapter 2

Management Tasks

2.1 Introduction

Management tasks should be identified from the point of view of the system administrator, rather than from the point of view of the resources to be managed, because taking the latter point of view leads to an explosion of management tasks with too fine a degree of functionality, requiring the administrator to perform a number of tasks in order to achieve a single desired action.

System administrators need to perform tasks relating to configuration management, performance management, fault management, security management and accounting management. In each of these areas, there are tasks that are concerned with interworking interfaces.

2.2 Configuration Management

2.2.1 Introduction

Configuration management includes:

- the installation and configuration of the hardware devices in the computers and networks
- the installation and configuration of the software (in particular, for the purposes of this technical study, of the communications interface software)
- the reconfiguration of the hardware and software as required:
  - — to accomodate moves and changes in the user population
  - — for functional upgrades to the system
  - — for performance tuning
  - — to minimise the effects of faults that occur.

The management tasks required for configuration management principally consist of:

- hardware installation
- software installation
- setting, changing and reading *configuration parameters* that affect the operation of the system.

2.2.2 Hardware Installation

Hardware installation impacts on interworking interfaces in that it will often require installation of new interface software or reconfiguration of existing interface software. These aspects are discussed below.

2.2.3 Software Installation

Software installation of interworking interfaces typically requires that the source programs be compiled, producing object code that is linked to create a module or library that is loaded. Some of these operations may be carried out before installation time, depending on the nature of the operating system platform and the design of the interface software.

Some X/Open interworking specifications contain provisions that relate to this process. For example:

- the **XTI** X/Open CAE specification refers to an *XTI Library* with which applications are compiled
- the **XMHS** X/Open CAE specification contains an appendix that explains how, in the context of selected operating systems (OS/2 and UNIX System V Release 4.0), an application can be bound at run time to an implementation.

Such provisions are not uniform in X/Open interworking specifications, and some specifications (for example, the **XNFS** X/Open CAE specification) do not contain any.

2.2.4 Configuration Parameters

Configuration parameters can include:

- hardware device registers that affect hardware operation
- software data items that affect software operation.

In general, where applications need to set or read either hardware or software configuration parameters, the X/Open interworking specifications define appropriate facilities. For example:

- the **XTI** X/Open CAE specification describes option management facilities that enable protocol parameters to be configured
- the **XAP** X/Open CAE specification describes facilities to set up the *XAP environment*, which includes parameters such as the protocol selection, the local presentation address and the calling application process title.

It should be noted that the parameters that can be accessed through each API are in all cases only a subset of all of the parameters that are relevant for communication. For example, XAP can be used as an interface to ACSE/Presentation services implemented over the OSI session and transport protocols and the X.25 protocol, but XAP does not provide facilities for accessing parameters of the underlying protocols (for example, X.25 packet size).

Where the application can set parameters, it is often the case that the implementation can supply defaults. Setting these defaults is an important part of configuration management. X/Open interworking specifications contain no provisions that describe how configuration management should be able to set them.

2.3 Performance Management

Performance management includes the monitoring and tuning of system performance.

In computers, the most important aspects of performance are:

- the time taken to respond to input from a terminal (the *terminal response time*)
- the amount of data that is processed in a given time (*data-processing throughput*).

These can be very much affected by CPU utilisation, memory utilisation and disk utilisation, which are often monitored as performance indicators.

Interworking interfaces contribute to terminal response times, data processing times and resource utilisation. Monitoring of their contribution is typically carried out using the facilities of the operating system platform rather than facilities in the implementations of the interfaces. Tuning of their contribution (where this is possible) is typically carried out by configuration management.

In networks, the most important aspects of performance are:

- the time taken to transmit data across the network (*transit delay*)
- the amount of data that can be transmitted in a given time (*network throughput*).

These aspects can, at least in part, be monitored by equipment in the network. They are typically largely governed by network equipment (multiplexors, switches etc.) and conditions (in particular, the degree of congestion) rather than by the interworking interfaces in the computers that are using the network. However, the interworking interfaces can monitor transit delay and network throughput more effectively, in many cases, than the network equipment can. Also, in some cases, they can affect transit delay and network throughput.

X/Open interworking specifications do not in general contain provisions relating to performance monitoring and control, except where the underlying protocol contains quality of service (QOS) parameters that are related to performance. The OSI connection-mode transport protocol has QOS parameters that include throughput, transit delay and residual error rate, and the **XTI** X/Open CAE specification allows the application to affect the negotiation of these parameters when connections are set up.

2.4 Fault Management

Fault management is concerned with the detection and correction of faults occurring in computer and network equipment. System administrators need:

- to be informed of the occurrence of faults
- to diagnose the causes of faults
- to reconfigure the system to provide the best possible level of service while faults are repaired
- to repair faults.

As regards faults in computer equipment, interworking interfaces are affected by faults in processing and memory resources, in the same way as other software modules are. In addition, they are affected by faults in input/output hardware.

Interworking interfaces are also affected by faults in network equipment and by traffic congestion, which may be regarded as a network fault. Although networking equipment can provide some means of detecting such faults, in some cases the interworking interfaces may provide the most effective means of detecting them.

Computer faults (other than those that prevent API calls from returning normally) and network faults will typically result in error returns to API calls. The X/Open interworking specifications describe such error returns, but they are at a general rather than at a detailed level. They indicate that a fault has occurred, but provide little help in diagnosing its cause.

An exception to this is the **XTI** X/Open CAE specification, which provides a DEBUG option management capability. This provides an implementation-defined trace of program execution. It is oriented towards the needs of software developers rather than those of system managers.

Applications can become aware of network congestion when input or output operations fail or are timed out.

For interworking interfaces, reconfiguration pending fault repair typically takes the form of re-routing traffic to avoid faulty network equipment or interface hardware. This will be achieved by setting protocol addresses and other protocol parameters through configuration management. Interworking interfaces specified by X/Open generally enable protocol addresses to be specified for the protocol with which the API is associated but not for supporting protocols. They do not generally enable routing information to be provided or enable interface hardware to be selected.

X/Open interworking specifications generally contain no provision for fault repair.

2.5 Security Management

Security management is concerned with the management of access control and other security countermeasures. For interworking interfaces, countermeasures are needed against threats of:

- misuse of network resources by computer system users (for example, a bank employee might attempt to originate an unauthorised funds transfer request to transfer money to his own account)
- misuse of computer resources by network users (for example, a ‘‘hacker’’ might attempt to gain unauthorised access to confidential files, or to infect a system with a virus).

Countermeasures include:

- **identification** and **authentication** of users
- **access control** to ensure that the only users that can access resources are those that are authorised to do so
- **data integrity protection** to ensure that data transmitted across a network is received exactly as it is sent
- **confidentiality protection** (usually, using *encryption*) to ensure that data in transit can not be read
- **non-repudiation** to ensure that users who have transmitted information can not subsequently deny having done so
- **security event reporting** to ensure that significant events, such as attempted breaches of security, are brought to the attention of someone who can take appropriate action
- **audit trail** to ensure that events that could assist with subsequent tracing of security breaches are recorded.

For security management, systems administrators need to:

- set the values of security parameters (such as whether confidentiality protection is to be applied to communications)
- maintain system security information (ACLs, password files, etc.)
- be made aware of reported security-relevent events
- be able to access a security audit trail.

Setting of security-management parameters and maintenance of system security information are similar operations to those of configuration management, except that a higher degree of security is generally required for operations such as changing user passwords than is required for operations such as setting default packet sizes.

Receiving security-relevent events and accessing a security audit trail are similar operations to those of performance monitoring except that, again, a higher level of security is generally required.

The X/Open interworking specifications contain no provisions that define security-management facilities.

2.6 Accounting Management

Accounting management is concerned with recording and reporting resource utilization so that costs can be apportioned to users.

The computing resources (CPU time, memory, etc.) used by interworking interfaces on behalf of users are typically recorded and reported by the operating system platform.

Interworking interfaces provide access to networking resources. These are often expensive resources, and accounting management of them may be required. X/Open interworking specifications generally contain no provisions that define accounting management facilities.

Chapter 3

Resources

3.1 Introduction

The underlying resources to which the X/Open interworking interfaces provide access are:

- communications protocol drivers
- hardware device drivers
- network services
- in the cases of XDS, BSFT and XFTAM, computing resources in remote systems.

All of these resources require to be managed. How far they can be managed through the interworking interfaces specified by X/Open is discussed in the following subsections.

3.2 Communications Protocol Drivers

Each of the X/Open interworking specifications except for the **XOM** X/Open CAE specification and the **SMB** X/Open CAE specification defines an interface that provides access to one or more communications protocols, as shown in Table 3-1. (The **XOM** X/Open CAE specification defines a data manipulation API for use in conjunction with other X/Open interworking APIs. The **SMB** X/Open CAE specification defines a communications protocol, an interface to which is defined in the **IPC SMB** X/Open developers' specification.)

Specification	Protocol
XTI	OSI Transport Protocols TCP, UDP and IP RFC 1006 mOSI X.25 NetBIOS
MPTN	TCP/IP and UDP/IP SNA, NetBEUI and NetBIOS
XAP	OSI ACSE, Presentation and Session protocols
XAP-TP	OSI TP
XAP-ROSE	OSI ROSE
XFTAM	FTAM
BSFT	FTAM
X.400 API	X.400 P1, P2 and P3
XMS	X.400 P7
XDS	X.500 DAP
XNFS	ONC RPC NFS
PCNFS	ONC RPC NFS
IPC Mechanisms for SMB	SMB

Table 3-1 Specifications and Protocols

In many cases, these protocols operate on top of other protocols. For example, the X.400 P7 protocol operates on top of the OSI ROSE, ACSE, Presentation, Session and Transport protocols, which in turn operate over lower layer protocols such as X.25 [including packet layer, link layer (HDLC) and physical layer (eg. X.21)]. Each X/Open interworking specification only defines access to the protocols shown opposite it in Table 3-1. It does not give the application the ability to affect the operation of the supporting protocols in any way. For example, the **XMS** X/Open CAE specification does not provide the ability to access the parameters of the OSI ROSE, ACSE Presentation, Session and Transport protocols, or of the X.25 protocol.

Moreover, where a specification defines access to protocols that support a protocol shown opposite another specification, an application can not generally use the two interfaces together. For example, an application using XDS could not use XAP-ROSE, XAP or XTI to set the parameters of the protocols supporting the X.500 DAP.

3.3 Hardware Device Drivers

As with supporting protocols, each of the X/Open interworking specifications listed in Table 3-1 on page 16 provides access to hardware device drivers, but provides no means of enabling applications to read or set their parameters.

3.4 Network Services

Network services are typically provided by some or all of:

- the user enterprise
- other enterprises with which the user enterprise corresponds
- communications service providers.

They can use most kinds of networking technology.

While interworking interfaces can give access to network services provided by any of the above, they are likely to contribute to the management only of services provided by the user enterprise.

X/Open interworking specifications provide no explicit support for managing the network services to which they provide access.

3.5 Computing Resources in Remote Systems

The **XDS** X/Open CAE specification defines an interface to directory services provided by remote computer systems. It provides the ability to add and modify entries, but does not provide management facilities for the directory.

The **BSFT** X/Open CAE specification and the **XFTAM** X/Open CAE specification provide file transfer and management services that enable users and applications to access filestores on remote systems. The file management services are concerned with normal user operations on files rather than with the management activities that are the subject of this technical study.

Chapter 4

Services

4.1 Introduction

The management services that are identified in the **Manageability Guidelines** X/Open snapshot and that might be provided by interworking interfaces specified by X/Open are discussed in the following subsections.

4.2 Installation Services

These are services, possibly based on the **POSIX 1387.2** draft IEEE standard, that support installation of applications. The question of software installation is discussed in Section 2.2 on page 8. For applications to be installable in a standard way, the interface specifications should define how applications that use the interfaces are built. At present, some X/Open interworking specifications do not do this, and those specifications that do it do not do it in a uniform way.

4.3 Licensing Services

These are services that support a software licensing mechanism for applications. No X/Open interworking specifications currently provide such a service, and there is no requirement for them to do so in the future.

4.4 Backup-Restore Services

An application that is collecting or generating critical data might want to back up the data for safety.

Applications that interface to communications services are generally aware that these services can be unreliable, and make separate provision where necessary for backing up data. If this point of view is maintained, there is in general no requirement for interworking interfaces to provide backup services.

Possible exceptions to this are the **XMHS** X/Open CAE specification and the **XMS** X/Open CAE specification. These specifications explicitly provide for the implementation to take over responsibility for messages from the application at certain points. A feature could be added to these specifications which, if selected, would ensure that a backup copy of each message is made before the implementation takes responsibility for it. This feature might be selected by the application or by the system manager.

4.5 Logging Services

A logging service might usefully be provided by interworking interfaces. It would record events such as incoming and outgoing connection establishment and termination. No such service is currently defined by X/Open interworking specifications.

The possible requirement for a security audit trail, which would perform a somewhat similar function, although for a different purpose, is discussed in Section 2.5 on page 12.

4.6 Performance Services

These are services that provide collection and recording of performance-related data. For interworking interfaces, they could make a useful contribution to performance management (see Section 2.3 on page 10).

4.7 Configuration Services

These are services that support configuration of applications. There is no requirement for interworking interfaces to provide such services (although there may be requirements for configuration management services to support configuration of the interworking interfaces, see Section 2.2 on page 8).

4.8 Event Services

An event service might usefully be provided by interworking interfaces. It would bring exception conditions in the interworking interfaces to the attention of someone who could deal with them. Such conditions might include connection aborts, for example. No such service is currently defined by X/Open interworking specifications.

The possible requirement for security event reporting, which would perform a somewhat similar function, although for a different purpose, is discussed in Section 2.5 on page 12.

4.9 Accounting Services

The possible requirement for interworking interfaces to provide accounting services is discussed in Section 2.6 on page 13.

Chapter 5

Relationship to Other Specifications

The only explicit management dependency between X/Open interworking specifications and other specifications is that applications that use the interface defined in the **XMP** X/Open CAE specification must also use the data manipulation interface defined in the **XOM** X/Open CAE specification.

A potential implicit dependency is that implementations of X/Open interworking specifications could use the interfaces defined in management standards to provide management services, as discussed in Section 1.4 on page 6.

Perhaps the most important relationship is to standards defining Management Information Bases (MIBs) relevant to the management of communications components. The following Internet RFCs define MIBs that are potentially relevant: 1213, 1238, 1381, 1382, 1461, 1565, 1566 and 1565 (see the list of Referenced Documents).

Chapter 6

Conclusions and Recommendations

6.1 Conclusions

The following manageability requirements have been identified as goals (in Section 1.2 on page 2) or for useful services (see Chapter 4 on page 19), and are not currently covered by the X/Open interworking specifications:

1. Where security countermeasures are provided by an interworking interface implementation, it should be possible to manage those countermeasures effectively (see Section 1.2.1 on page 2).

   The **Security in Interworking Specifications**, X/Open technical study makes recommendations regarding security aspects of X/Open interworking specifications. The requirement for manageability should apply to any enhancements (such as security event recording or audit trail) that are made as a result of those recommendations.

2. Where configuration information can not be supplied through the interface specified by X/Open, or where system defaults can be used, there should be effective provision for values to be supplied through configuration management (see Section 1.2.2 on page 3). The principal classes of configuration information concerned are:

   — default parameters of the highest level protocols

   — parameters of supporting protocols

   — hardware interface parameters.

   (See Section 2.2.4 on page 9).

3. Performance management facilities associated with an interface should enable the throughput and transit delay of data across the interface and over the network to be measured and optimised (see Section 1.2.3 on page 3).

4. Interworking interfaces should detect and report faults, and should re-route traffic to avoid them, where possible (see Section 1.2.4 on page 3).

5. Interworking interfaces should be able to provide accounting information about use of network resources (see Section 1.2.5 on page 4).

6. For applications to be installable in a standard way, the interface specifications should define how applications that use the interfaces are built. (At present, some X/Open interworking specifications do not do this, and those specifications that do it do not do it in a uniform way, see Section 4.2 on page 19).

7. A feature could be added to the **XMHS** X/Open CAE specification and the **XMS** X/Open CAE specification which, if selected, would ensure that a backup copy of each message is made before the implementation takes responsibility for it (see Section 4.4 on page 19).

8. A logging service might usefully be provided by interworking interfaces (see Section 4.5 on page 20).

9. An event service might usefully be provided by interworking interfaces (see Section 4.8 on page 20).

6.2 Recommendations

The following recommendations are made as to how X/Open should address the requirements identified in Section 6.1. They result from discussion of the conclusions by the XNET group of X/Open.

[1] The appropriate way to achieve manageability of interworking components is by the definition of MIBs so that these components can be managed using standard systems management APIs and protocols, and not by extending existing interworking APIs to incorporate management facilities.

In this context, MIBs include those defined for Internet and OSI protocols, and could also include further MIBs defined specifically for X/Open interworking components by, for example, X/Open.

[2] X/Open should consider each of the requirements identified in Section 6.1 on page 231 as a desirable requirement for manageability of interworking interfaces, and should decide whether to take action to satisfy it, having regard to the needs of users and to the available resources of implementors.

[3] For each requirement that X/Open decides should be satisfied, X/Open should consider which of the interworking specifications it should apply to, having regard to the fact that it may not be appropriate to define enhancements to specifications whose main purpose is to promote interworking with legacy systems.

[4] For each requirement that X/Open decides should be satisfied, and for each interworking specification that it should apply to, X/Open should promote the definitions of MIBs that enable that requirement to be satisfied for those specifications, where such MIBs do not already exist, except as noted in recommendation [5] below.

[5] The requirements relating to installation of applications (see Conclusion 6) and backup of messages (see Conclusion 7) are for further study.

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