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Information processing systems — Open Systems Interconnection — Basic Reference Model —

Part 4 :
Management framework

Systèmes de traitement de l'information — Interconnexion de systèmes ouverts — Modèle de référence de base —

Partie 4 : Cadre général de gestion

Reference number
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Foreword

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

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for approval before their acceptance as International Standards. They are approved in accordance with procedures requiring at least 75 % approval by the national bodies voting.

International Standard ISO/IEC 7498-4 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology.*

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Introduction

The Basic Reference Model of Open Systems Interconnection (OSI), ISO/IEC 7498, provides a description of the activities necessary for systems to interwork using communication media. This part of ISO/IEC 7498 forms Part 4 of ISO/IEC 7498 and provides a description of the framework and structure of OSI Management in a way that supplements and clarifies the description of management contained in ISO/IEC 7498.

The purpose of this part of ISO/IEC 7498 is to provide a common basis for the coordinated development of management standards.

It is also the purpose of this part of ISO/IEC 7498 to identify areas for developing or improving standards, and to provide a common reference for maintaining consistency of all related standards. It is not the intent of this part of ISO/IEC 7498 either to serve as an implementation specification, or to be a basis for appraising the conformance of actual implementations, or to provide a sufficient level of detail to define precisely the services and protocols of the management architecture. Rather, this part of ISO/IEC 7498 provides a conceptual and functional framework which allows independent teams of experts to work productively on the development of management standards.

This part of ISO/IEC 7498 provides an extension to ISO/IEC 7498 and therefore assumes as a basis the concepts and terminology included therein. The objective of this document is to describe a framework for those management activities pertinent to OSI, and to identify the management services which are supported by OSI Management protocols.

The description of the Management Framework given in this part of ISO/IEC 7498 is developed in stages:

Clause 1 defines the scope of this part of ISO/IEC 7498.

Clause 2 lists related OSI Standards.

Clause 3 defines terms and abbreviations used in this part of ISO/IEC 7498

Clause 4 provides the description of general concepts relating to management.

Clause 5 defines a model for OSI Management.

Clause 6 introduces the areas of OSI Management standardization, specifies how each of the component parts of OSI Management operate and defines the form of management information exchanges.

Management is manifest in a number of ways. Management is related to activities which control or monitor the use of resources. Within *Open Systems* the resources can be those which provide data storage or processing capabilities, or they can be those which provide interconnection capabilities. It is only the latter and the communications concerning their management which fall within the scope of OSI Management standardization.

Human beings are ultimately responsible for managing the OSI Environment, although responsibilities may be delegated to automated processes.

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Information processing systems — Open Systems Interconnection — Basic Reference Model —

Part 4 : Management framework

1 Scope

This part of ISO/IEC 7498 establishes a framework for coordinating the development of existing and future standards for OSI Management, and is provided for reference by those standards.

It

a) defines terminology of and describes concepts for OSI Management;

b) provides a structure for OSI Management together with an overview of the objectives of and facilities provided by OSI Management; and

c) describes OSI Management activities.

This part of ISO/IEC 7498 does not specify services or protocols for OSI Management. It is neither an implementation specification for systems, nor a basis for appraising the conformance of implementations.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 7498. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 7498 are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO/IEC 7498:1984, *Information processing systems - Open Systems Interconnection - Basic Reference Model.*

ISO/IEC 7498-2:1988, *Information processing systems - Open Systems Interconnection - Basic Reference Model - Part 2: Security Architecture.*

3 Definitions and abbreviations

3.1 This part of ISO/IEC 7498 makes use of the OSI terminology defined in ISO/IEC 7498, specifically:

a) (N)-entity

b) (N)-layer

c) (N)-protocol

d) (N)-protocol-data-unit

e) open system

f) systems management

3.2 Terms defined in ISO/IEC 7498 which are redefined for the purposes of this part of ISO/IEC 7498:

3.2.1 Systems management application-entity: An application-entity for the purpose of systems management communication.

3.3 For the purpose of this part of ISO/IEC 7498, the following definitions apply:

3.3.1 OSI Management: The facilities to control, coordinate and monitor the resources which allow communications to take place in the OSI Environment.

3.3.2 (N)-layer operation: The monitoring and control of a single instance of communication.

3.3.3 Managed object: The OSI Management view of a resource within the OSI Environment that may be managed through the use of OSI Management protocol(s).

3.3.4 Management Information Base: The conceptual repository of management information within an open system.

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3.4 Abbreviations

MIB Management Information Base

OSI open systems interconnection

OSIE OSI environment

PDU protocol-data-unit

SMAE systems management application-entity

4 Concepts in OSI Management

4.1 Users' requirements of OSI Management

Recognising the need for interconnection services which will carry information in a reliable and economic manner, OSI Management supports the users' needs for

a) activities which enable managers to plan, organise, supervise, control and account for the use of interconnection services;

b) the ability to respond to changing requirements;

c) facilities to ensure predictable communications behaviour; and

d) facilities which provide for information protection and for the authentication of sources of and destinations for transmitted data.

The management tools which provide this support may vary in complexity depending upon the users' requirements. Such tools may operate locally or co-operate across a number of open systems. OSI Management does not constrain the user interface.

4.2 The OSI Management environment

The OSI Management environment is that subset of the total OSI environment (OSIE) which is concerned with the tools and services needed to monitor, control and coordinate interconnection activities. The OSI Management environment includes both the capability for managers to gather information and to exercise control, and the capability to maintain an awareness of and report on the status of resources in the OSIE.

The individual open systems within the OSIE may have aspects of management responsibility delegated to them. The responsibility may be manifest in terms of

a) autonomous management of the open system; and

b) co-operation with other open systems, through the exchange of information, to perform coordinated management activities.

This management responsibility is directed at individual resources, each of which may operate with a degree of independence from other resources. This management responsibility may be further extended to co-ordinate and control sets of resources to increase functionality and performance.

4.3 Managed objects, their attributes and operations

A managed object is the OSI Management view of a resource within the OSIE that is subject to management, such as a layer entity, a connection or an item of physical communications equipment. Thus a managed object is the abstracted view of such a resource that represents its properties as seen by (and for the purposes of) management.

A managed object is defined in terms of attributes it possesses, operations that may be performed upon it, notifications that it may issue and its relationships with other managed objects. This is distinct from, but related to, any definition or specification of the resource represented by the managed object as an element of the OSIE.

The set of managed objects within a system, together with their attributes, constitutes that system's Management Information Base (MIB).

4.4 Management relationships between open systems

The users' requirements for OSI Management may be met either by local operations or by the communication of information between open systems, or by both. OSI Management is achieved between open systems through co-operation between one or more components of the management activity taking a managing role and others taking a managed role. The role played by a particular system may be static or may change over time, and may depend upon the particular management communication.

OSI Management information flow between open systems is defined in terms of operations and notifications.

4.5 OSI Management functional areas

4.5.1 Introduction

OSI Management is required for a number of purposes. These requirements are categorized into a number of functional areas

a) fault management (see 4.5.2);

b) accounting management (see 4.5.3);

c) configuration management (see 4.5.4);

d) performance management (see 4.5.5); and

e) security management (see 4.5.6).

Specific management functions, within these functional areas, are provided by OSI Management mechanisms. Many of the mechanisms are general in the sense that they are used to fulfil requirements in more than one functional area. Similarly, managed objects are general in the sense that they may be common to more than one functional area.

Each of these functional areas is described briefly below. The lists of functions are not necessarily exhaustive.

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4.5.2 Fault management

Fault management encompasses fault detection, isolation and the correction of abnormal operation of the OSI Environment. Faults cause open systems to fail to meet their operational objectives and they may be persistent or transient. Faults manifest themselves as particular events (e.g. errors) in the operation of an open system. Error detection provides a capability to recognise faults. Fault management includes functions to

a) maintain and examine error logs;

b) accept and act upon error detection notifications;

c) trace and identify faults;

d) carry out sequences of diagnostic tests; and

e) correct faults.

4.5.3 Accounting management

Accounting management enables charges to be established for the use of resources in the OSIE, and for costs to be identified for the use of those resources. Accounting management includes functions to

a) inform users of costs incurred or resources consumed;

b) enable accounting limits to be set and tariff schedules to be associated with the use of resources; and

c) enable costs to be combined where multiple resources are invoked to achieve a given communication objective.

4.5.4 Configuration management

Configuration management identifies, exercises control over, collects data from and provides data to open systems for the purpose of preparing for, initialising, starting, providing for the continuous operation of, and terminating interconnection services. Configuration management includes functions to

a) set the parameters that control the routine operation of the open system;

b) associate names with managed objects and sets of managed objects;

c) initialize and close down managed objects;

d) collect information on demand about the current condition of the open system;

e) obtain announcements of significant changes in the condition of the open system; and

f) change the configuration of the open system.

4.5.5 Performance management

Performance management enables the behaviour of resources in the OSIE and the effectiveness of communication activities to be evaluated. Performance management includes functions to

a) gather statistical information;

b) maintain and examine logs of system state histories;

c) determine system performance under natural and artificial conditions; and

d) alter system modes of operation for the purpose of conducting performance management activities.

4.5.6 Security management

The purpose of security management is to support the application of security policies by means of functions which include

a) the creation, deletion and control of security services and mechanisms;

b) the distribution of security-relevant information; and

c) the reporting of security-relevant events.

NOTE - ISO/IEC 7498-2 provides further information on the placement of OSI Management functions within the overall Security Architecture.

5 Model for OSI Management

5.1 Overview

OSI Management encompasses those activities needed to control, coordinate and monitor the resources which allow communications to take place in the OSI Environment. Activities relate to the means by which

a) a real open system obtains information to enable the supervision and control of its communications resources; and

b) real open systems cooperate to supervise and control the OSI Environment.

The model of OSI Management is defined in terms of

c) the OSI Management structure (see 5.2);

d) the supporting functionality required by OSI Management (see 5.3);

e) the Management Information Base (see 5.4);

f) the flow of control amongst processes (see 5.5); and

g) the flow of information between entities (see 5.6).

5.2 OSI Management structure

Management is effected through a set of management processes. These processes are not necessarily located at one local system but may be distributed in many ways over a number of systems. Where management processes which are not co-resident need to communicate with one another

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in the OSI Environment, they communicate using OSI Management protocols. OSI Management is accomplished through

a) systems management;

b) (N)-layer management; and

c) (N)-layer operation.

Systems management provides mechanisms for the monitoring, control and coordination of managed objects through the use of application-layer systems management protocols. OSI communications concerning systems management functions are realized through a systems management application-entity (SMAE). Systems management may be used to manage any objects within or associated with an open system.

(N)-layer management provides mechanisms for the monitoring, control and coordination of managed objects which relate to communications activities within the (N)-layer, through the use of special-purpose management protocols within the (N)-layer. (N)-layer management can affect multiple instances of communication. The (N)-layer may therefore be managed through the use of systems management protocols or through the use of (N)-layer management protocols.

(N)-layer operation provides mechanisms for the monitoring and control of a single instance of communication.

This part of ISO/IEC 7498 does not imply any particular relationships among management mechanisms.

5.3 Supporting functionality required by OSI Management

An open system must have sufficient functionality at all seven layers to support an SMAE before the systems management functionality provided by that SMAE can be accessed by another open system.

When the functionality to support any SMAEs does not exist, the greatest OSI Management functionality that can be available on such an open system is the set of separate, individual functionalities provided by the layer managements of the (N)-layers within that open system. In order to support (N)-layer management, sufficient communication functionality must exist at layers 1 to (N-1).

When neither systems management nor (N)-layer management can be provided, then the greatest OSI Management functionality that can be available is the set of separate, individual management functionalities provided by (N)-layer operation.

An SMAE can exist on an open system independently of the existence of (N)-layer management entities at any of the layers.

5.4 Management Information Base

A Management Information Base (MIB) is that information within an open system which may be transferred or affected through the use of OSI Management protocols. The MIB is the set of managed objects within an open system, however only the managed objects relating to the OSI Environment are subject to standardization. In addition, the logical structure of management information is standardized. This does not imply any form of physical or logical storage for the information and its implementation is a matter of local concern and outside the scope of OSI standards.

Management information may be shared between management processes and structured according to the requirements of those processes. The MIB neither restricts the interpretation of management data to a pre-defined set, nor to whether the data is stored in a processed or unprocessed form. However both the abstract syntax and the semantics of information which is part of the MIB are defined so that they can be represented in OSI protocol exchanges.

5.5 Flow of management control

Management processes, which support OSI Management, receive control information

a) from people and/or software acting as administrative agents local to a management process; and

b) from remote systems through their:

1) SMAEs
2) (N)-layer management entities
3) (N)-entities

The management processes exert control

c) directly upon managed objects in the same open system; and

d) upon managed objects in other open systems by protocol exchanges through their:

1) SMAEs
2) (N)-layer management entities
3) (N)-entities

The flow of control from administrative agents to local management processes occurs entirely within the Local System Environment, and as such is outside the scope of OSI Management standardization. Such local control may result in OSI Management communications. The abstract syntax and semantics of control flow within the OSI Environment are defined so that they can be represented in OSI protocol exchanges.

5.6 Flow of management information

The OSI Management information within a Management Information Base may be provided by, and made available to

a) local administrative agents; and

b) remote open systems, through:

1) systems management protocols
2) (N)-layer management protocols
3) (N)-protocols

Information exchanges may provide monitoring information or may result in the exercise of control. Information exchanges between administrative agents and the MIB occur entirely within the local system and are outside the scope of OSI Management standardization.

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6 OSI Management specifics

6.1 OSI Management standardization

Areas of OSI Management standardization include

a) the services and protocols used to transfer management information between open systems; and

b) the abstract syntax and semantics of the information transferred in management protocols.

These areas of standardization apply to systems management, (N)-layer management and normal (N)-layer operation.

The actual specification of the syntax, semantics, services and protocols, and the concepts applicable to managed objects are provided in specific OSI standards. The physical representation of managed objects and their physical storage are local matters and are not subject to standardization.

Systems management standards specify the systems management services and protocols, plus the abstract syntax and semantics of the information transferred in such protocols.

The (N)-layer management protocols and the management aspects of (N)-protocols are defined by International Standards specifying those protocols in order to cover layer related aspects of the above management facilities. (N)-layer standards may specify (N)-layer management protocols and their use.

This standard does not imply that any systems management protocols or layer management protocols are mandatory, neither does it constrain the use of management information in any (N)-protocol exchanges.

6.2 OSI Management operation

6.2.1 Systems management

Systems management communications provide the normal method for exchanging OSI management information. These communications take place between Systems Management applications-entities. Systems Management protocols are application layer protocols. Any application-process which communicates according to Systems Management protocol standards does so through an SMAE. The service elements used to support Systems Management are Application Service Elements.

Not all open systems provide the full functionality of the seven layers specified in ISO/IEC 7498. Where such open systems are not the initial source of, nor the ultimate destination for the transfer of data, they act for such instances of communication as relay open systems. Where such systems are required to act as sources of system management information or are subject to systems management control, information is communicated using systems management protocols.

6.2.2 (N)-layer management

(N)-layer management supports the monitoring, control and coordination of (N)-layer managed objects. (N)-layer management protocols are supported by protocols of the layers (N-1) and below. They do not provide communication capability offered by the (N+1) and higher layers. (N)-layer management protocols can only convey management information between peer (N)-layer management entities pertinent to the (N)-subsystems in which these entities reside.

(N)-layer management protocols should only be used where special requirements dictate that systems management protocols are inappropriate or when systems management protocols are not available.

(N)-layer management protocols provide such functions as

a) communicating parameter values associated with managed objects which relate to the operation of the (N)-layer;

b) testing the functionality provided by the (N-1)-layer;and

c) conveying error information describing faults or diagnostic information related to the operation of the (N)-layer.

Each (N)-layer management protocol is independent of other layer management protocols. This part of ISO/IEC 7498 does not require the development of (N)-layer management protocols for each of the seven layers.

6.2.3 (N)-layer operation

Management functions may exist within the (N)-protocols in all seven layers of OSI. The management information that is carried within an (N)-protocol must be distinguishable from information which the protocol carries for other purposes. It is the responsibility of the (N)-protocol to provide this distinction.

Management information carried by (N)-protocol exists for the purpose of controlling and monitoring a single instance of communication. Examples of management information carried within an (N)-protocol are

a) parameters carried in connection establishment PDUs that apply to the specific instance of communication which is being established;

b) parameters carried in particular PDUs which can modify the environment in which this instance of communication operates;

c) error information describing faults encountered during the operation of that specific instance of communication; and

d) parameters carried in connection release PDUs which report information pertaining to that specific instance of communication which is being released.

6.2.4 Relationships between systems management, (N)-layer management and (N)-layer operation

Whereas the specification of (N)-layer management and (N)-layer operation standards is not the concern of systems management, the semantics of (N)-layer management information and the operations permitted thereon must be consistent with such information and operations defined by systems management.

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(N)-layer management entities are of different types from those (N)-entities which operate (N)-protocols as defined in ISO/IEC 7498. (N)-layer management protocols are distinguished from normal (N)-protocols by the use of (N-1)-layer addressing mechanisms or by discrimination mechanisms within the (N)-layer.

(N)-layer management entities and (N)-entities operate, independently of each other, upon managed objects which relate to the operation of the (N)-layer.

6.3 The form of management information exchanges

Management information exchanges are effected by the use of Application Layer or (N)-layer services; these may be normal (N)-services, or services provided specifically for management purposes. The information exchanges may be either 2-party or N-party in nature, depending upon the requirements of the initiator of the exchange and the nature of the services available to carry out the exchange.

Any party may take the role of initiator in a management exchange; the remaining parties to the exchange take the role of responder. The exchange may be initiated for the purposes of performing management operations or notifications.

6.4 OSI Management conformance

This part of ISO/IEC 7498 does not imply any conformance requirements for systems management, (N)-layer management or (N)-layer operation.

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ANNEX A

(informative)

COMMENTS RELATING TO THE OSI MANAGEMENT FRAMEWORK

A.1 Introduction

The OSI Management Framework provides the concepts and an abstract model of OSI Management for use by those developing OSI Standards.

The purpose of this Annex is to provide additional explanatory material as an aid to understanding the concepts in the body of this part of ISO/IEC 7498 and to explain their application.

A.2 Abbreviations

QoS Quality of Service

A.3 Brief Overview of OSI Management Scope and Concepts

Three forms of management information exchange are defined within the OSI Management architecture for which standards are expected

a) systems management;
b) (N)-layer management; and
c) (N)-layer operation.

Systems management is the preferred form of management information exchange and provides mechanisms for the exchange of information relating to the monitoring, control and coordination of communications resources of concern to open systems. The Framework uses the term *managed objects* to describe the management view of these resources. Systems management acts upon managed objects in order to manage the resources to which these objects relate. Such managed objects can relate to one or more OSI layers.

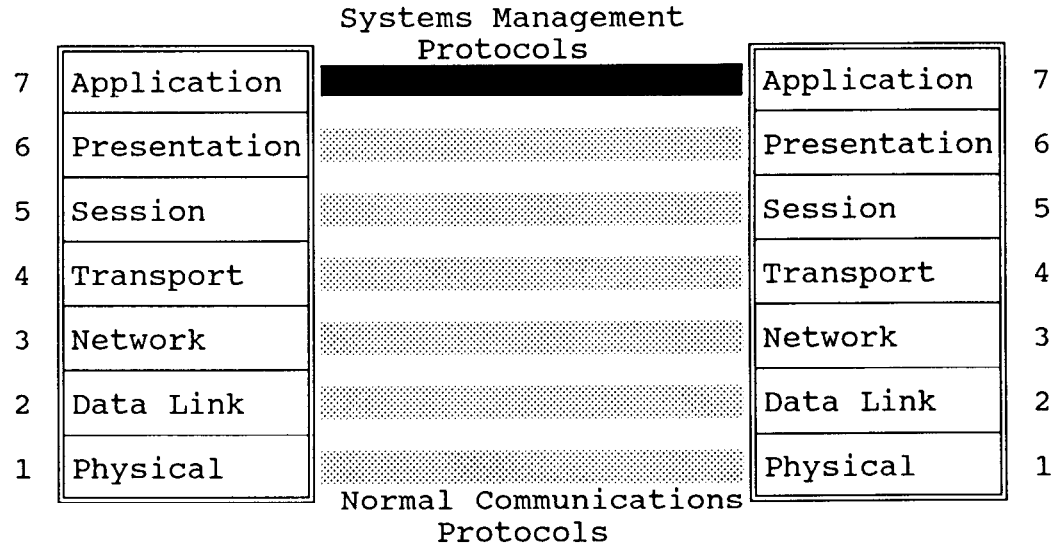


Figure A.1 - Systems Management Information Exchange

It is perceived that the majority of management information exchanges between open systems will require context negotiation, the establishment of a management session, a reliable end-to-end transport service etc., in exactly the same way as other application layer exchanges. Therefore systems management communication is effected through application layer protocols (see figure A.1). Note that the Framework does not exclude the use of connectionless services.

Systems management services and protocols are being developed by the OSI Management Working Group in ISO.

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(N)-layer management is used in special circumstances to carry information relating specifically to the operation of an (N)-layer. An example of layer management is the transport layer **network connection management subprotocol** (NCMS). It is important to note that layer management at one layer should not replicate any of the functionality of the layers above it, as this would be at variance with the Basic Reference Model. Figure A.2 shows an example of such an exchange in the transport layer. (N)-layer management exchanges can occur in any layer, although layers 2, 3 and 4 are those where such standards are most likely to occur.

Layer management standards are the responsibility of the relevant layer standards group, within ISO.

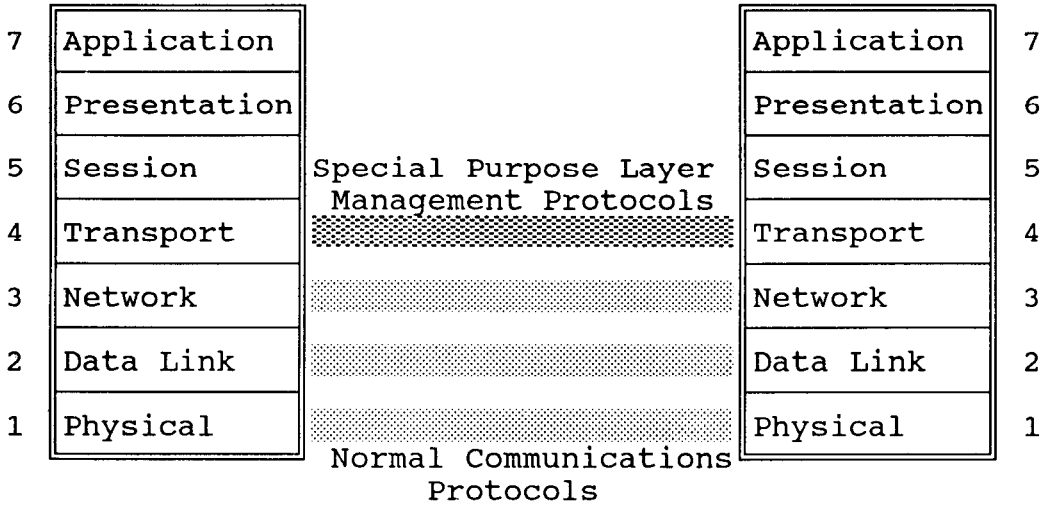


Figure A.2 - (N)-Layer Management Exchange

(N)-layer operation is the set of facilities which control and manage a single instance of communication. These facilities can be embedded within an existing 'normal' (N)-protocol exchange (see figure A.3), for example the passing of charging information in an X.25 Clear packet, or they may be a special element of protocol, such as an X.25 Reset.

Standards for (N)-layer operation are the responsibility of the relevant layer standards group, within ISO.

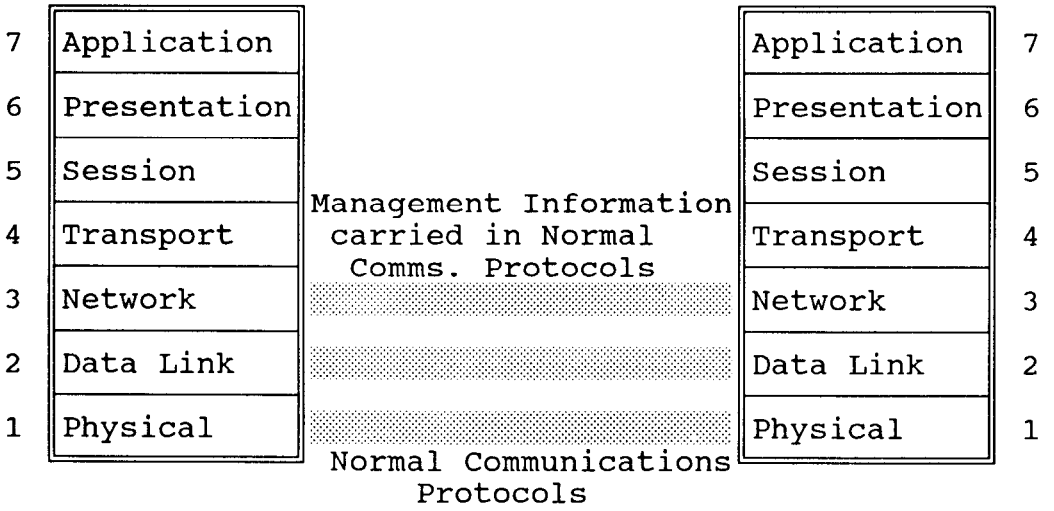


Figure A.3 - (N)-Layer Operation

A.4 Systems Management Standards

There are requirements for standardized application services and protocols for the exchange of management information covering a number of functions. A set of application layer standards for systems management are being developed to give users a 'toolkit' of services and protocols to allow the exchange of management information between open systems.

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A.5 Management Information and the Management Information Base

It is important to recognize that the real information being carried in OSI management protocols is in fact information generated by (and defined by) the individual layer standards. Thus the specification and identification of these 'real' elements of management information needs to be carried out by the layer standards groups, in liaison with the OSI Management working group, as part of their standardization activity.

A common approach is needed across the layers if a consistent definition is to be produced without omissions or duplications. There is also the problem that not all elements are layer-related. Furthermore, the top-level statements of allocation of functions to the set of OSI Management protocols are not complete. This makes it hard for those who have identified particular user needs for management activities (e.g. for access control or QoS) to express them constructively and to direct contributions to the appropriate groups.

Consequently, the MIB can be viewed as that information within an open system which can be transferred or affected by the use of OSI Management protocols.

The MIB can also be visualized as the set of managed objects within an open system, which relate to the OSI Environment. In addition, the logical structure of management information must be standardized, however this does not imply any form of physical or logical storage for the information and its implementation is a matter of local concern and outside the scope of OSI standards.

Management information may be shared between management processes and structured according to the requirements of those processes. The MIB neither restricts the interpretation of management data to a pre-defined set, nor to whether the data is stored as received or processed. However both the abstract syntax and the semantics of information which is part of the MIB are defined so that they can be represented in OSI protocol exchanges.

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Descriptors : data processing, information interchange, network interconnection, open systems interconnection, models, management.

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