
**Information technology — Open Systems
Interconnection — Systems management
overview**

*Technologies de l'information — Interconnexion de systèmes ouverts
(OSI) — Aperçu général de la gestion-système*

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. 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 voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 10040 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 33, *Distributed application services*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.701.

This second edition cancels and replaces the first edition (ISO/IEC 10040:1992), which has been technically revised. It also incorporates Amendment 1:1995, Technical Corrigendum 1:1994 and Technical Corrigendum 2:1996.

Annex A forms an integral part of this International Standard. Annex B is for information only.

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INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION –
SYSTEMS MANAGEMENT OVERVIEW**1 Scope**

This Recommendation | International Standard:

- provides an overview to the family of systems management standards;
- establishes the basis for partitioning the systems management standards into separate groups, specifying the scope of each group and identifying the principal components within each group;
- gives guidance on the development of systems management standards and identifies the way they relate to each other;
- defines terms for use by other systems management standards;
- is applicable to the definition of all systems management standards and to all aspects of systems management of whatever scale;
- is applicable to situations in which the responsibility for systems management is centralized and those where it is decentralized;
- establishes a model for systems management, identifies several aspects of systems management (i.e. information, functional, communications, and organizational), and further refines the model to clarify these aspects;
- identifies the principles governing conformance requirements and conformance claims to systems management standards.

There are no conformance requirements on the main body of this Recommendation | International Standard, however it does specify requirements on standards claiming compliance to systems management.

Annex A defines an application context for systems management and specifies the rules for negotiating systems management functional units. There are conformance requirements associated with these rules.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreement based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical ITU-T Recommendations | International Standards

- ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*.
- ITU-T Recommendation X.207 (1993) | ISO/IEC 9545:1994, *Information technology – Open Systems Interconnection – Application layer structure*.
- ITU-T Recommendation X.217 (1995) | ISO/IEC 8649:1996, *Information technology – Open Systems Interconnection – Service definition for the association control service element*.
- ITU-T Recommendation X.227 (1995) | ISO/IEC 8650-1:1996, *Information technology – Open Systems Interconnection – Connection-oriented protocol for the association control service element: Protocol specification*.

- ITU-T Recommendation X.680 (1994) | ISO/IEC 8824-1:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation.*
- ITU-T Recommendation X.681 (1994) | ISO/IEC 8824-2:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification.*
- ITU-T Recommendation X.682 (1994) | ISO/IEC 8824-3:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification.*
- ITU-T Recommendation X.683 (1994) | ISO/IEC 8824-4:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Parameterization of ASN.1 specifications.*
- ITU-T Recommendation X.690 (1994) | ISO/IEC 8825-1:1995, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).*
- ITU-T Recommendation X.691 (1995) | ISO/IEC 8825-2:1995, *Information technology – ASN.1 encoding rules: Specification of Packed Encoding Rules (PER).*
- ITU-T Recommendation X.702 (1995) | ISO/IEC 11587:1996, *Information technology – Open Systems Interconnection – Application context for systems management with transaction processing.*
- CCITT Recommendation X.712 (1992) | ISO/IEC 9596-2:1993, *Information technology – Open Systems Interconnection – Common management information protocol: Protocol Implementation Conformance Statement (PICS) proforma plus Technical Corrigenda 1 and 2 (1996).*
- CCITT Recommendation X.720 (1992) | ISO/IEC 10165-1:1993, *Information technology – Open Systems Interconnection – Structure of management information: Management information model.*
- CCITT Recommendation X.721 (1992) | ISO/IEC 10165-2:1992, *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information.*
- CCITT Recommendation X.722 (1992) | ISO/IEC 10165-4:1992, *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definition of managed objects.*
- ITU-T Recommendation X.723 (1993) | ISO/IEC 10165-5:1994, *Information technology – Open Systems Interconnection – Structure of management information: Generic management information.*
- ITU-T Recommendation X.724 (1993) | ISO/IEC 10165-6:1994, *Information technology – Open Systems Interconnection – Structure of management information: Requirements and guidelines for implementation conformance statement proformas associated with OSI management.*
- ITU-T Recommendation X.725 (1995) | ISO/IEC 10165-7:1996, *Information technology – Open Systems Interconnection – Structure of management information: General relationship model.*
- CCITT Recommendation X.730 (1992) | ISO/IEC 10164-1:1993, *Information technology – Open Systems Interconnection – Systems Management: Object management function.*
- CCITT Recommendation X.731 (1992) | ISO/IEC 10164-2:1992, *Information technology – Open Systems Interconnection – Systems Management: State management function.*
- CCITT Recommendation X.732 (1992) | ISO/IEC 10164-3:1993, *Information technology – Open Systems Interconnection – Systems Management: Attributes for representing relationships.*
- CCITT Recommendation X.733 (1992) | ISO/IEC 10164-4:1992, *Information technology – Open Systems Interconnection – Systems Management: Alarm reporting function.*
- CCITT Recommendation X.734 (1992) | ISO/IEC 10164-5:1993, *Information technology – Open Systems Interconnection – Systems Management: Event report management function.*
- CCITT Recommendation X.735 (1992) | ISO/IEC 10164-6:1993, *Information technology – Open Systems Interconnection – Systems Management: Log control function.*
- CCITT Recommendation X.736 (1992) | ISO/IEC 10164-7:1992, *Information technology – Open Systems Interconnection – Systems Management: Security alarm reporting function.*
- ITU-T Recommendation X.737 (1995) | ISO/IEC 10164-14:1996, *Information technology – Open Systems Interconnection – Systems Management: Confidence and diagnostic test categories.*
- ITU-T Recommendation X.738 (1993) | ISO/IEC 10164-13:1995, *Information technology – Open Systems Interconnection – Systems Management: Summarization function.*
- ITU-T Recommendation X.739 (1993) | ISO/IEC 10164-11:1994, *Information technology – Open Systems Interconnection – Systems Management: Metric objects and attributes.*

- CCITT Recommendation X.740 (1992) | ISO/IEC 10164-8:1993, *Information technology – Open Systems Interconnection – Systems Management: Security audit trail functions.*
- ITU-T Recommendation X.741 (1995) | ISO/IEC 10164-9:1995, *Information technology – Open Systems Interconnection – Systems Management: Objects and attributes for access control.*
- ITU-T Recommendation X.742 (1995) | ISO/IEC 10164-10:1995, *Information technology – Open Systems Interconnection – Systems Management: Usage metering function for accounting purposes.*
- ITU-T Recommendation X.745 (1993) | ISO/IEC 10164-12:1994, *Information technology – Open Systems Interconnection – Systems Management: Test management function.*
- ITU-T Recommendation X.746 (1995) | ISO/IEC 10164-15:1995, *Information technology – Open Systems Interconnection – Systems Management: Scheduling function.*
- ITU-T Recommendation X.751 (1995) | ISO/IEC 10164-17:1996, *Information technology – Open Systems Interconnection – Systems Management: Change over function.*

2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.208 (1988), *Specification of Abstract Syntax Notation 1 (ASN.1).*
ISO/IEC 8824:1990, *Information technology – Open Systems Interconnection – Specification of Abstract Syntax Notation One (ASN.1).*
- CCITT Recommendation X.209 (1988), *Specification of basic encoding rules for Abstract Syntax Notation One (ASN.1).*
ISO/IEC 8825:1990, *Information technology – Open Systems Interconnection – Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1).*
- CCITT Recommendation X.219 (1988), *Remote operations: Model, notation and service definition.*
ISO/IEC 9072-1:1989, *Information processing systems – Text communication – Remote Operations – Part 1: Model, notation and service definition.*
- CCITT Recommendation X.229 (1988), *Remote operations: Protocol specification.*
ISO/IEC 9072-2:1989, *Information processing systems – Text communication – Remote Operations – Part 2: Protocol specification.*
- ITU-T Recommendation X.290 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – General concepts.*
ISO/IEC 9646-1:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 1: General concepts.*
- ITU-T Recommendation X.296 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Implementation conformance statements.*
ISO/IEC 9646-7:1995, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 7: Implementation Conformance Statements.*
- CCITT Recommendation X.700 (1992), *Management framework for Open Systems Interconnection (OSI) for CCITT applications.*
ISO/IEC 7498-4:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 4: Management framework.*
- CCITT Recommendation X.710 (1991), *Common management information service definition for CCITT applications.*
ISO/IEC 9595:1991, *Information technology – Open Systems Interconnection – Common management information service definition.*
- CCTT Recommendation X.711 (1991), *Common management information protocol specification for CCITT applications.*
ISO/IEC 9596-1:1991, *Information technology – Open Systems Interconnection – Common management information protocol – Part 1: Specification.*
- CCITT Recommendation X.860 (1992), *Open Systems Interconnection – Distributed transaction processing – Model.*
ISO/IEC 10026-1:1992, *Information technology – Open Systems Interconnection – Distributed Transaction Processing – Part 1: OSI TP Model.*

- CCITT Recommendation X.861 (1992), *Open Systems Interconnection – Distributed transaction processing: Service definition*.
ISO/IEC 10026-2:1992, *Information technology – Open Systems Interconnection – Distributed Transaction Processing – Part 2: OSI TP Service*.
- CCITT Recommendation X.862 (1993), *Open Systems Interconnection – Distributed transaction processing: Protocol specification*.
ISO/IEC 10026-3:1992, *Information technology – Open Systems Interconnection – Distributed Transaction Processing – Part 3: Protocol specification*.

2.3 Additional references

- ISO 8571:1988, *Information processing systems – Open Systems Interconnection – File Transfer, Access and Management*.
- ISO/IEC 9545:1994, *Information technology – Open Systems Interconnection – Application Layer structure*.

3 Definitions

3.1 Basic reference model definitions

This Recommendation | International Standard is based on the concepts in the Basic Reference Model for Open Systems Interconnection and makes use of the following terms defined in ITU-T Rec. X.200 | ISO/IEC 7498-1:

- a) application service element;
- b) systems management.

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This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.700 | ISO/IEC 7498-4:

- a) managed object;
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- b) management information base;
- c) systems management application entity.

3.3 CMISE definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.710 | ISO/IEC 9595:

- a) attribute (of managed object);
- b) common management information service element;
- c) common management information services.

3.4 Management information model definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.720 | ISO/IEC 10165-1:

- a) attribute type;
- b) naming tree;
- c) managed object boundary.

This Recommendation | International Standard makes use of the following term defined in ITU-T Rec X.725 | ISO/IEC 10165-7:

- d) managed relationship.

3.2 Management framework definitions

4 ITU-T Rec. X.701 (1997 E)

3.5 OSI conformance testing methodology and framework definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.290 | ISO/IEC 9646-1 and ITU-T Rec. X.296 | ISO/IEC 9646-7:

- a) Protocol Implementation Conformance Statement (PICS);
- a) PICS proforma;
- b) system conformance statement;
- c) implementation conformance statement (ICS);
- d) ICS proforma.

3.6 Systems management overview definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.6.1 agent: An MIS-User, which for a particular systems management interaction, has taken an agent role.

3.6.2 agent role: A role taken by an MIS-User in which it is capable of performing management operations on managed objects and of emitting notifications on behalf of managed objects.

3.6.3 generic definitions: Definitions of managed object classes, attribute types, notification types or management operation types, made available for general use.

3.6.4 (management) interaction: A single management operation or a single notification or an identified set of logically related management operations and notifications during which the manager and agent role do not change.

3.6.5 managed object class: A named set of managed objects sharing the same (named) sets of attributes, notifications, management operations (packages), and which share the same conditions for presence of those packages.

NOTE – The following two definitions are aligned with the corresponding definitions in OSI Conformance Testing Methodology and Framework ITU-T Rec. X.290 | ISO/IEC 9646-1 for PICS and PICS proforma.

3.6.6 managed object conformance statement (MOCS): A statement made by a supplier of a managed object implementation, stating the capabilities and options which have been implemented, and any features which have been omitted.

3.6.7 management information conformance statement (MICS): A statement from a supplier about an implementation's manager role capabilities and options relating to management information which have been implemented and any features which have been omitted.

3.6.8 MICS proforma: A document, in the form of a questionnaire, which when completed by the supplier of an implementation having manager role capability becomes a MICS.

3.6.9 MOCS proforma: A document, in the form of a questionnaire, designed by the managed object definer or conformance test suite specifier, which when completed for a managed object implementation becomes the MOCS.

3.6.10 managed (open) system: A real open system containing an MIS-User which can take the agent role.

3.6.11 management domain: A specification of a collection of managed objects of interest.

3.6.12 management information: The information within an open system which may be transferred by OSI management protocols.

3.6.13 management jurisdiction: A representation of the relationship between a management policy and a management domain.

3.6.14 management policy: An identifiable specification that can be evaluated with respect to managed objects.

3.6.15 management policy violation: The condition existing when managed objects fail to comply with the semantics of a policy.

3.6.16 management support object: A systems managed object defined specifically to support a systems management function (e.g. log, discriminator).

3.6.17 manager: An MIS-User, which for a particular systems management interaction, has taken a manager role.

3.6.18 manager role: A role taken by an MIS-User in which it is capable of issuing management operations and of receiving notifications.

3.6.19 managing (open) system: A real open system containing an MIS-User which can take the manager role.

3.6.20 MIS-User: An application making use of systems management services.

3.6.21 notification: Information emitted by a managed object relating to an event that has occurred within the managed object.

3.6.22 notification type: A named data-type defining a specific kind of notification.

3.6.23 (N)-layer managed object: A managed object specific to the (N)-layer.

3.6.24 (N)-layer management protocol: An (N)-layer protocol for the exchange of (N)-layer management information supported solely by protocols of the layers (N-1) and below.

NOTE – This Recommendation | International Standard neither specifies nor requires the use of (N)-layer management protocols. The definition is included here for the sake of completeness.

3.6.25 (systems management) operation: An operation on a managed object to effect systems management.

3.6.26 systems managed object: A managed object relevant to more than one layer, to the system as a whole, or to specific management functions.

3.6.27 systems management application process: An application process participating in systems management.

3.6.28 systems management application service element: An application service element providing systems management services.

3.6.29 systems management function: A part of systems management activities which satisfy a set of logically related user requirements.

3.6.30 systems management functional area: A category of systems management user requirements.

3.6.31 systems management functional unit: A named non-empty set of systems management services defined for the purpose of identifying specific sets of functionality where there is a requirement to establish or negotiate the use of such functionality between end systems or for reference purposes in other standards.

3.6.32 systems management functional unit package: A named non-empty set of systems management functional units, defined for the purposes of negotiation of functional units on an association.

3.6.33 systems management (application) protocol: An application layer protocol supporting systems management services.

3.6.34 systems management service: A named set of service primitives that provide a service for use in systems management.

4 Abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviations apply:

ACSE	Association Control Service Element
ASE	Application Service Element
ASN.1	Abstract Syntax Notation One
B-ISDN	Broadband Integrated Services Digital Network
CMIP	Common Management Information Protocol
CMIPDU	Common Management Information Protocol Data Unit
CMIS	Common Management Information Service
CMISE	Common Management Information Service Element
CSPDN	Circuit Switched Public Data Network
DMI	Definitions of Management Information
FTAM	File Transfer, Access and Management
GDMO	Guidelines for the Definition of Managed Objects
GMI	Generic Management Information
GMOCS	Guidelines for Managed Object Conformance Statements
GRM	General Relationship Model
ICS	Implementation Conformance Statement
Id	Identifier

ISDN	Integrated Services Digital Network
LAN	Local Area Network
MAPDU	Management Application Protocol Data Unit
MCS	Management Conformance Summary
MHS	Message Handling System
MIB	Management Information Base
MICS	Management Information Conformance Statement
MIDS	Management Information Definition Statement
MIS	Management Information Service
MOCS	Managed Object Conformance Statement
MOTIS	Message Oriented Text Interchange System
MRCS	Managed Relationship Conformance Statement
OSI	Open Systems Interconnection
PICS	Protocol Implementation Conformance Statement
PSPDN	Packet Switched Public Data Network
ROSE	Remote Operations Service Element
SACF	Single Association Control Function
SMAE	Systems Management Application Entity
SMAPM	Systems Management Application Protocol Machine
SMASE	Systems Management Application Service Element
SMF	Systems Management Function
SMFA	Systems Management Functional Area
SMFU	Systems Management Functional Unit
SMI	Structure of Management Information
TMN	Telecommunications Management Network
TP	Transaction Processing
VT	Virtual Terminal
WAN	Wide Area Network

5 Systems management

Systems management provides mechanisms for the monitoring, control and coordination of resources and OSI protocol standards for communicating information pertinent to those resources. In order to describe management operations on resources, the resources are viewed as managed objects with defined properties. Information required for systems management purposes in any open system may be provided through local input, may result from input from other open systems through systems management (application layer) communication or may be a result of lower layer protocol exchanges.

In particular, systems management applies to but is not limited to (e.g. use of ITU-T M.3000-Series, TMN, is also considered a valid application of systems management):

- OSI Layer 1 (Dedicated lines/leased lines, satellite connections);
- OSI Layer 2 (LAN, WAN, etc.);
- OSI Layer 3 (CSPDN, PSPDN, ISDN, B-ISDN, ITU-T Rec. X.300 subnetwork, etc.);
- OSI Layer 4 (Transport Layer Entities);
- OSI Layer 5 (Session Layer Entities);
- OSI Layer 6 (Presentation Layer Entities);
- OSI Layer 7 (MHS | MOTIS, FTAM, VT, TP, Directory).

NOTE – While the principal impetus for the development of these standards has been the need to manage OSI resources, they also have broader applicability. Furthermore, it is possible that in the future, standards development may be undertaken to specifically address additional areas.

Systems management is applicable to a wide range of distributed processing and communications environments. These environments range from local area networks interconnecting small systems, to interconnected corporate and national networks on a global scale. Small scale environments may be managed by appropriate small scale management systems, consisting of a single manager capable of controlling and coordinating the open communication environment through a number of agents. The standards and concepts are also applicable to large scale environments supporting multiple managers.

There are three main groupings within the set of systems management standards. They are:

- a) a set of standards specifying systems management functions;
- b) a set of standards relating to the specification of managed objects;
- c) a set of application layer service and protocol standards for communicating information relating to management functions.

The requirements to be satisfied by systems management activities can conveniently be grouped into five areas, each of which gives rise to one or more standards covering one or more functions. These areas as defined by the OSI Management Framework (see CCITT Rec. X.700 | ISO/IEC 7498-4) are:

- fault management;
- configuration management;
- accounting management;
- performance management;
- security management.

However, many items of information, their associated management operations and the communication protocols are known to be common to more than one area. And, in performing management activities, sets of management functions may be combined to effect a particular management policy.

For these reasons, systems management standards form a closely interrelated set of standards.

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6 Systems management model

6.1 Introduction

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This clause identifies a number of concepts of systems management and provides a model to clarify these concepts and their relationships.

The following subclauses describe the various aspects of the systems management model:

- information aspects;
- functional aspects;
- OSI communications aspects;
- organizational aspects.

Management of a communications environment is an information processing application. Because the environment being managed is distributed, the individual components of the management activities are themselves distributed. Management applications perform the management activities in a distributed manner, by establishing associations between systems management application entities.

As shown in Figure 1 the interactions which take place between systems management application entities are abstracted in terms of management operations and notifications issued by one entity to the other; these are communicated using systems management services and protocols.