

INTERNATIONAL  
STANDARD

**ISO/IEC**  
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**Information technology — Open Systems  
Interconnection — Structure of  
management information: Management  
Information Model**  
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*Technologies de l'information — Interconnexion de systèmes ouverts —  
Structure des informations de gestion: Modèle d'informations de gestion*  
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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 10165-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in collaboration with CCITT. The identical text is published as CCITT Recommendation X.720.

ISO/IEC 10165 consists of the following parts, under the general title *Information technology – Open Systems Interconnection – Structure of management information*:

- Part 1: *Management information model*
- Part 2: *Definition of management information*
- Part 4: *Guidelines for the definition of managed objects*
- Part 5: *Generic management information*
- Part 6: *Requirements and guidelines for implementation conformance statement proformas associated with management information*

## Introduction

ISO/IEC 10165 is a multipart standard developed according to ISO 7498 and ISO/IEC 7498-4. ISO/IEC 10165 is related to the following International Standards:

- ISO/IEC 9595:1990, *Information technology – Open Systems Interconnection – Common management information service definition*;
- ISO/IEC 9596:1990, *Information technology – Open Systems Interconnection – Common management information protocol*;

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- ISO/IEC 10040:1992, *Information technology – Open Systems Interconnection – Systems management overview*;
- ISO/IEC 10165:1992, *Information technology – Open Systems Interconnection – Structure of management information*.

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## INTERNATIONAL STANDARD

## CCITT RECOMMENDATION

**INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION –  
STRUCTURE OF MANAGEMENT INFORMATION:  
MANAGEMENT INFORMATION MODEL**

**1 Scope**

This Recommendation | International Standard is one of the set of Recommendations | International Standards for the OSI Management Information Service (MIS). It defines the Information Model of managed objects and their attributes that corresponds to the Information aspects of the systems management model introduced in the Systems Management Overview CCITT Rec. X.701 | ISO/IEC 10040, thus providing the modelling concepts necessary for the development of the other systems management Recommendations | International Standards. It also defines the principles of naming managed objects and attributes.

This Recommendation | International Standard defines the logical structure of systems management information. In accordance with CCITT Rec. X.700 | ISO 7498-4 and X.701 | ISO/IEC 10040 management information is structured in terms of **managed objects**, their **attributes**, the **management operations** that can be performed upon them, and the **notifications** that they can emit. The set of managed objects in an open system, together with their attributes, constitutes that open system's **management information base (MIB)**.

This Recommendation | International Standard defines the concepts of managed objects in the Information Model, and prescribes the principles for **naming** the managed objects and their attributes so that they may be identified in and accessed by management protocols. This Recommendation | International Standard also describes the concept of managed object classes and the relationships into which managed objects and managed object classes can enter, including: inheritance, specialization, allomorphy and containment.

This Recommendation | International Standard applies to all definitions of managed objects and their attributes for the purposes of systems management.

NOTE – Although this Recommendation | International Standard applies to systems management, layer management, when defined, can also use this Recommendation | International Standard.

**2 Normative references**

The following CCITT 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 agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent editions of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The CCITT Secretariat maintains a list of currently valid CCITT Recommendations.

**2.1 Identical Recommendations | International Standards**

- CCITT Recommendation X.701 (1992) | ISO/IEC 10040:1992, *Information technology – Open Systems Interconnection – Systems management overview.*
- CCITT Recommendation X.722 (1992) | ISO/IEC 10165-4:1992, *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definition of management objects.*
- CCITT Recommendation X.734 (1992) | ISO/IEC 10164-5:1993, *Information technology – Open Systems Interconnection – Systems Management – Event report management function.*

## 2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.200 (1988), *Reference Model of Open Systems Interconnection for CCITT Applications*.  
ISO 7498:1984, *Information processing systems – Open Systems Interconnection – Basic Reference Model*.
- CCITT Recommendation X.208 (1988), *Specification of Abstract Syntax Notation One (ASN.1)*.  
ISO/IEC 8824:1990, *Information technology – Open Systems Interconnection – Specification of Abstract Syntax Notation One (ASN.1)*.
- CCITT Recommendation X.700 (1992), *Management Framework Definition 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*.
- CCITT 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.800 (1991), *Security Architecture for CCITT Applications*.  
ISO 7498-2:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 2: Security architecture*.
- CCITT Recommendation X.501 (1988), *The Directory – Models*.  
ISO/IEC 9594-2:1990, *Information technology – Open Systems Interconnection – The Directory – Part 2: Models*.
- CCITT Recommendation X.511 (1988), *The Directory – Abstract Service Definition*.  
ISO/IEC 9594-3:1990, *Information technology – Open Systems Interconnection – The Directory – Part 3: Abstract service definition*.

## 2.3 Additional references

- ISO/IEC 7498-3:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 3: Naming and addressing*.

## 3 Definitions

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

### 3.1 Basic reference model definitions

This Recommendation | International Standard makes use of the following terms defined in the OSI Basic Reference Model, CCITT Rec. X.200 | ISO 7498.

- a) open system;
- b) systems management;
- c) (N)-entity;
- d) (N)-layer;
- e) (N)-protocol.



### 3.2 Management framework definitions

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

- a) management information base;
- b) managed object.

### 3.3 Systems management overview definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.701 | ISO/IEC 10040.

- a) agent;
- b) manager;
- c) notification;
- d) managed object class;
- e) (systems management) operation.

### 3.4 Common management information service definitions

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

- a) attribute;
- b) set-valued attribute.

### 3.5 Abstract Syntax Notation One definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.219 | ISO/IEC 8824.

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### 3.6 Guidelines for the definition of managed objects definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.722 | ISO/IEC 10165-4.

template

### 3.7 Security architecture definitions

This Recommendation | International Standard uses the following terms defined in CCITT Rec. X.800 | ISO 7498-2.

- a) access control;
- b) security policy.

### 3.8 Additional definitions

**3.8.1 action:** An operation on a managed object, the semantics of which are defined as part of the managed object class definition.

**3.8.2 actual class:** The managed object class of which a managed object is an instance, as distinct from an allomorphic class of that managed object.

**3.8.3 allomorphic class (of a managed object):** A class, other than the managed object's actual class, which a managed object can be managed as, using allomorphy.

**3.8.4 allomorphy:** The ability of a managed object that is an instance of a given class to be managed as an instance of one or more other managed object classes.

- 3.8.5 attribute group:** A group of attributes which have been assigned a single identifier for ease of access.
- 3.8.6 attribute identifier:** An identifier used to distinguish an attribute of a managed object class from all other attributes.
- 3.8.7 attribute type:** A named definition of a specific kind of attribute, including definitions of its syntax (type) and semantics. An attribute is an instance of an attribute type.
- 3.8.8 attribute value assertion:** A statement, which may be true or false, concerning the value of an attribute.
- 3.8.9 attribute value set:** A set of values, members of which are valid values of an attribute.
- 3.8.10 behaviour:** The way in which managed objects, name bindings, attributes, notifications and actions interact with the actual resources they model and with each other.
- 3.8.11 characteristic:** An element of a managed object class definition; that is an attribute definition, an attribute group definition, a notification definition, a behaviour definition, a parameter definition or a package definition.
- 3.8.12 conditional package:** A package which is present in a given managed object if the condition given in its managed object class definition is satisfied.
- 3.8.13 containment:** A structuring relationship for managed objects in which the existence of a managed object is dependent on the existence of a containing managed object.
- 3.8.14 distinguished name:** The name of an object formed from the sequence of the RDNs of the object and each of its superior objects.
- 3.8.15 encapsulation:** A relation between a managed object and its attributes and behaviour, which represents the property that attributes and behaviour may be observed only through management operations on the managed object or notifications emitted by it.
- 3.8.16 inheritance:** The conceptual mechanism by which attributes, notifications, operations and behaviour are acquired by a subclass from its superclass.
- 3.8.17 inheritance hierarchy:** A hierarchical arrangement of managed object classes where the hierarchy is organized on the basis of the class specialization.
- 3.8.18 initial value managed object:** A managed object that serves as a source for the derivation of initial values of another managed object.
- 3.8.19 instantiation:** The process of creating a managed object according to a managed object class definition.
- 3.8.20 managed object boundary:** The conceptual location where aspects of an underlying resource are made visible to management and which bounds the scope of the managed object's definition.
- 3.8.21 mandatory package:** A package which must be present in all instances of a given managed object class.
- 3.8.22 multiple inheritance:** A conceptual mechanism that allows a subclass to acquire attributes, notifications, operations and behaviour from more than one superclass.
- 3.8.23 name binding:** A relation between object classes which specifies that an object of one identified class may be the superior of an object of another named class. A name binding definition also includes other information about the relation, and may be defined to also apply to subclasses of the superior or the subordinate class or both.
- 3.8.24 naming schema:** A collection of name bindings.
- 3.8.25 naming tree:** A hierarchical arrangement of objects where the hierarchy is organized on the basis of the name binding relationship. An object used to name another managed object is higher in the hierarchy than the named object. The naming object is referred to as the **superior** of the named object, which is referred to as the **subordinate**.
- 3.8.26 package:** A collection of attributes, notifications, operations and/or behaviour which is treated as a single module in the specification of a managed object class. Packages may be specified as being mandatory or conditional when referenced in a managed object class definition.
- 3.8.27 parameter:** A value of a type which has associated semantics and is associated with an object identifier and other information where the value of the type may be carried in protocol.

- 3.8.28 permitted value set:** An attribute value set which includes all of the values which an attribute of a specified attribute type is permitted to take.
- 3.8.29 relative distinguished name:** An attribute value assertion that a particular attribute has a particular value used to identify one object out of all those immediately subordinate to a given object. It serves as a component of a distinguished name of an object.
- 3.8.30 required value set:** An attribute value set which includes all of the values which an attribute of a specified attribute type is required to take.
- 3.8.31 specialization:** The technique of deriving a new managed object class from one or more existing managed object classes by inheritance and by the addition of new characteristics.
- 3.8.32 subclass:** A class derived from another class by specialization.
- 3.8.33 superclass:** A class used in deriving another class by specialization.
- 3.8.34 superior object:** See 3.8.25
- 3.8.35 subordinate object:** See 3.8.25
- 3.8.36 uninstantiable managed object class:** A class that is not intended to be instantiated, either by a systems management operation or by a local operation within the open system.

NOTE – The terms

- attribute;
- attribute value assertion;
- relative distinguished name;
- distinguished name;

are also used in the Directory, CCITT X.500 Series 1 ISO/IEC 9594, and have been deliberately used here in a similar sense in order to reflect similarities between the Directory model and the Management information model. However, the use of these terms in the two models are not identical in their details.

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## 4 Abbreviations

AVA	Attribute value assertion
CMIP	Common management information protocol
CMIS	Common management information service
GDMO	Guidelines for the definition of managed objects
Id	Identifier
IVMO	Initial value managed object
MIB	Management information base
MIS	Management information services
RDN	Relative distinguished name
SMI	Structure of management information

## 5 Information Model

The purpose of the Information Model is to give structure to the management information conveyed externally by systems management protocols and to model management aspects of the related resources (e.g. an X.25 protocol machine). The information model deals with managed objects. Managed objects are abstractions of data processing and data communications resources (e.g. protocol state machines, connections, and modems) for the purposes of management. The resources exist independently of their need to be managed. The relationship that exists between the resource and the managed object as an abstraction of that resource is not modelled in a general way; that is, the precise properties abstracted and the specific effects of management operations on a resource must be specified as part of the managed object class specification.

The distinction between the managed object as **visible to management** and the resource that it represents for management purposes may be described by saying that the attributes, operations and notifications are visible to management at the **managed object boundary**, whereas the internal functioning of the resource that is represented by the managed object is not otherwise visible to management. This concept of a managed object boundary has no implications for implementation, but provides an architectural distinction between the definitions to be developed by managed object class definers (e.g. layer groups), which are at and inside the boundary, and the definitions and Recommendations | International Standards of the remainder of systems management, which are at and outside the boundary.

A managed object class is defined as a collection of *packages*, each of which is defined to be a collection of attributes, operations, notifications and related behaviour. Packages are either mandatory or conditional upon some explicitly stated condition. A managed object is an instance of a managed object class.

In order to document the specification of a managed object class and its associated characteristics, a set of templates is used. The templates used for systems management are specified in CCITT Rec. X.722 | ISO/IEC 10165-4.

The definition of a managed object class, as specified by templates, consists of

- the position of the managed object class in the **inheritance hierarchy**;
- a collection of **mandatory packages** of attributes, operations, notifications and behaviour;
- a collection of **conditional packages** of attributes, operations, notifications and behaviour, together with the condition under which each package will be present;
- within the package structure,
  - the **attributes** visible at the managed object boundary;
  - the **operations** which can be applied to the managed object;
  - the **behaviour** exhibited by the managed object;
  - the **notifications** which can be emitted by the managed object.

Other templates specify the possible superior objects for instances of a given managed object class, together with the attribute used for naming (see clause 6) in these circumstances.

Other aspects of the resources represented by a managed object class are not visible to systems management.

A managed object is instantiated according to a set of rules. These rules specify how the class specification, as defined by means of the template, is to be realized in creating the managed object. The rules are

- a) that a managed object shall support all the attributes, management operations, behaviour and notifications specified in all the mandatory packages and in all the conditional packages whose condition is satisfied;
- b) that a managed object shall support the name binding, as specified by the appropriate template, with which it is instantiated. Instantiation will fail if an unsupported name binding is requested.

Each managed object is an instance of a class that includes all managed objects that share the same definition. A distinguished name is used to name each managed object unambiguously.

A managed object exists, from a management point of view, if it has a distinguished name (as defined in 6.3.2) and supports the operations and notifications defined for its class. Otherwise, it does not exist from a management point of view, even if a physical counterpart exists.

## 5.1 Managed object concepts using object-oriented design

In the formulation of systems management Recommendations | International Standards, new managed object classes and functions will be added as needs are identified. The design of systems management, therefore, requires that an approach be adopted that will allow the Recommendations | International Standards to be standardized in a modular fashion and provide for extensibility of the protocol and procedures. The information model makes use of object-oriented design principles because they provide the above capabilities and provide for reuse of pieces of specification.

In the Information model, object-oriented design is applied to the specification of management information as seen in protocol exchanges by open systems involved in management activities. It need not be applied to system implementation.