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Information technology — Open Systems Interconnection — Structure of management information —

Part 4:

Guidelines for the definition of managed objects

*Technologies de l'information — Interconnexion de systèmes ouverts —
Structures des informations de gestion —*

Partie 4: Principes directeurs pour la définition des objets gérés



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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 10165-4 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, in collaboration with the CCITT. The identical text is published as CCITT Recommendation X.722.

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*

Annex A is for information only.

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*;
- ISO/IEC 10040 : 1992, *Information technology – Open Systems Interconnection – Systems management overview*;
- ISO/IEC 10164 : 1992, *Information technology – Open Systems Interconnection – Systems management*.

OSI management standardization inevitably involves coordinated work by a number of standards bodies. CCITT SGVII and ISO/IEC JTC1 SC21/WG4 are jointly responsible for the development of Recommendations | International Standards that describe the architecture for OSI management, the services, protocols and functions that are used for systems management, and the structure of management information. Other working groups, in CCITT, ISO/IEC JTC1 SC21, ISO/IEC JTC1 SC6 and elsewhere, are responsible for the development of Recommendations | International Standards that describe the management aspects of particular layers of the OSI Basic Reference Model; these may describe (N)-layer management protocols, management aspects of (N)-layer operation, and managed objects that provide a "management view" of aspects of the layer operation and are visible to systems management.

This Recommendation | International Standard provides the developers of managed object class definitions with the information and documentation tools required in order to produce complete managed object class definitions that are compatible with the OSI management standards developed jointly by ISO/IEC and CCITT. A beneficial side effect of the use of these guidelines will be that a common approach will be taken to the documentation of these Recommendations | International Standards, regardless of where the development takes place.

CCITT Rec. X.700 | ISO/IEC 7498-4 and CCITT Rec. X.701 | ISO/IEC 10040 define the architecture for OSI management, and describe the content of and relationships between OSI management standards.

CCITT Rec. X.720 | ISO/IEC 10165-1 describes the model of management information in terms of managed objects.

CCITT Rec. X.721 | ISO/IEC 10165-2 (DMI) defines generic managed object classes and characteristics. Where a suitable definition of management information exists in DMI, it is recommended that this definition be referenced in preference to defining a new information element with the same structure.

CCITT Rec. X.208 | ISO/IEC 8824 defines the notation used to express the abstract syntax of the data elements associated with managed object characteristics that shall be carried in systems management protocol.

INTERNATIONAL STANDARD**CCITT RECOMMENDATION****INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION –
STRUCTURE OF MANAGEMENT INFORMATION :
GUIDELINES FOR THE DEFINITION OF MANAGED OBJECTS****1 Scope**

This Recommendation | International Standard provides developers of Recommendations and International Standards that contain managed object definitions with guidance that will

- a) encourage consistency between managed object definitions;
- b) ensure the development of such definitions in a manner compatible with the OSI management Recommendations and International Standards;
- c) reduce duplication of effort in other working groups by identifying commonly useful documentation layouts, procedures and definitions.

To this end, this Recommendation | International Standard specifies

- a) the relationships between the relevant OSI management Recommendations and International Standards and the definition of managed object classes, and how those Recommendations and International Standards should be used by managed object class definitions;
- b) the appropriate methods to be adopted for the definition of managed object classes and their attributes, notifications, actions and behaviour, including
 - 1) a summary of aspects that shall be addressed in the definition;
 - 2) the notational tools that are recommended to be used in the definition;
 - 3) consistency guidelines that the definition may follow.
- c) the relationship of managed object class definitions to management protocol, and what protocol-related definitions are required;
- d) the recommended documentation structure for managed object class definitions.

This Recommendation | International Standard is applicable to the development of any Recommendation | International Standard which defines

- a) management information which is to be transferred or manipulated by means of OSI management protocol;
- b) the managed objects to which that information relates.

This Recommendation | International Standard does not specify or imply

- a) any constraints on the development of managed object class definitions in terms of their functionality, the Recommendations | International Standards to which they relate, or the uses to which they are put in a particular management environment;
- b) guidelines for the definition of resources; it provides guidelines only for the definition of the managed objects which provide the management view of resources.

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 International 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 edition of the Recommendations and International Standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards. The CCITT Secretariat maintains a list of the currently valid CCITT Recommendations.

2.1 Identical CCITT Recommendations | International Standards

- CCITT Recommendation X.660¹⁾ | ISO/IEC 9834-1²⁾, *Information technology – Open Systems Interconnection – Procedures for the operation of OSI registration authorities – Part 1: General procedures.*
- CCITT Recommendation X.701 (1992) | ISO/IEC 10040 : 1992, *Information technology – Open Systems Interconnection – Systems management overview.*
- CCITT Recommendation X.720 (1992) | ISO/IEC 10165-1 : 1992, *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.732 (1992) | ISO/IEC 10164-3 : 1992, *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.*

2.2 Paired CCITT 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.501 (1989), *The Directory – Models.*

¹⁾ Presently at state of draft Recommendation.

²⁾ To be published.

ISO/IEC 9594-2 : 1990, *Information technology — Open Systems Interconnection — The Directory — Part 2: Models*.

- CCITT Recommendation X.650 (1992), *Naming and Addressing for Open Systems Interconnection (OSI) for CCITT Applications*.

ISO 7498-3 : 1989, *Information processing systems — Open Systems Interconnection — Basic Reference Model — Part 3: Naming and Addressing*.

- CCITT Recommendation X.700¹⁾, *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 : 1990, *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*.

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 CCITT Rec. X.200 | ISO 7498:

- a) (N)-connection;
- b) (N)-entity;
- c) (N)-layer;
- d) (N)-service-access-point;
- e) open system;
- f) systems management.

3.2 Naming and addressing definitions

This Recommendation | International Standard makes use of the following term defined in CCITT Rec. X.650 | ISO 7498-3:

(N)-selector

3.3 Management framework definitions

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

- a) managed object;
- b) (N)-layer operation.

¹⁾ Presently at state of draft Recommendation.

3.4 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) generic definitions;
- c) managed object class;
- d) management information;
- e) manager;
- f) (N)-layer management protocol;
- g) notification;
- h) notification type;
- i) (systems management) operation;
- j) systems management (application) protocol.

3.5 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) action;
- b) actual class;
- c) attribute group;
- d) attribute identifier;
- e) attribute type;
- f) attribute value set;
- g) behaviour;
- h) characteristic;
- i) conditional package;
- j) containment;
- k) inheritance;
- l) inheritance hierarchy;
- m) initial value managed object;
- n) instantiation;
- o) mandatory package;
- p) multiple inheritance;
- q) name binding;
- r) package;
- s) parameter;
- t) permitted value set;
- u) relative distinguished name;
- v) required value set;
- w) specialization;
- x) subclass;
- y) subordinate object;
- z) superclass;
- aa) superior object.

3.6 CMIS definitions

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

- a) attribute;
- b) Common Management Information Services.

3.7 ASN.1 definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.208 | ISO/IEC 8824:

- a) object identifier;
- b) sequence type;
- c) sequence-of type;
- d) set type;
- e) set-of type;
- f) subtype;
- g) type;
- h) type reference name;
- i) value reference name.

3.8 Additional definitions

- 3.8.1 managed object class definition:** A set of attribute, operation, notification and behaviour definitions to which a managed object class name has been allocated, documented by the use of a managed object class template and one or more other templates, of the types defined in this Recommendation | International Standard, which are directly or indirectly referenced by the managed object class template. The definition of a managed object class includes all elements of definition inherited from the superclass(es) of the managed object class and all elements of definition that constitute specialization(s) of the superclass(es).
- 3.8.2 template:** A standard format for the documentation of name bindings, and managed object class definitions and their components, such as packages, parameters, attributes, attribute groups, behaviour definitions, actions or notifications.
- 3.8.3 directory object class:** An object class, as defined in CCITT Rec. X.501 | ISO/IEC 9594-2.

4 Abbreviations

ASN.1	Abstract Syntax Notation One
CMIP	Common Management Information Protocol
CMIS	Common Management Information Services
DMI	Definition of Management Information
IVMO	Initial Value Managed Object
MOCS	Managed Object Conformance Statement
(N)-SAP	(N)-service-access-point
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
SAP	Service Access Point
SDU	Service Data Unit
SMI	Structure of Management Information
RDN	Relative Distinguished Name

5 Conventions

Distinctive typefaces are used throughout this Recommendation | International Standard where the text makes use of ASN.1 notation or the notational tools defined in clause 8.

No externally defined conventions are used in this Recommendation | International Standard.

6 Global issues

6.1 Relationship integrity

When defining managed object classes, it is important to consider situations where there are consistency requirements that will apply to instances of those classes, for example, situations where the behaviour of a managed object is constrained by rules that depend not only upon its own state but also upon the state of other managed objects in the system. Any such constraints must be expressed as behaviour associated with the managed object classes concerned.

A particular case where the definitions associated with the instantiation of a managed object shall explicitly define consistency rules is that of the Delete operation; for this operation, such consistency rules are specified in name binding(s) associated with the managed object class. The effect of a Delete operation shall be defined in such a way that it is clear under what circumstances deletion is permitted, and what the consequences of deletion are. In particular, the name binding shall specify whether deletion of an instance of the class is permitted when contained managed objects still exist, and what rules apply in cases where other (non-containment) relationships exist between the managed object being deleted and other managed objects, such as those that may exist as a consequence of the presence of relationship attributes as defined in CCITT Rec. X.732 | ISO/IEC 10164-3. The consistency rules that are applied for deletion shall be such that the delete operation cannot result in inconsistent relationships. As these consistency rules are specified as part of a name binding, the rules that apply to the deletion of a given managed object are established at the time that the managed object is instantiated.

6.2 Inherited characteristics

The process of inheritance results in the inclusion of all characteristics of the superclass(es) of a managed object class in the managed object class definition. This rule is applied recursively, terminating at the apex of the inheritance hierarchy, known as top. A given managed object class therefore includes all characteristics that are part of the definition of top, plus all characteristics that are added in the process of defining any subclasses of top that form part of the managed object class's inheritance hierarchy.

6.3 Optionality

In general, the provision of options in managed object class definitions is discouraged, on the grounds that interworking becomes more difficult as the number of options increases. As stated in CCITT Rec. X.720 | ISO/IEC 10165-1, the managed object class definition may include conditional packages which are present in an instance of the managed object class if the specified condition applies. It is the intention that the conditions applied to these packages should relate to standardized features of the resource to which the managed object class applies, or to optional management functions supported by the management system.

6.4 Registration

The process of defining managed object classes requires the assignment of globally unique identifiers, known as object identifiers, to various aspects of the managed object class, such as the managed object class name, attribute types, etc. The values of these identifiers are used in management protocols to uniquely identify aspects of managed objects and their associated attributes, operations and notifications. It is therefore a necessary precursor to the development of a managed object class definition that the standards body or organization concerned should identify or establish a suitable registration mechanism that is capable of issuing object identifier values for its use. CCITT Rec. X.208 | ISO/IEC 8824 specifies the structure of the object identifier and the values of the initial arcs; further information on the establishment of registration mechanisms and registration authorities may be found in CCITT Rec. X.660 | ISO/IEC 9834-1.

Once an item of management information has been assigned an object identifier value, it is a requirement that any revision of the definition of that item shall not alter the semantics of the information. In practice, this means that editorial changes to registered management information definitions are permissible, but the definitions shall not be changed in ways that would be visible in protocol.

All object identifier values registered in systems management Recommendations | International Standards are allocated under the arc

{joint-iso-ccitt ms(9)}

The allocation of arcs below **{joint-iso-ccitt ms(9)}** is defined by this Recommendation | International Standard. The arcs below **{joint-iso-ccitt ms(9)}** are allocated on a per-Systems-Management-standard basis, as shown in Table 1.

Table 1 – Allocation of arcs below {joint-iso-ccitt ms(9)}

Arc	Standard
smo(0)	Systems management overview, CCITT Rec. X.701 ISO/IEC 10040
cmip(1)	Common management information protocol, CCITT Rec. X.711 ISO/IEC 9596-1
function(2)	Systems management functions, CCITT Rec. X.7NN ISO/IEC 10164-X, where X is the part number of the standard in the ISO/IEC numbering scheme, and X.7NN is the corresponding CCITT Recommendation number.
smi(3)	Structure of management information, CCITT Rec. X.72N ISO/IEC 10165-X, where X is the part number of the standard in the ISO/IEC numbering scheme, and X.72N is the corresponding CCITT Recommendation number.

The allocation of arcs below this level is defined in 6.4.1 to 6.4.5. Further arcs required by existing or future systems management standards will be allocated, as required, by means of amendments to this Recommendation | International Standard.

NOTE – The scheme for the allocation of object identifier values described in this clause and its sub-clauses applies only to the allocation of object identifier values in the systems management standards developed jointly by ISO/IEC JTC1 SC21/WG4 and CCITT SGVII. It is necessary for other standards bodies or organizations that require to allocate object identifier values in the course of the development of management standards to establish their own allocation schemes under an appropriate registration authority. The structure adopted by the systems management standards activity may serve as a useful example of how a suitable allocation scheme may be established, but the final choice of allocation scheme is the responsibility of the organization concerned. In order to improve human readability of object identifier values, it is recommended that the name and number form for the representation of object identifier values, as defined in CCITT Rec. X.208 | ISO/IEC 8824, be used wherever possible.

6.4.1 Object identifier allocation for systems management overview

NOTE – The systems management overview is responsible for the allocation of these arcs; they are included for information only.

Below {joint-iso-ccitt ms(9) smo(0)}, the following arcs are allocated for the registration of application contexts, abstract syntaxes and ASN.1 module identifiers, as shown in Table 2.

Table 2 – Allocation of arcs below {joint-iso-ccitt ms(9) smo(0)}

Arc	Purpose
applicationContext(0)	Allocation of application context identifiers
negotiationAbstractSyntax(1)	Allocation of version identifiers to the negotiation abstract syntax
asn1Modules(2)	Allocation of ASN.1 module identifiers

Below {joint-iso-ccitt ms(9) smo(0) applicationContext(0)} further arcs are allocated, as specified by CCITT Rec. X.701 | ISO/IEC 10040, for the registration of particular application context identifiers, as shown in Table 3.

Table 3 – Allocation of arcs below {joint-iso-ccitt ms(9) smo(0) applicationContext(0)}

Arc	Purpose
systems-management(2)	Identifier of the Systems management application context

Below {joint-iso-ccitt ms(9) smo(0) negotiationAbstractSyntax(1)} further arcs are allocated, as specified by CCITT Rec. X.701 | ISO/IEC 10040, for the registration of particular versions of the negotiation abstract syntax, as shown in Table 4.

Table 4 – Allocation of arcs below {joint-iso-ccitt ms(9) smo(0) negotiationAbstractSyntax(1)}

Arc	Purpose
version1(1)	Identifies version 1 of the negotiation abstract syntax

Below {joint-iso-ccitt ms(9) smo(0) asn1Modules(2)} further arcs are allocated, as specified by CCITT Rec. X.701 | ISO/IEC 10040, for the registration of particular ASN.1 module identifiers, as shown in Table 5.

Table 5 – Allocation of arcs below {joint-iso-ccitt ms(9) smo(0) asn1Modules(2)}

Arc	Purpose
negotiationDefinitions(0)	Allocation of version identifiers to the ASN.1 module that contains the definitions associated with the negotiation abstract syntax

Below {joint-iso-ccitt ms(9) smo(0) asn1Modules(2) negotiationDefinitions(0)} further arcs are allocated, as specified by CCITT Rec. X.701 | ISO/IEC 10040, for the registration of particular versions of the ASN.1 module, as shown in Table 6.

Table 6 – Allocation of arcs below {joint-iso-ccitt ms(9) smo(0) asn1Modules(2) negotiationDefinitions(0)}

Arc	Purpose
version1(1)	Identifies Version 1 of the ASN.1 module that contains the definitions associated with the negotiation abstract syntax

6.4.2 Object identifier allocation for CMIP

NOTE – CMIP is responsible for the allocation of these arcs; they are included for information only. CMIP version 1 is obsolete and has been superseded by version 2. Version 1 was documented in ISO/IEC 9596, for which there is no corresponding CCITT Recommendation.

Below {joint-iso-ccitt ms(9) cmip(1)}, arcs are allocated for each version of CMIP, as described in 6.4.2.1 and 6.4.2.2.

6.4.2.1 CMIP version 1

Below {joint-iso-ccitt ms(9) cmip(1)}, arcs are allocated for version 1 of CMIP, as shown in Table 7.

Table 7 – Allocation of arcs below {joint-iso-ccitt ms(9) cmip(1)} for CMIP version 1

Arc	Purpose
version1(1)	Allocation of object identifiers for CMIP version 1

Below {joint-iso-ccitt ms(9) cmip(1) version1(1)}, arcs are allocated for the purposes described in ISO/IEC 9596, as shown in Table 8.

Table 8 – Allocation of arcs below {joint-iso-ccitt ms(9) cmip(1) version1(1)}

Arc
aAssociateUserInfo(1)
aAbortUserInfo(2)
protocol(3)
abstractSyntax(4)

6.4.2.2 CMIP version 2

Below {joint-iso-ccitt ms(9) cmip(1)}, arcs are allocated for version 2 of CMIP, as shown in Table 9.

Table 9 – Allocation of arcs below {joint-iso-ccitt ms(9) cmip(1)} for CMIP version 2

Arc	Purpose
modules(0)	Allocation of object identifiers for CMIP ASN.1 modules
cmip-pci(1)	Allocation of object identifiers for CMIP protocol control information

Below {joint-iso-ccitt ms(9) cmip(1) modules(0)}, arcs are allocated for the purposes described in CCITT Rec. X.711 | ISO/IEC 9596-1, as shown in Table 10.

Table 10 – Allocation of arcs below {joint-iso-ccitt ms(9) cmip(1) modules(0)}

Arc
aAssociateUserInfo(1)
aAbortUserInfo(2)
protocol(3)

Below {joint-iso-ccitt ms(9) cmip(1) cmip-pci(1)}, arcs are allocated for the purposes described in CCITT Rec. X.711 | ISO/IEC 9596-1, as shown in Table 11.

Table 11 – Allocation of arcs below {joint-iso-ccitt ms(9) cmip(1) cmip-pci(1)}

Arc
reserved1(1)
reserved2(2)
reserved3(3)
abstractSyntax(4)

6.4.3 Object identifier allocation for function standards

Below {joint-iso-ccitt ms(9) function(2)}, arcs are allocated to identify each function Recommendation | International Standard as shown in Table 12.

Table 12 – Allocation of arcs below {joint-iso-ccitt ms(9) function(2)}

Arc	Standard
partX(X)	CCITT Rec. X.7NN ISO/IEC 10164-X where X is the part number of the Systems Management Function in the ISO/IEC numbering scheme, and X.7NN is the corresponding CCITT Recommendation number.

Below {joint-iso-ccitt ms(9) function(2) partX(X)}, arcs are allocated as shown in Table 13.

Table 13 – Allocation of arcs below {joint-iso-ccitt ms(9) function(2) partX(X)}

Arc	Purpose
standardSpecificExtension(0)	Standard-specific extensions to the allocation scheme
functionalUnitPackage(1)	Allocation of functional unit package identifiers
asn1Module(2)	Allocation of ASN.1 module identifiers
managedObjectClass(3)	Allocation of managed object class identifiers
package(4)	Allocation of package identifiers
parameter(5)	Allocation of parameter identifiers
nameBinding(6)	Allocation of name binding identifiers
attribute(7)	Allocation of attribute identifiers
attributeGroup(8)	Allocation of attribute group identifiers
action(9)	Allocation of action types
notification(10)	Allocation of notification types

Within each function Recommendation | International Standard, further arcs may be allocated below this level (e.g., to allocate particular attribute identifiers), as required by the function Recommendation | International Standard.

6.4.4 Object identifier allocation for SMI standards

Below {joint-iso-ccitt ms(9) smi(3)}, arcs are allocated to identify each SMI Recommendation | International Standard as shown in Table 14.

Table 14 – Allocation of arcs below {joint-iso-ccitt ms(9) smi(3)}

Arc	Standard
partX(X)	CCITT Rec. X.72N ISO/IEC 10165-X where X is the part number of the standard in the ISO/IEC numbering scheme, and X.72N is the corresponding CCITT Recommendation number.

Below {joint-iso-ccitt ms(9) smi(3) partX(X)}, arcs are allocated as shown in Table 15.

Table 15 – Allocation of arcs below {joint-iso-ccitt ms(9) smi(3) partX(X)}

Arc	Purpose
standardSpecificExtension(0)	Standard-specific extensions to the allocation scheme
asn1Module(2)	Allocation of ASN.1 module identifiers
managedObjectClass(3)	Allocation of managed object class identifiers
package(4)	Allocation of package identifiers
parameter(5)	Allocation of parameter identifiers
nameBinding(6)	Allocation of name binding identifiers
attribute(7)	Allocation of attribute identifiers
attributeGroup(8)	Allocation of attribute group identifiers
action(9)	Allocation of action types
notification(10)	Allocation of notification types

Within each Recommendation | International Standard, further arcs may be allocated below this level (e.g., to allocate particular attribute identifiers), as required by that Recommendation | International Standard.

6.4.5 Object identifier allocation for actual class

The object identifier value

{joint-iso-ccitt ms(9) smi(3) part4(4) managedObjectClass(3) actualClass(42)}

is allocated by this Recommendation | International Standard to convey the semantics of *actual class* as defined in CCITT Rec. X.720 | ISO/IEC 10165-1. When used to specify the base managed object class in a CMIS operation service request, this object identifier value indicates that the recipient of the systems management operation shall respond as a member of its actual class.

6.5 Conformance

CCITT Rec. X.701 | ISO/IEC 10040 specifies general conformance related requirements for management information standards.

6.6 Complexity of managed object definitions

Through the modelling process, complexity in the managed object definitions should be minimized. In any case, management operations should be no more complex than the corresponding properties of the OSI entity involved.

6.7 Managed object creation and deletion

Creation and deletion of managed object instances may occur in the following ways:

- managed objects may be created and deleted by management protocol interactions. Create and delete operations are defined for this purpose, with associated semantics;
- managed objects may be created and deleted as a result of the operation of the resource to which they relate, typically a protocol machine. Create and delete operations would not be defined in this case. An example is the representation for management purposes of connections;

- managed objects may be created and deleted by other means. Create and Delete operations are not defined for them. An example is a managed object which is always created automatically when a piece of equipment is initialized, and which cannot be deleted through management.

The choice among these three methods for managed object creation may differ from the choice for managed object deletion.

In some cases, there may be only one means by which a managed object of a particular class may be created or deleted; in other cases, there may be the possibility to create or delete managed objects of a particular class by means of more than one of these mechanisms.

6.7.1 Initial value managed objects

When a managed object is created, it may be desirable to provide the capability to allocate default values to be used on creation which are themselves subject to modification by management operation. This may be achieved by the specification of an Initial Value Managed Object (IVMO), whose attributes are modifiable by management operation, and which is capable of providing default values for corresponding attributes on the creation of instances of another managed object class.

When a new managed object is created using an IVMO, the values of attributes in the IVMO are used as initial values of corresponding attributes in the new managed object. The managed object class definition may specify how the IVMO is selected. The specification of the IVMO shall define the circumstances in which it provides the initial values, how it provides the initial values, and to which attributes the initial values it provides are applicable.

When management operations are used to modify the attributes of an IVMO, attributes of managed objects previously created using that IVMO are not affected. Similarly, management operations performed upon the attributes of managed objects created using an IVMO do not affect the attributes of the IVMO.

6.7.2 Sources of initial attribute values

Initial attribute values for managed objects, used at creation time, are obtained from a number of sources, as defined in CCITT Rec. X.720 | ISO/IEC 10165-1. When an attribute represents a specific value that must be consistent with an underlying resource, this value forms the mandatory initial value used at creation time.

7 General principles for managed object definition

The general principles described here are intended for the guidance of managed object definers, and to promote consistency between managed object definitions; for this reason, managed object definers are encouraged to apply the guidance offered wherever it is applicable.

7.1 Commonality

Managed object definers should strive to identify and use as a basis

- common managed object classes, defined in CCITT Recommendations | International Standards;
- common managed object classes and other properties as defined in CCITT Rec. X.721 | ISO/IEC 10165-2.

Managed object definers should also strive to consider and re-use definitions originating in other groups in order to increase commonality of definitions. This objective may be met by development of models of things to be managed that are common to a number of groups of managed object definers.

7.2 What to manage

The definition of managed object classes and their components should fulfil clearly justified requirements related to particular management objectives. Such requirements are likely to include the management of peer protocol aspects of the operation of a layer or sub-layer and perceived problems not specifically reported by the underlying service provider across the service boundary (e.g., Quality Of Service provided by underlying service not meeting acceptable levels). It is important to retain justification for each management objective during the development of the management

information definitions. Comments should be used to explain how each component of a management information definition, (e.g., managed object classes, attributes, operations, notifications, etc.) relates to this justification.

Things of interest to management should be recorded via the managed objects that represent the resources where the things happen. That is, if a managed object has been defined representing a particular resource (for example, a connection), then information concerning that resource should be reflected through the corresponding managed object(s) and not elsewhere.

7.3 Structuring

A number of techniques are available for representing structure in managed objects, to reflect groupings of data or functionality. Each of these techniques has advantages and disadvantages; the choice of the most appropriate technique(s) for a particular specification requirement depends on a number of criteria, as described below.

The structuring techniques described in CCITT Rec. X.720 | ISO/IEC 10165-1 include

- attribute groups;
- subclasses (specialization);
- multiple inheritance;
- contained managed objects;
- packages.

Groupings of attributes, operations and notifications may be defined which are present or absent based on a standardized condition, such as the choice of particular options in a base standard. Such groupings of functionality are either present or absent as a whole. Groupings of functionality may arise as a consequence of option selection in the layer Recommendation | International Standard for the resource (e.g., provision of Transport Class 4), leading to additional management requirements or capability, or as a consequence of support for a defined management function (e.g., accounting). These groupings of functionality are defined using the conditional package techniques provided by the managed object class template.

One important criterion in the choice of structuring techniques is the static or dynamic presence of the grouping. If the presence of the grouping is fixed at specification time, then the use of attribute groups, subclasses, multiple inheritance, or contained managed objects may be appropriate. If the presence is fixed at implementation, installation or instantiation time, then the use of contained managed objects or conditional packages may be appropriate. If the presence of the grouping can change through the life of the containing/encapsulating managed objects, then the use of contained managed objects that are dynamically created and deleted may be appropriate.

Another criterion is whether there are multiple instances of the grouping within the managed object. Where this is the case, the use of contained managed objects is appropriate; otherwise, any of the five structuring techniques may be appropriate.

7.4 Managed objects

7.4.1 Instantiation of superclasses

Managed object classes that are never instantiated may be defined to provide a common base from which to specialize subclasses; for example, a generic virtual circuit managed object class may be defined, of which permanent and switched virtual circuits could be subclasses.

In some cases, particularly where subclasses are defined in order to revise a standard, there may be superclasses of which instances may be created.