

INTERNATIONAL STANDARD

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Information technology — Open Systems Interconnection — Systems Management: Management knowledge management function

*Technologies de l'information — Interconnexion de systèmes
ouverts (OSI) — Gestion-systèmes: Fonction de gestion de connaissance
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 10164-16 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 21, *Open systems interconnection, data management and open distributed processing*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.750.

ISO/IEC 10164 consists of the following parts, under the general title *Information technology — Open Systems Interconnection — Systems Management*:

- *Part 1: Object Management Function*
- *Part 2: State Management Function*
- *Part 3: Attributes for representing relationships*
- *Part 4: Alarm reporting function*
- *Part 5: Event Report Management Function*
- *Part 6: Log control function*
- *Part 7: Security alarm reporting function*
- *Part 8: Security audit trail function*
- *Part 9: Objects and attributes for access control*
- *Part 10: Usage metering function for accounting purposes*
- *Part 11: Metric objects and attributes*
- *Part 12: Test Management Function*
- *Part 13: Summarization Function*
- *Part 14: Confidence and diagnostic test categories*
- *Part 15: Scheduling function*
- *Part 16: Management knowledge management function*
- *Part 17: Change over function*
- *Part 18: Software management function*

- *Part 19: Management domain and management policy management functions*
- *Part 20: Time management function*
- *Part 21: Command sequencer*
- *Part 22: Response time monitoring function*

Annexes A to F form an integral part of this part of ISO/IEC 10164. Annexes G and H are for information only.

INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION – SYSTEMS MANAGEMENT: MANAGEMENT KNOWLEDGE MANAGEMENT FUNCTION

1 Scope

This Recommendation | International Standard defines the Management knowledge management function. The Management knowledge management function is a Systems Management function which may be used by an application process in a centralized or decentralized management environment to interact for the purpose of systems management, as defined by the OSI Management framework, CCITT Rec. X.700 and ISO/IEC 7498-4. This Recommendation | International Standard defines a function which consists of generic definitions and services. This function is positioned in the application layer of the OSI reference model, ITU-T Rec. X.200 | ISO/IEC 7498-1, and is defined according to the model provided by ITU-T Rec. X.207 | ISO/IEC 9545. The role of systems management functions is described by CCITT Rec. X.701 | ISO/IEC 10040.

This Recommendation | International Standard:

- identifies the set of requirements satisfied by the function;
- provides a model for the behaviour of management knowledge objects;
- specifies the management requirements of the function and how these are realized by specification of managed objects and their behaviour or by specification of Directory objects;
- specifies the mapping of these services onto the CMIS services;
- specifies the abstract syntax of the parameters of the MAPDUs that will be used to refer to managed objects and their characteristics.

This Recommendation | International Standard does not:

- define the nature of any implementation intended to provide the Management knowledge management function;
- specify the manner in which management is to be accomplished by the user of the Management knowledge management function;
- define the nature of any interactions which result in the use of the Management knowledge management function;
- specify the services necessary for the establishment, normal and abnormal release of a management association;
- define the interactions which result by the simultaneous use of several management functions;
- define connection establishment or authorization requirements for the use of these functions or for any associated activity;
- preclude the definition of further management knowledge object classes.

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 agreements 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.210 (1993) | ISO/IEC 10731:1994, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services.*
- 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.501 (1993) | ISO/IEC 9594-2:1995, *Information technology – Open Systems Interconnection – The Directory: Models.*
- ITU-T Recommendation X.511 (1993) | ISO/IEC 9594-3:1995, *Information technology – Open Systems Interconnection – The Directory: Abstract service definition.*
- ITU-T Recommendation X.520 (1993) | ISO/IEC 9594-6:1995, *Information technology – Open Systems Interconnection – The Directory: Selected attribute types.*
- ITU-T Recommendation X.521 (1993) | ISO/IEC 9594-7:1995, *Information technology – Open Systems Interconnection – The Directory: Selected object classes.*
- 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).*
- CCITT Recommendation X.701 (1992) | ISO/IEC 10040:1992, *Information technology – Open Systems Interconnection – Systems management overview.*
- CCITT Recommendation X.720 (1992) | ISO/IEC 10165-1:1993, *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.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.735 (1992) | ISO/IEC 10164-6:1993, *Information technology – Open Systems Interconnection – Systems Management: Log control function.*
- ITU-T Recommendation X.741 (1995) | ISO/IEC 10164-9:1995, *Information technology – Open Systems Interconnection – Systems Management: Objects and attributes for access control.*

2.2 Paired ITU-T Recommendations | International Standards equivalent in technical content

- 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.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.290 (1992), *OSI Conformance testing methodology and framework for protocol Recommendations for CCITT applications – General concepts*.
ISO/IEC 9646-1:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 1: General concepts*.
- CCITT Recommendation X.291 (1992), *OSI Conformance testing methodology and framework for protocol Recommendations for CCITT applications – Abstract test suite specification*.
ISO/IEC 9646-2:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 2: Abstract Test Suite specification*.
- 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 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*.

2.3 Additional references

- ISO/IEC ISP 11183-1:1992, *Information technology – International Standardized Profiles AOMIn OSI Management – Management Communications – Part 1: Specification of ACSE, presentation and session protocols for the use by ROSE and CMISE*.
- ISO/IEC ISP 11183-2:1992, *Information technology – International Standardized Profiles AOMIn OSI Management – Management Communications – Part 2: CMISE/ROSE for AOMI2 – Enhanced Management Communications*.
- ISO/IEC ISP 11183-3:1992, *Information technology – International Standardized Profiles AOMIn OSI Management – Management Communications – Part 3: CMISE/ROSE for AOMI1 – Basic Management Communications*.

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 ITU-T Rec. X.200 | ISO/IEC 7498-1:

- a) open system;
- b) (N)-protocol data unit;
- c) systems management;
- d) systems management application entity.

3.2 Application layer structure definitions

This Recommendation | International Standard makes use of the following term defined in ITU-T Rec. X.207 | ISO/IEC 9545:

- application service element.

3.3 OSI conformance testing definitions

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

- a) ICS proforma;
- b) implementation conformance statement;
- c) PICS proforma;
- d) protocol implementation conformance statement.

3.4 Directory definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.501 | ISO/IEC 9594-2:

- a) alias entry;
- b) attribute;
- c) auxiliary object class;
- d) Directory entry;
- e) Directory information tree;
- f) Directory name;
- g) Directory object class;
- h) Directory system agent;
- i) Directory user agent;
- j) distinguished name;
- k) DIT content rule;
- l) relative distinguished name;
- m) structural object class;
- n) subordinate;
- o) superior;
- p) the Directory.

NOTE – The terms "attribute", "distinguished name", "relative distinguished name", "subordinate" and "superior" are defined in both ITU-T Rec. X.501 | ISO/IEC 9594-2 and either CCITT Rec. X.710 and ISO/IEC 9595 or CCITT Rec. X.720 | ISO/IEC 10165-1 because of similarities between the Directory model and the Management information model. However, the uses of these terms in the two models are not identical in all details. The context of use, a Directory object or a managed object, identifies the appropriate definition.

3.5 Management framework definitions

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

- managed object.

3.6 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) agent role;
- c) generic definitions;
- d) managed system;
- e) managed object conformance statement;
- f) management information;
- g) management information conformance statement;
- h) management operation;
- i) manager;
- j) manager role;
- k) managing system;
- l) MICS proforma;
- m) MIS-user;
- n) MOCS proforma;
- o) notification;
- p) notification type;
- q) systems management application service element;
- r) systems management functional unit.

3.7 CMIS definitions

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

- a) attribute;
- b) common management information service element;
- c) common management information service(s);
- d) set-valued (attribute).

3.8 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) allomorphic class;
- d) attribute group;
- e) attribute identifier;
- f) attribute type;
- g) behaviour;
- h) characteristic;

- i) conditional package;
- j) containment;
- k) distinguished name;
- l) instantiation;
- m) mandatory package;
- n) name binding;
- o) naming tree;
- p) package;
- q) parameter;
- r) relative distinguished name;
- s) specialization;
- t) subclass;
- u) superclass;
- v) subordinate (object);
- w) superior (object).

3.9 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:

- a) managed object class definition;
- b) template.

3.10 Requirements and guidelines for ICS proformas associated with OSI management definitions

This Recommendation | International Standard makes use of the following term defined in ITU-T Rec. X.724 | ISO/IEC 10165-6:

- a) managed relationship conformance statement;
- b) management conformance summary;
- c) MCS proforma;
- d) MRCS proforma.

3.11 General relationship model definitions

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

- managed relationship.

3.12 Additional definitions

3.12.1 management knowledge object: A managed object or a Directory object that makes management knowledge available.

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

CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
CMISE	Common Management Information Service Element
Cnf	Confirm
DIT	Directory Information Tree
DKDT	Definition Knowledge Directory Tree
DSA	Directory System Agent
DUA	Directory User Agent
GDMO	Guidelines for the Definition of Managed Objects
ICS	Implementation Conformance Statement
Id	Identifier
Ind	Indication
ISP	International Standardized Profile
MAPDU	Management Application Protocol Data Unit
MCS	Management Conformance Summary
MICS	Management Information Conformance Statement
MIS	Management Information Service
MKM	Management Knowledge Management Function
MOCS	Managed Object Conformance Statement
MRCS	Managed Relationship Conformance Statement
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statement
RDN	Relative Distinguished Name
Req	Request
Rsp	Response
SMAE	Systems Management Application Entity
SMAPM	Systems Management Application Protocol Machine
SMASE	Systems Management Application Service Element

5 Conventions

This Recommendation | International Standard defines services for the Management knowledge management function following the descriptive conventions defined in ITU-T Rec. X.210 | ISO/IEC 10731.

The following notation is used in the service parameter tables:

M	The parameter is mandatory
C	The parameter is conditional
(=)	The value of the parameter is identical to the corresponding parameter in the interaction described by the preceding related service primitive
U	The use of the parameter is a service-user option
–	The parameter is not present in the interaction described by the primitive concerned
P	The parameter is subject to the constraints imposed by ITU-T Rec. X.710 and ISO/IEC 9595.

NOTE – The parameters which are marked “P” in service tables of this Recommendation | International Standard are mapped directly onto the corresponding parameters of the CMIS service primitive, without changing the semantics or syntax of the parameters. The remaining parameters are used to construct an MAPDU.

6 Requirements

Open systems which are participating, or may participate, in OSI Systems Management associations require specific knowledge in order to determine the peer open systems with which to associate, to enable association and to fulfil the functions of OSI Systems Management. Particular requirements, categorized by field of knowledge, are listed herein.

Three types of management knowledge are identified:

- *Repertoire knowledge*: Information on what the managed system is capable of performing. There are three categories of capabilities:
 - managed object class capabilities;
 - managed relationship class capabilities;
 - function capabilities.

There is a need for a manager to be able to discover capabilities of managed systems without accessing each managed system.

- *Definition knowledge*: Information on the formal specification of managed object classes, name bindings, etc., e.g. templates for classes, name bindings.
- *Instance knowledge*: Information regarding what managed objects and managed relationships are made visible by a managed system and what systems management application entities can be used to establish an association to a managed system that makes a given managed object visible.

Knowledge sharing mechanisms shall preserve all access control requirements upon the open systems about which information is provided. In particular, knowledge sharing mechanisms for the purpose of OSI Systems Management shall not expose information to a given user if that user is otherwise prohibited from obtaining that information when using OSI Systems Management services.

The requirements necessary to acquire repertoire, definition and instance knowledge are subdivided into the following five major categories (see Table 1).

Table 1 – Requirements

Subclause	Major categories	Types of management knowledge		
		Repertoire knowledge	Definition knowledge	Instance knowledge
6.1	Managed object class knowledge	X		
6.2	Managed object class instance knowledge			X
6.3	Relationship knowledge	X		X
6.4	MIS-user knowledge	X		X
6.5	Management information definition knowledge		X	

6.1 Managed object class knowledge

There is a need to determine the following repertoire knowledge:

- the managed object classes that can be made available by a given managed system;
- the constraints imposed upon managed objects of a given class (e.g. the implemented value set for a given attribute);
- for a given managed object class, the conditional packages that are always included and those that are never included in an instance of the class;
- the initial values of an instance of a particular class that can be created in a given managed system;
- the supported allomorphs for each supported managed object class.

6.2 Managed object class instance knowledge

Without obligatory recourse to the CMIS multiple object selection functional unit, there is a need to determine the following instance knowledge:

- the instances of a given managed object class made visible by a given managed system;
- the managed systems making a given managed object visible;
- how many instances of a given managed object class are made visible by a given managed system.

6.3 Relationship knowledge

There is a need to determine the following repertoire knowledge:

- the relationship classes supported by a given managed system;
- the relationship role bindings, including name bindings, that may exist between managed object classes made visible by a given managed system;

as well as the following instance knowledge:

- the relationship instances that exist between managed objects made visible by a given managed system or by different managed systems.

6.4 MIS-user knowledge

There is a need to determine the following repertoire knowledge:

- the SMAE titles of the managed systems or managing systems with which management associations can be established;
- the presentation addresses of those SMAEs;
- the application contexts supported by those SMAEs, including the syntaxes and identifiers of information associated with those application contexts;
- which functional units for SMASE, CMISE, ACSE and any additional ASEs used for management purposes are supported by those SMAEs for systems management associations;
- which standard profiles are supported,

as well as the following instance knowledge:

- given a global name of a managed object, the systems management application entities that can be used to establish an association to a managed system that makes the managed object visible.

6.5 Management information definition knowledge

There is a need to determine the following definition knowledge:

- the formal definitions of management information, including managed object classes, name bindings, test categories, relationship classes and all attendant information;
NOTE – Where a Directory service is available, some or all of this information may be held in and made available through such a Directory service. Definitions for such a solution are provided in Annex B;
- which management information definitions are understood by a given managing system?

7 Model

This model discusses how information on various types of management knowledge can be made available. This information is specified as:

- 1) managed objects according to the Guidelines for the definition of managed objects, CCITT Rec. X.722 | ISO/IEC 10165-4; or
- 2) Directory objects according to The Directory: Models, ITU-T Rec. X.501 | ISO/IEC 9594-2.

These management knowledge objects are described in 7.1 and 7.2 respectively.

This model is consistent with the way standardized management knowledge is specified in CCITT Rec. X.701 | ISO/IEC 10040.

7.1 Management knowledge managed objects

The model for managed objects which are used to store and share particular aspects of management knowledge follows.

7.1.1 Repertoire managed objects

Repertoire managed objects satisfy the requirement to identify information on what a managed system is capable of performing.

7.1.1.1 Repertoire managed objects

Repertoire managed objects satisfy requirements for determining the managed object classes, name bindings, managed relationship classes and CMIP profiles which are supported by a managed system.

Managed objects of the repertoire managed object class make available lists of the managed object classes supported by the managed system. This list includes actual classes and allomorphic classes. A list of name bindings and a list of relationship classes supported by the managed system are also made available. An instance of the repertoire managed object that represents the managed system components that support communications also has an attribute that identifies the CMIP profiles that are supported by the managed system.

The use of a fixed relative distinguished name for naming a repertoire managed object allows for a common way to access that repertoire managed object. Therefore, a name binding is provided to support the containment of a repertoire managed object within a system managed object, with a fixed relative distinguished name. If a managed system has any repertoire managed objects, it must have one named under system with the RDN value of "REP1". The repertoire information may also be made available by other means, for instance using the Directory.

An instance of the repertoire managed object class may contain subordinate managed object class repertoire managed objects, each of which makes available knowledge of the conditional packages supported for a particular managed object class.

7.1.1.2 Managed object class repertoire managed objects

Managed object class repertoire managed objects and their subclasses identify information pertaining to the implementation of a managed object class. They may be named by the managed object class repertoire Id attribute, the value of which is the object identifier of the class for which implementation information is represented. They may be contained within a repertoire managed object.

A managed object class repertoire managed object has a set-valued attribute to identify the conditional packages supported by the implementation.

A managed object class repertoire managed object may have a set-valued attribute to identify the implemented values (e.g. initial values, value ranges and default values).

7.1.2 Definition managed objects

Definition managed objects satisfy the requirement to identify management information definitions.

Knowledge of definitions is required during association. Some managing systems will only be able to make limited use of definition knowledge gained during association. For example, simple managing systems will find the classes of managed object managed by a managed system to be of use if and only if they already have support for those classes or compatible classes.

Other managing systems will have greater capability in that they will be able to interpret definitions shared during association thereby providing users with some capability to manage managed objects of hitherto unknown classes. For example, a managing system may be able to ask a managed system which actions are supported by a particular managed object class. For those actions already known to the interrogating managing system, support is already available. For unknown actions, it may be possible to obtain further information, such as the syntax of requests.

Inevitably, such interrogation will lead to information which cannot be used without knowledge of its semantics. However there is no reason in principle why descriptions of managed object classes cannot be made available to intelligent users and there is no reason in principle why such users should be prohibited from using such information. A case in point is the event report: whilst a managing system which has not hitherto known of a particular notification cannot be expected to take particular action upon receiving such a notification, there may be a requirement for as much as possible of the information about that notification to be made available to users. This could entail requests to the issuing managed system for the GDMO specification of the notification and for the syntax of its argument. This would facilitate decoding of the notification and display of its argument.

There are two approaches to the specification of definition managed objects. Either the definition managed object contains specifications as a textual form attribute or it has attributes which represent elements of specifications. The former is very simple and facilitate sharing of the information in the same format as it might be received from any textual source. The latter provides OSI Management with access to every feature of the specification.

The granularity at which definition knowledge should be shared can be determined by examining the requirements of the users of such information. Users fall into two categories – those that wish to browse the information, such as to determine the attributes of a particular managed object class, for example, and those that wish to interpret it, such as an ASN.1 or GDMO compiler. Interpreters generally will use text input. Browsers may wish simply to retrieve the information in its textual form and scan it at their leisure. However, some may wish access to specific elements of knowledge to determine the feasibility and potential value of attempting to manage managed objects of hitherto unknown classes. For example, such information may be required for configuring event forwarding discriminators.

There are three types of definition managed objects: document managed objects, template managed objects and ASN.1 module managed objects. Document managed objects represent a collection of templates and ASN.1 modules, and have attributes which identify the name and identifier of the document, as specified by GDMO, and the GDMO and ASN.1 specifications in textual form. Template managed objects are contained within document managed objects, are named by the GDMO template label and have attributes which represent the template constructs. ASN.1 module managed objects are contained within document managed objects, are named by the ASN.1 module reference and have attributes representing the registered object identifier, if any, the ASN.1 version and the ASN.1 module in textual form.

Two name bindings are provided to support the containment of a document managed object within a system managed object. These name bindings do not preclude additional name bindings, that would allow definition information to be accessed by use of Directory services or through third parties by use of systems management services.

7.1.3 Discovery managed objects

Discovery managed objects satisfy the requirements to identify managed objects made visible by a managed system.

Discovery of the managed objects that a system makes visible is required, independent of the level of CMIP capability possessed. Conformance to CMIP does not require the implementation of scoping capabilities. This precludes the use of scoping over the managed objects made visible by a managed system. The concept of a discovery managed object satisfies this need.

The discovery managed object employs a tree discovery action. The action argument has the base object, the required scope of the search and an optional class request parameter. The response is a set of rooted tree structures that together cover the requested scope under the requested base object. Each rooted tree has the distinguished name of its root but does not repeat common name components within its structure, i.e. only the RDN is used to identify subordinate managed objects.

The action response shall, if specified in the request, also report the managed object class of each managed object in the scope of the search.

The action response may be split across multiple linked replies. The manager can construct the complete set of managed objects that are within the specified scope by combining the contents of all linked replies.

The use of a fixed relative distinguished name for naming the discovery managed object allows for a common way to access the discovery managed object. Therefore, a name binding is provided to support the containment of a discovery managed object within a system managed object, with a fixed relative distinguished name.

7.2 Management knowledge Directory objects

The strength of the Directory is the provision of relatively static information. Therefore, in the context of Management knowledge management, Directory objects are used to store repertoire knowledge related to managed systems (e.g. the presentation address of a systems management application entity) and definition knowledge (see Figure 1).

7.2.1 Repertoire Directory objects

The requirement to identify MIS-users can be met by the use of repertoire Directory objects. The use of the Directory (as described in Figure 1) satisfies the requirements for the following repertoire knowledge:

- Directory name of a systems management application entity;
- presentation address of a systems management application entity;
- application contexts supported by a systems management application entity;
- functional units supported by a systems management application entity;

- CMIP profiles supported by a systems management application entity;
- list of the managed objects made visible by a systems management application entity;
- given a global name of a managed object, which systems management application entities can be used to establish an association to a managed system that makes the managed object visible.

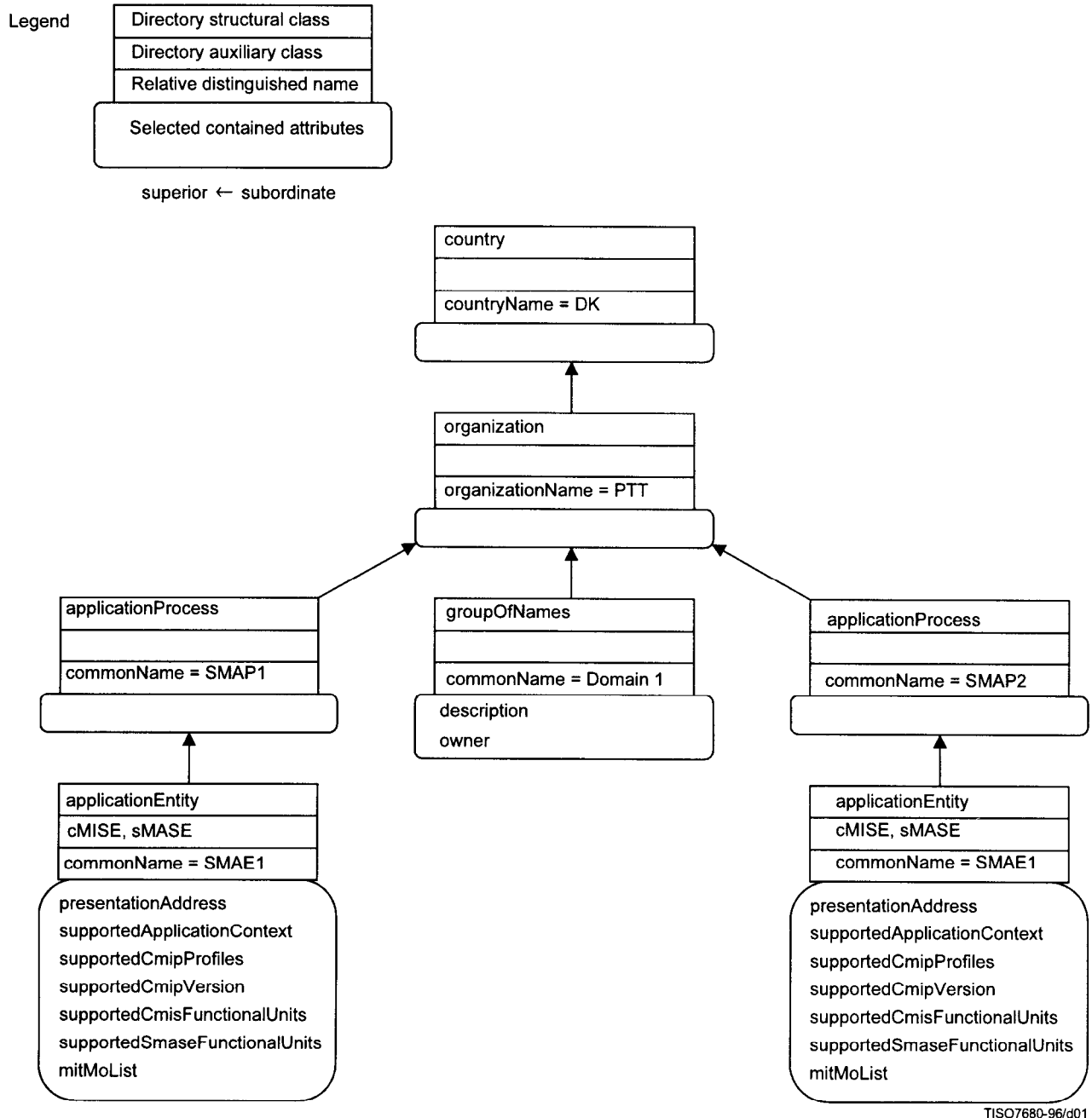


Figure 1 – Use of the Directory for repertoire knowledge

Repertoire knowledge on the systems management application entities of managing and managed systems is provided in the Directory by instances of the Directory structural object class Application Entity. The specific characteristics of systems management application entities are covered by the definition of the Directory auxiliary object classes Systems management application service element and Common management information service element which will be included in an instance of class Application Entity. An instance of class Application Entity may contain attributes that make available the presentation address and the supported application contexts.

The auxiliary object class Systems management application service element makes available the supported systems management application service functional units. It may also have an attribute that identifies the managed object classes supported and optionally lists the managed objects of a class that remain in existence for a relatively long time.

The auxiliary object class Common management information service element makes available the supported common management information service functional units, the supported CMIP version and the supported CMIP profiles.

A manager can use the information stored in the Directory in the following way (see Figure 2):

- 1) if a manager does not know the managed systems it may manage, the manager reads the list of the Directory entries representing managed systems from the member attribute of a Directory entry of class groupOfNames {countryName = DK, organizationName = PTT, commonName = Domain1};
- 2) in order to find the systems management application entities that can be used to establish an association to the managed system it wants to operate on, the manager issues a Directory Search operation using the name returned above and requests that the presentation address, and optionally other protocol-related information such as the supported application contexts or supported CMIS functional units, be returned. In order to find the systems management application entity that is best suited to the needs of the manager, the search can be based on the values of attributes defined by the structural Directory object class Application Entity, for example, Supported application context, or on the values of attributes defined by the Directory auxiliary object classes Systems management application service element and Common management information service element, for example, Supported SMASE functional units or Supported CMIP version;
- 3) the manager selects one systems management application entity from the returned list of application entities that satisfies the needs of the manager and uses the obtained presentation address to establish a management association with the managed system it wants to operate on.

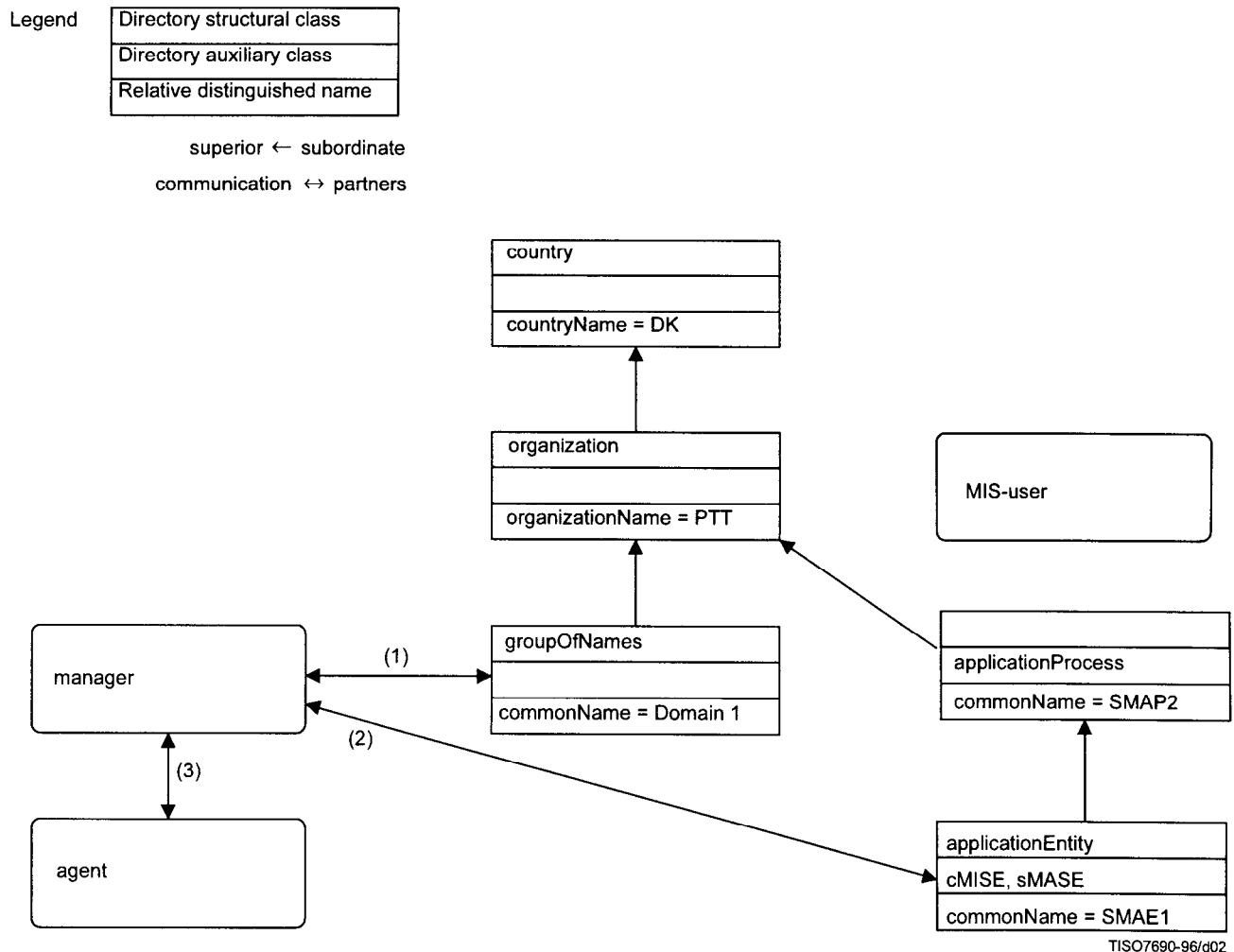
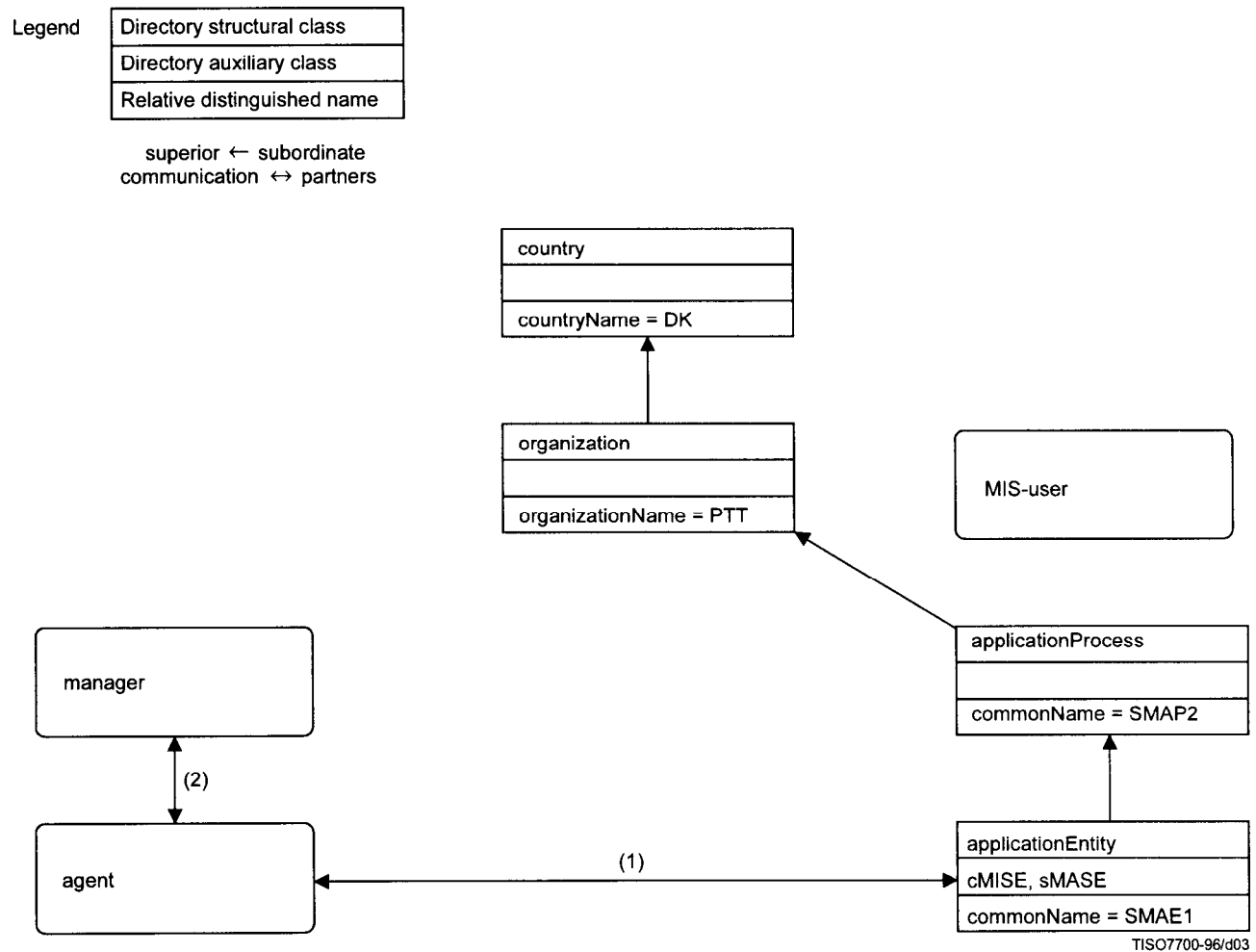


Figure 2 – Example of a manager using repertoire Directory objects

An agent can use the information stored in the Directory in the following way (see Figure 3):

- 1) if an event report has to be forwarded to a manager, the agent obtains the manager’s application entity title from the destination attribute of the event forwarding discriminator. The agent reads the presentation address of the systems management application entities from the Directory entry that is named by the manager’s application entity title. (For the example, the manager’s application entity title is {countryName = DK, organizationName = PTT, commonName = SMAP2, commonName = SMAE1}.) If the agent is also interested in other attributes, such as the supported CMIS and systems management functional units, it also reads them from the Directory entry;
- 2) the agent establishes a management association with the systems management application entity at the obtained presentation address.



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Figure 3 – Example of an agent using repertoire Directory objects

The distinguished name of the Directory entry representing a managed system, e.g. a Directory entry of class applicationProcess, can be used to construct the global names of managed objects made visible by that managed system.

NOTE 1 – The distinguished name of the Directory entry representing a managed system can be obtained as the final result of the resolution of Directory alias names.

Depending on the relative distinguished name that is used for naming the system managed object, the global names of the system managed object itself and all of its directly and indirectly contained managed objects can be constructed in the following way.

If the system Id attribute is used to name the system managed object, the global name of a given managed object is constructed by prefixing its local distinguished name with the distinguished name of the Directory entry representing the managed system and the RDN of the system managed object. For example, if the managed system is represented by the Directory entry {countryName = DK, organizationName = PTT, commonName = SMAP1} (see Figure 4 a) the global name of the discriminator managed object is {countryName = DK, organizationName = PTT, commonName = SMAP1, systemId = xyz, discriminatorId = 1}.

NOTE 2 – This approach can also be used if the root of the local containment tree, instead of being an instance of system managed object class, is an instance of the network managed object class as defined in Recommendation M.3100.

If the system title attribute with the distinguished name syntax choice is used to name the system managed object, the value of the systemTitle attribute is set to the distinguished Directory entry representing the managed system. For example, if the managed system is represented by the Directory entry {countryName = DK, organizationName = PTT, commonName = SMAP1} (see Figure 4 b), the global name of the discriminator managed object is {systemTitle = {countryName = DK, organizationName = PTT, commonName = SMAP1}, discriminatorId = 1}.

If the system title attribute with the object identifier syntax choice is used to name the system managed object, the object identifier shall be mapped to the distinguished name of the Directory entry representing the managed system.

NOTE 3 – The mechanism to map the object identifier to a distinguished name is out of scope of this Recommendation | International Standard.

A manager can determine the systems management application entities that can be used to establish an association to a managed system that makes a given managed object visible in the following way (see Figure 4):

- 1) a) if the system Id attribute is used, the manager issues a Directory Read operation using the global name of the managed object. The Directory will return a NameError indicating the problem noSuchObject. Included with this error is the parameter matched which contains the lowest entry in the DIT that was matched. This partial name match identifies the Directory entry representing the managed system;
- 1) b) if the system title attribute is used, the manager extracts the value of the system title attribute which identifies the Directory entry representing the managed system;
- 2) in order to find the systems management applications entities that can be used to establish an association to the managed system, the manager then issues a Directory Search operation using the name of the Directory entry representing the managed system as obtained by step 1) a) or 1) b), respectively, and requests that the presentationAddress attribute, and optionally other protocol-related attributes such as Supported CMIS functional units, be returned. In order to find the systems management application entity that is best suited to the needs of the manager, the search can be based on the values of attributes defined by the structural Directory object class applicationEntity, for example supportedApplicationContext, or on the values of attributes defined by the auxiliary Directory object classes Systems management application service element and Common management information service element, for example Supported SMASE functional units, Supported CMIS functional units or Supported CMIP version attributes;
- 3) from the list of suitable systems management application entities that is returned as result of the Directory Search operation, the manager selects a systems management application entity and uses its associated presentation address (and optional other returned protocol-related information) to establish a management association.

7.2.2 Definition Directory objects

This model describes how to store management information definitions in the definition knowledge directory tree. It is based on the concept of the object identifier tree described in ITU-T Rec. X.680 | ISO/IEC 8824-1. It additionally allows the insertion of information definitions in the definition knowledge directory tree which have not been assigned an object identifier.

The entries in the Directory representing the definition knowledge directory tree are of the Directory structural class Registered information. Furthermore, Directory auxiliary classes can be defined that contain further information depending on the type of information to be registered. Instances of these auxiliary classes can be included in entries of class Registered information.

Constructing the distinguished name of a Registered information entry from a given object identifier is straightforward. Figure 5 shows the distinguished names for two of the definitions of CCITT Rec. X.721 | ISO/IEC 10165-2:

- the system managed object class which is registered as {joint-iso-ccitt(2) ms(9) smi(3) part2(2) managedObjectClass(3) 13};
- the Attribute-ASN1Module which is registered as {2 9 3 2 2 1}

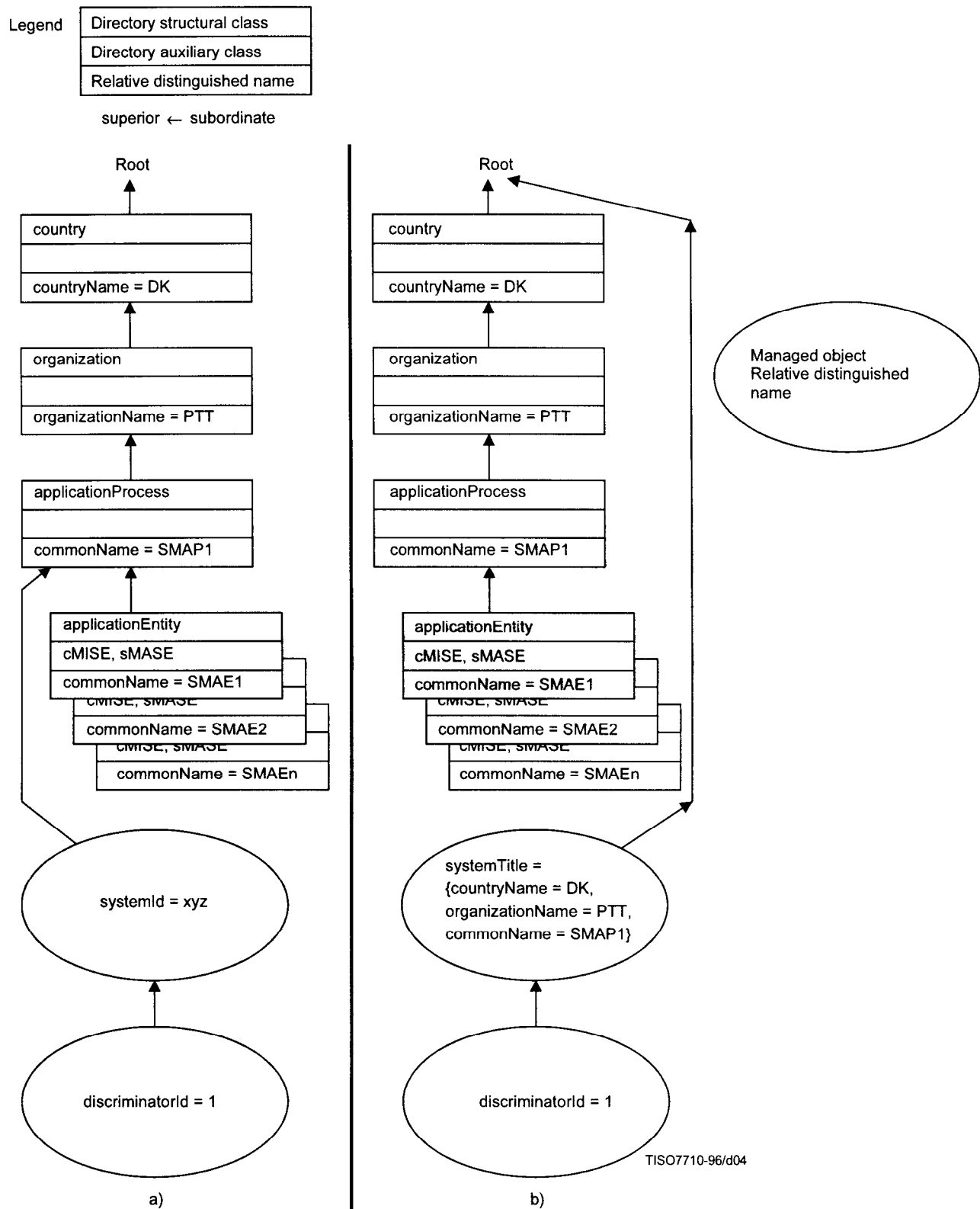


Figure 4 – Construction of an MKM global name

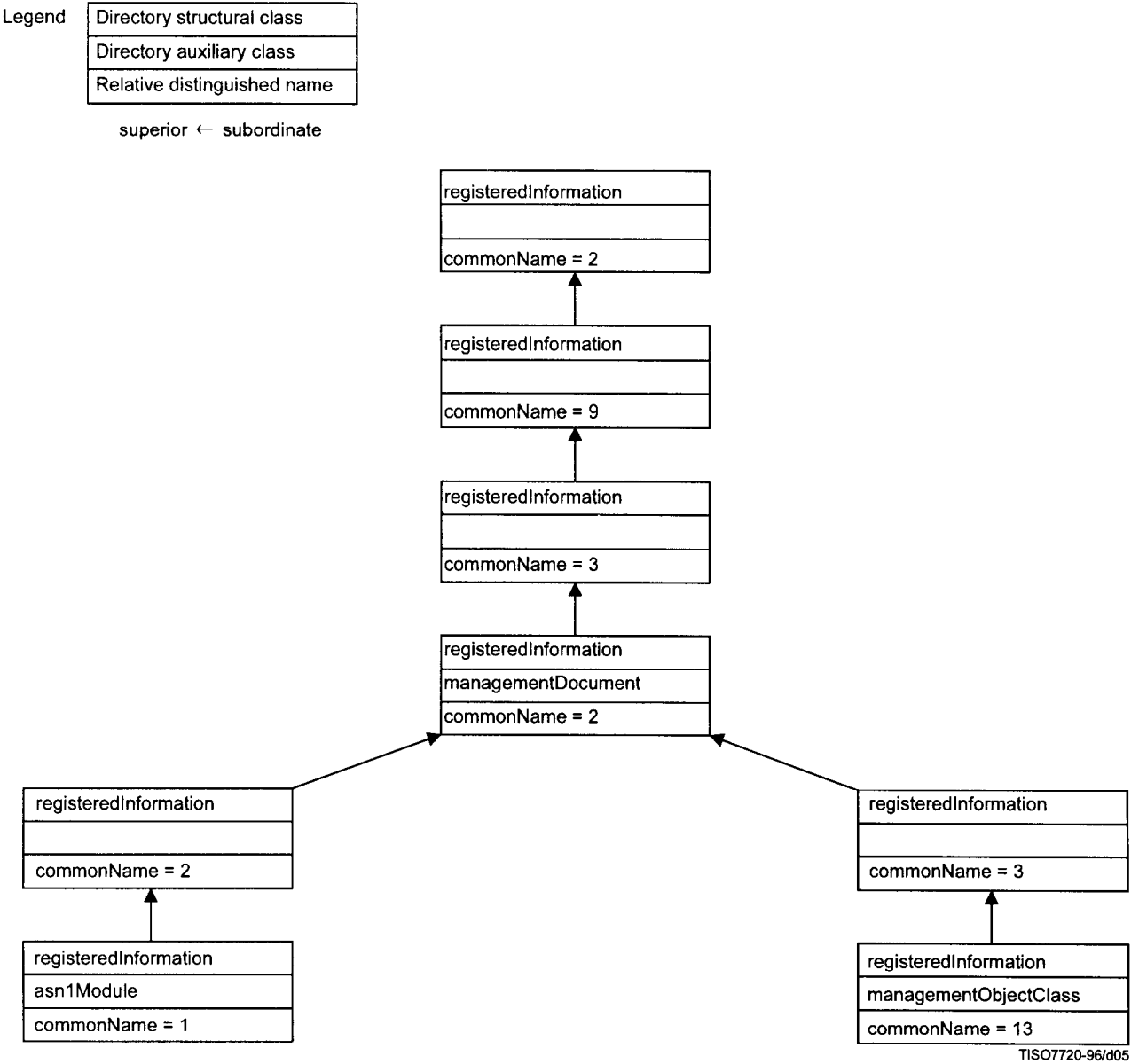


Figure 5 – Example of a definition knowledge directory tree

The object identifier value of { 2 9 3 2 3 13 } is mapped to the distinguished name of {commonName = 2, commonName = 9, commonName = 3, commonName = 2, commonName = 3, commonName = 13}.

NOTE – Depending on where the definition knowledge directory tree is to be included in the global Directory information tree a prefix has to be added to this distinguished name (see Annex H).

7.3 Relationship between management knowledge requirements and model

Table 2 shows the relationship between the management knowledge requirements and the management knowledge objects defined in the model. An “X” indicates that the associated knowledge requirement is fulfilled by the corresponding management knowledge objects.

Table 2 – Requirements and model

Knowledge requirement	Management knowledge objects				
	Repertoire managed objects	Definition managed objects	Discovery managed objects	Repertoire Directory objects	Definition Directory objects
Managed object class knowledge	X	–	–	X (Note 1)	–
Managed object class instance knowledge	–	–	X (Note 2)	X (Note 3)	–
Relationship knowledge (Note 4)	X (Note 5)	–	–	–	–
MIS-user knowledge	X (Note 6)	–	–	X	–
Management information definition knowledge	–	X (Note 7)	–	–	X (Note 7)
NOTES 1 Currently this Recommendation International Standard defines repertoire Directory objects only to represent the managed object classes supported by a managed system. 2 Only managed objects made visible by a given managed system can be determined. 3 Only managed objects that exist for a fairly long period of time are expected to be registered. 4 Currently no management knowledge objects are defined specifically for representing relationship instance knowledge. 5 Currently the only information represented is the set of managed relationship classes and the set of name bindings supported by a managed system. 6 Currently only information about supported CMIP profiles is provided. 7 Currently definition knowledge includes support only for GDMO templates and ASN.1 modules.					

8 Generic definitions

8.1 Managed objects

This Recommendation | International Standard defines management knowledge managed object classes, with their associated characteristics.

8.1.1 Managed objects for repertoire knowledge

8.1.1.1 Managed object class repertoire managed object

Managed object class repertoire managed objects identify supported capabilities for a particular managed object class.

The managed object class repertoire managed object class is defined as a subclass of the top managed object class defined in CCITT Rec. X.721 | ISO/IEC 10165-2. Its mandatory, read-only attributes are:

- a) managed object class repertoire Id;
- b) supported conditional package list.

Its optional, read-only attribute is:

- c) implemented values.

The managed object class repertoire managed object supports the following notifications:

- a) object creation;
- b) object deletion;
- c) attribute value change.

8.1.1.2 Repertoire managed object

Repertoire managed objects identify the managed object classes, managed relationship classes, name bindings and CMIP profiles supported by a system.

A repertoire managed object may serve as the superior object for contained objects, each of which conveys knowledge pertaining to an implementation's support of a specific managed object class.

The repertoire managed object class is defined as a subclass of the top managed object class defined in CCITT Rec. X.721 | ISO/IEC 10165-2. Its mandatory, read-only attributes are:

- a) repertoire Id;
- b) supported name binding list;
- c) supported managed object class list;
- d) supported relationship class list.

Its optional, read-only attribute is:

- e) supported CMIP profiles.

The repertoire managed object supports the following notifications:

- a) object creation;
- b) object deletion;
- c) attribute value change.

8.1.2 Managed objects for definition knowledge

8.1.2.1 Action template managed object

The action template managed object represents a GDMO action specification.

The action template managed object class is defined as a subclass of the template managed object class. Its mandatory, read-only attributes are:

- a) behaviour;
- b) mode confirmed;
- c) parameters;
- d) with information syntax;
- e) with reply syntax;
- f) registered as.

8.1.2.2 ASN.1 module managed object

The ASN.1 module managed object represents in textual form the contents of an ASN.1 module.

The ASN.1 module managed object class is defined as a subclass of the top managed object class defined in CCITT Rec. X.721 | ISO/IEC 10165-2. Its mandatory, read-only attributes are:

- a) ASN.1 module contents;
- b) ASN.1 version;
- c) module reference;
- d) optionally registered as.

The ASN.1 module managed object also has an action to query the ASN.1 module contents.

The action response can use linked replies, if acceptable on the association, to return the textual version of the ASN.1 module contents.

8.1.2.3 Attribute group template managed object

The attribute group template managed object represents a GDMO attribute group specification.

The attribute group template managed object class is defined as a subclass of the template managed object class. Its mandatory, read-only attributes are:

- a) group elements;
- b) fixed;
- c) description;
- d) registered as.

8.1.2.4 Attribute template managed object

The attribute template managed object represents a GDMO attribute specification.

The attribute template managed object class is defined as a subclass of the template managed object class. Its mandatory, read-only attributes are:

- a) derived or with syntax choice;
- b) matches for;
- c) behaviour;
- d) parameters;
- e) optionally registered as.

8.1.2.5 Behaviour template managed object

The behaviour template managed object represents a GDMO behaviour specification.

The behaviour template managed object class is defined as a subclass of the template managed object class. Its mandatory, read-only attribute is:

- defined as.

The behaviour template managed object also has an action to query the behaviour description.

The action response can use linked replies, if acceptable on the association, to return the textual version of the behaviour description.

8.1.2.6 Document managed object

The document managed object represents a document which contains GDMO and ASN.1 specifications so acts as a container for template managed objects.

The document managed object class is defined as a subclass of the top managed object class defined in CCITT Rec. X.721 | ISO/IEC 10165-2. Its mandatory, read-only attributes are:

- a) document name;
- b) document object identifier.

The document specification conditional package is present if the document managed object supports the textual representation of all of the GDMO and ASN.1 specifications contained within the document and, if present, has the following read-only attribute:

- c) specification.

The conditional package also has an action to query the specification. If the conditional package is present, the document managed object responds to actions to get the textual representation of the GDMO and ASN.1 specifications contained within the document.

The action response can use linked replies, if acceptable on the association, to return the textual version of the specification.

If this conditional package is not present, the textual versions of the specifications may be sought from subordinate template managed objects.

8.1.2.7 Managed object class template managed object

The managed object class template managed object represents a GDMO managed object class specification.

The managed object class template managed object class is defined as a subclass of the template managed object class. Its mandatory, read-only attributes are:

- a) derived from;
- b) characterized by;
- c) conditional packages;
- d) registered as.

8.1.2.8 Name binding template managed object

The name binding template managed object represents a GDMO name binding specification.

The name binding template managed object class is defined as a subclass of the template managed object class. Its mandatory, read-only attributes are:

- a) subordinate managed object class;
- b) named by superior object class;
- c) with attribute;
- d) behaviour;
- e) create;
- f) delete;
- g) registered as.

8.1.2.9 Notification template managed object

The notification template managed object represents a GDMO notification specification.

The notification template managed object class is defined as a subclass of the template managed object class. Its mandatory, read-only attributes are:

- a) behaviour;
- b) mode confirmed;
- c) parameters;
- d) with information syntax;
- e) and attribute Id's;
- f) with reply syntax;
- g) registered as.

8.1.2.10 Package template managed object

The package template managed object represents a GDMO package specification.

The package template managed object class is defined as a subclass of the template managed object class. Its mandatory, read-only attributes are:

- a) behaviour;
- b) attributes;
- c) attribute groups;
- d) actions;
- e) notifications;
- f) optionally registered as.

8.1.2.11 Parameter template managed object

The parameter template managed object represents a GDMO parameter specification.

The parameter template managed object class is defined as a subclass of the template managed object class. Its mandatory, read-only attributes are:

- a) context;
- b) syntax or attribute;
- c) behaviour;
- d) optionally registered as.

8.1.2.12 Template managed objects

The template managed object class is the managed object class from which managed object classes for representing GDMO templates may be derived. If only textual representations of GDMO templates are supported, then managed objects of the template managed object class are instantiated. It provides the naming attribute for managed objects representing templates and enables all such managed objects to be contained within document managed objects by the specification of a single name binding.

The template managed object class is a subclass of the top managed object class defined in CCITT Rec. X.721 | ISO/IEC 10165-2. Its mandatory, read-only attribute is:

- a) template name.

The template managed object may also have the template definition conditional package which, if present, has the following read-only attribute:

- b) template definition.

The conditional package also has an action to query the template definition. If the conditional package is present, the template managed object responds to actions to get the textual representation of the template definition.

The action response can use linked replies, if acceptable on the association, to return the textual version of the template definition.

8.1.3 Managed objects for instance knowledge

8.1.3.1 Discovery managed object

The discovery managed object is used to determine all or selected subtrees of managed objects within a managed system's naming tree.

The discovery managed object class is a subclass of the top managed object class defined in CCITT Rec. X.721 | ISO/IEC 10165-2. Its mandatory, read-only attribute is:

- discovery Id.

The use of a name binding of discovery to system, with a fixed relative distinguished name value, allows for a common way to access the discovery managed object.

The discovery managed object responds to actions containing queries concerning subtrees of managed objects within a managed system's naming tree. The query specifies a base object and the required scope of the search.

The response is a set of rooted tree structures that together cover the requested scope under the requested base object. Each rooted tree has the distinguished name of its root but does not repeat common name components within its structure, i.e. only the RDN is used to identify subordinate managed objects.

8.2 Name bindings

8.2.1 Name bindings for repertoire knowledge

8.2.1.1 Managed object class repertoire – Repertoire

This name binding enables managed object class repertoire managed objects, and specializations thereof, to be contained within repertoire managed objects, and specializations thereof.

The managed object class repertoire Id attribute shall be used for naming. Its value is the object identifier for the managed object class Id which the repertoire is associated with.

8.2.1.2 Repertoire – System

This name binding enables repertoire managed objects, and specializations thereof, to be contained within system managed objects, and specializations thereof. The repertoire Id attribute shall be used for naming.

The use of a fixed relative distinguished name for a common way to access a repertoire managed object is provided by this name binding when the value "REP1" is used for the repertoire Id attribute.

8.2.2 Name bindings for definition knowledge

8.2.2.1 ASN.1 module – Document

This name binding enables ASN.1 module managed objects and their specializations to be contained within document managed objects, and specializations thereof, and to be identified by the module reference attribute.

8.2.2.2 Document – System

This name binding enables document managed objects and their specializations to be contained within system managed objects, and specializations thereof, and to be identified by the document object identifier attribute.

8.2.2.3 Document – System2

This name binding enables document managed objects and their specializations to be contained within system managed objects, and specializations thereof, and to be identified by the document name attribute.

8.2.2.4 Template – Document

This name binding enables template managed objects and their specializations to be contained within document managed objects, and specializations thereof, and to be identified by the template name attribute.

8.2.3 Name bindings for instance knowledge

8.2.3.1 Discovery – System

This name binding enables discovery managed objects, and specializations thereof, to be contained within system managed objects, and specializations thereof.

The discovery Id attribute shall be used for naming. The use of a fixed relative distinguished name for a common way to access a discovery managed object is provided by this name binding when the value "DSC1" is used for the discovery Id attribute.

Subordinate to a given system managed object, there shall be only one allowed value for the discovery Id attribute, namely "DSC1".

8.3 Actions

This Recommendation | International Standard defines one action type for definition knowledge:

- get textual representation,

and defines one action type for instance knowledge:

- management information tree search.

For any managed object class that includes either of these action types, it is the role of the managed object class definer to fully detail the requirements that a managed object of that class has for responding to these actions.

8.3.1 Actions for definition knowledge

The get textual representation action argument has the attribute Id parameter. The response is the textual representation of the identified attribute's value sent as a sequence of line images.

The action response may be split across multiple linked replies.

The following describes the action parameters.

8.3.1.1 Attribute Id

The attribute Id parameter specifies the attribute of the managed object whose value is to be returned. The managed object class definition indicates the attributes that may be specified.

8.3.1.2 Textual representation

The textual representation parameter contains the response or, when linked replies are used, a contiguous portion of the response.

8.3.2 Actions for instance knowledge

The management information tree search action argument has the base object, the required scope of the search and an optional class request parameter. The response is a set of rooted tree structures that together cover the requested scope under the requested base object. Each rooted tree has the distinguished name of its root but does not repeat common name components within its structure, i.e. only the RDN is used to identify subordinate managed objects.

The action response shall, if specified in the request, also report the managed object class of each managed object in the scope of the search.

The action response may be split across multiple linked replies.

The following describes the action parameters.

8.3.2.1 Base

The base parameter specifies the base of the managed system's subtree to be discovered.

8.3.2.2 Discovery scope

The discovery scope parameter specifies the scope of the managed system's subtree to be discovered. It has the same syntax as the CMIP scope.

8.3.2.3 Class request

The class request parameter is a boolean, that if true, specifies that the action result shall include managed object class information. The default value is false.

8.3.2.4 Rooted name tree

The rooted name tree parameter contains the identification of the root managed object and may also contain a recursively defined tree structure that describes a subtree requested in the management information tree search request. The recursively defined tree structure includes the RDNs for each managed object discovered. The class of each managed object discovered shall also be included if requested.

8.4 Compliance

Managed object class definitions may import the appropriate specification of managed objects, actions, parameters or attribute types defined in this Recommendation | International Standard. This is achieved by reference to the templates defined in this Recommendation | International Standard. The reference mechanism is defined in CCITT Rec. X.722 | ISO/IEC 10165-4.

8.5 Generic definitions from the Object management function

This Recommendation | International Standard makes use of following generic definitions in CCITT Rec. X.730 | ISO/IEC 10164-1:

- attribute value change notification;
- object creation notification;
- object deletion notification.

8.6 Directory objects

8.6.1 Repertoire Directory objects

The Directory auxiliary object classes Systems management application service element and Common management information service element are defined for inclusion in Directory entries representing application entities that makes use of OSI systems management. They shall be used in a DIT content rule together with the Directory structural object class Application Entity (see ITU-T Rec. X.521 | ISO/IEC 9594-7, 6.12) as described in the following.

The Directory auxiliary object class Systems management application service element must contain the attribute Supported SMASE functional units. The attribute Supported SMASE functional units specifies which functional units in which roles are supported by a systems management application entity. The Directory auxiliary object class Systems management application service element may contain the attributes Supports MKM global names and Management information tree managed object list. The Supports MKM global names attribute indicates whether a systems management application entity is able to handle global managed object names as described in this Recommendation | International Standard. The Management information tree managed object list attribute specifies the list of the managed object names made visible by that systems management application entity. For managed objects that exist only for a brief period of time, only the managed object class is expected to be registered in the list.

The Directory auxiliary object class Common management information service element must contain the attributes Supported CMIP version, Supported CMIP profiles and Supported CMIS functional units. The Supported CMIP version attribute indicates the versions of the common management information protocol the systems management application entity is able to handle. The Supported CMIP profiles attribute specifies the standardized CMIP profiles that are supported by a systems management application entity. The Supported CMIS functional units attribute specifies the CMIS functional units which are supported by a systems management application entity.

8.6.2 Definition Directory objects

The Directory structural class Registered information represents an information object that has been assigned an object identifier as described in ITU-T Rec. X.680 | ISO/IEC 8824-1. It must contain the attribute commonName which is used for naming instances of this class. Its value is the last component of the object identifier that has been assigned to the represented information object.

Instances of this class may contain the attributes Name form, Information status and Additional information. The Name form attribute specifies the symbolic name of the object identifier component numeric form value stored in the commonName attribute. The Information status attribute indicates whether the information is:

- active, i.e. the information definition is fixed and can be used;
- deleted, i.e. the information definition is obsolete and should not be referenced by new information definitions; or
- preliminary, i.e. the information definition is provided for information purposes only but changes may occur in the future (for example during the progression of a Committee Draft to a Draft International Standard).

Additional information about the definition information including the date of creation and a comment on the definition is optionally stored in the attribute Additional information.

NOTE – Additional Directory auxiliary classes can be defined for inclusion in Registered information Directory entries.

The Directory auxiliary class Document is defined for inclusion in Directory entries of Directory structural class Registered information and represents a document which contains GDMO specifications. It must contain the attributes Document name, Document object identifier and Specification. The attribute Document name identifies the name of the document represented by an instance, e.g. CCITT Rec. X.721 | ISO/IEC 10165-2. The value of the attribute Document object identifier is that of the object identifier of the document which it represents, as specified in CCITT Rec. X.722 | ISO/IEC 10165-4. The attribute Specification may contain a representation of the GDMO specifications contained within the document.

The Directory auxiliary class Template is the Directory auxiliary class from which Directory auxiliary classes representing GDMO templates may be derived. It must contain the attribute Template name the value of which is that of the label of the GDMO template which is represented. It may contain the attribute Template definition which contains a textual representation of the GDMO template definition.

The Directory auxiliary class Managed object class template is defined for inclusion in Directory entries of Directory structural class Registered information and represents the GDMO managed object class specifications. It must contain the attributes Derived from, Characterized by, Conditional packages and Registered as.

The Derived from attribute identifies the immediate superclasses of a managed object class. The Characterized by attribute specifies the mandatory packages of a managed object class while the Conditional packages attribute identifies the conditional packages and their conditions. The Registered as attribute contains the object identifier of the represented managed object class.

The Directory auxiliary class Package template is defined for inclusion in Directory entries of Directory structural class Registered information and represents the GDMO package specifications. It must contain the attributes Behaviour, Attributes, Attribute groups, Actions, Notifications and Optionally registered as.

The Behaviour attribute specifies the behaviour associated with the package. The Attributes attribute identifies the attributes, and associated qualifiers and parameters, of the represented package. The Attribute groups attribute identifies the attribute groups, and associated attributes, of the represented package. The Actions attribute specifies the actions, and associated parameters, of the represented package. The Notifications attribute identifies the notifications, and associated parameters, of the represented package. The Optionally registered as attribute contains the object identifier of the represented package or null if no identifier has been assigned.

The Directory auxiliary class Parameter template is defined for inclusion in Directory entries of Directory structural class Registered information and represents the GDMO parameter specifications. It must contain the attributes Context, Syntax or attribute, Behaviour and Optionally registered as. The Context attribute identifies the context of the represented parameter. The Syntax or attribute attribute identifies the syntax specification of the represented parameter. The Behaviour attribute specifies the behaviour associated with the parameter. The Optionally registered as attribute contains the object identifier of the represented parameter or null if no identifier has been assigned.

The Directory auxiliary class Name binding template is defined for inclusion in Directory entries of Directory structural class Registered information and represents the GDMO name binding specifications. It must contain the attributes Subordinate managed object class, Named by superior object class, With attribute, Behaviour, Create, Delete and Registered as.

The Subordinate managed object class attribute identifies the subordinate managed object classes of the represented name binding. The Named by superior object class attribute specifies the superior object classes of the represented name binding. The With attribute identifies the naming attribute of the represented name binding. The Behaviour attribute specifies the behaviour associated with the name binding. The Create and Delete attributes contain the create element and delete element specifications of the represented name binding. If no create or delete element is present, then the corresponding attribute's value shall be null. The Registered as attribute contains the object identifier of the represented name binding.

The Directory auxiliary class Attribute template is defined for inclusion in Directory entries of Directory structural class Registered information and represents the GDMO attribute specifications. It must contain the attributes Derived or with syntax choice, Matches for, Behaviour, Parameters and Optionally registered as. The Derived or with syntax choice attribute contains the syntax specification of the represented attribute. The Matches for attribute specifies the matching characteristics of the represented attribute. The Behaviour attribute specifies the behaviour associated with the represented attribute. The Parameters attribute identifies the parameters associated with the represented attribute. The Optionally registered as attribute contains the object identifier of the represented attribute or null if no identifier has been assigned.

The Directory auxiliary class Attribute group template is defined for inclusion in Directory entries of Directory structural class Registered information and represents the GDMO attribute group specifications. It must contain the attributes Group elements, Fixed, Description and Registered as. The Group elements attribute specifies the elements of the represented attribute group. The Fixed attribute identifies the represented attribute group as being fixed or dynamic. The Description attribute contains the description of the represented attribute group. The Registered as attribute contains the object identifier of the represented attribute group.

The Directory auxiliary class Behaviour template is defined for inclusion in Directory entries of Directory structural class Registered information and represents the GDMO behaviour specifications. It must contain the attribute Defined as that specifies the behaviour definition.

The Directory auxiliary class Action template is defined for inclusion in Directory entries of Directory structural class Registered information and represents the GDMO action specifications. It must contain the attributes Behaviour, Mode confirmed, Parameters, With information syntax, With reply syntax and Registered as.

The Behaviour attribute specifies the behaviour associated with the represented action. The Mode confirmed attribute identifies the action as being confirmed or not. The Parameters attribute identifies the parameters associated with the represented action. The With information syntax attribute specifies the syntax of the action argument while the With reply syntax attribute contains the syntax of the action reply. The Registered as attribute contains the object identifier of the represented action.

The Directory auxiliary class Notification template is defined for inclusion in Directory entries of Directory structural class Registered information and represents the GDMO notification specifications. It must contain the attributes Behaviour, Mode confirmed, Parameters, With information syntax, And attribute Id's, With reply syntax and Registered as.

The Behaviour attribute specifies the behaviour associated with the represented notification. The Mode confirmed attribute identifies the notification as being confirmed or not. The Parameters attribute identifies the parameters associated with the represented notification. The With information syntax attribute specifies the syntax of the notification argument while the With reply syntax attribute contains the syntax of the notification reply. The And attribute Id's attribute specifies the assignments of attributes to fields of the notification's argument. The Registered as attribute contains the object identifier of the represented notification.

The Directory auxiliary class ASN.1 module is defined for inclusion in Directory entries of Directory structural class Registered information and represents the contents of an ASN.1 module. It must contain the attributes Module reference, ASN.1 module contents, Optionally registered as and ASN.1 version. The Module reference attribute identifies the name of the ASN.1 module. The ASN.1 module contents attribute holds the ASN.1 module contents in textual form. The ASN.1 version attribute identifies the version or versions of ASN.1 compilers that should be able to parse this module. The Optionally registered as attribute contains the object identifier of the represented ASN.1 module or null if no identifier has been assigned.

9 Service definition

9.1 Introduction

This function provides action services.

9.2 Management knowledge managed objects

The PT-GET service can be used to retrieve information pertaining to management knowledge managed objects.

9.3 Notification services

No notifications are defined in this Recommendation | International Standard.

9.4 Action services

9.4.1 Get textual representation service definition

The get textual representation service maps onto the CMIS M-ACTION service as follows.

The get textual representation service uses the parameters defined in 8.3.1 in addition to the general M-ACTION service parameters defined in CCITT Rec. X.710 and ISO/IEC 9595. Table 3 lists the parameters for this service.

Table 3 – Get textual representation service

Parameter name	Req/Ind	Rsp/Cnf
Invoke identifier	P	P
Linked identifier	–	P
Mode	P	–
Base object class	P	–
Base object instance	P	–
Scope	P	–
Filter	P	–
Managed object class	–	P
Managed object instance	–	P
Access control	P	–
Synchronization	P	–
Action type	M	C(=)
Action Information		
Attribute Id	M	–
Action result	–	M
Textual representation	–	M
Attribute not available this action	–	U
Errors	–	U (Note)
NOTE – If the response does not fit into a single PDU (e.g. if linked replies cannot be used), the CMIP error “ComplexityLimitation” may be returned.		

9.4.2 Management information tree search service definition

The management information tree search service maps onto the CMIS M-ACTION service as follows.

The management information tree search service uses the parameters defined in 8.3.2 in addition to the general M-ACTION service parameters defined in CCITT Rec. X.710 | ISO/IEC 9595. Table 4 lists the parameters for this service.

Table 4 – Management information tree search service

Parameter name	Req/Ind	Rsp/Cnf
Invoke identifier	P	P
Linked identifier	–	P
Mode	P	–
Base object class	P	–
Base object instance	P	–
Scope	P	–
Filter	P	–
Managed object class	–	P
Managed object instance	–	P
Access control	P	–
Synchronization	P	–
Action type	M	C(=)
Action Information		
Base	M	–
Discovery scope	M	–
Class request	U	–
Action result	–	M
Rooted name tree	–	M
Root object	–	M
Class of root	–	C (Note 1)
Subordinates	–	U
RDN	–	M
Managed object class (for subordinate)	–	C (Note 1)
Errors	–	U (Note 2)
NOTES 1 The managed object class of the root of the name tree and the managed object class of each subordinate in that tree shall be specified if the Class request parameter is true in the management information tree search service request; otherwise, the managed object class of the root of the name tree and the managed object class of each subordinate shall be omitted from the action response. 2 If the response does not fit into a single PDU (e.g. if the discovery scope is large and linked replies cannot be used), the CMIP error “ComplexityLimitation” may be returned.		

9.5 Directory services

The Directory read and search operations can be used to retrieve information pertaining to management knowledge Directory objects.

10 Systems management functional units

This Recommendation | International Standard specifies no functional units. The managed object classes defined here provide specifications for a managed system to disseminate knowledge of its repertoire of capabilities, its management information definitions and its managed objects.