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DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS

OSI MANAGEMENT

INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION – SYSTEMS MANAGEMENT: CHANGE OVER FUNCTION

ITU-T Recommendation X.751

(Previously “CCITT Recommendation”)

FOREWORD

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. Some 179 member countries, 84 telecom operating entities, 145 scientific and industrial organizations and 38 international organizations participate in ITU-T which is the body which sets world telecommunications standards (Recommendations).

The approval of Recommendations by the Members of ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, 1993). In addition, the World Telecommunication Standardization Conference (WTSC), which meets every four years, approves Recommendations submitted to it and establishes the study programme for the following period.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC. The text of ITU-T Recommendation X.751 was approved on 21st of November 1995. The identical text is also published as ISO/IEC International Standard 10164-17.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized private operating agency.

ITU-T X-SERIES RECOMMENDATIONS

DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS

(February 1994)

ORGANIZATION OF X-SERIES RECOMMENDATIONS

Subject area	Recommendation Series
PUBLIC DATA NETWORKS	
Services and Facilities	X.1-X.19
Interfaces	X.20-X.49
Transmission, Signalling and Switching	X.50-X.89
Network Aspects	X.90-X.149
Maintenance	X.150-X.179
Administrative Arrangements	X.180-X.199
OPEN SYSTEMS INTERCONNECTION	
Model and Notation	X.200-X.209
Service Definitions	X.210-X.219
Connection-mode Protocol Specifications	X.220-X.229
Connectionless-mode Protocol Specifications	X.230-X.239
PICS Proformas	X.240-X.259
Protocol Identification	X.260-X.269
Security Protocols	X.270-X.279
Layer Managed Objects	X.280-X.289
Conformance Testing	X.290-X.299
INTERWORKING BETWEEN NETWORKS	
General	X.300-X.349
Mobile Data Transmission Systems	X.350-X.369
Management	X.370-X.399
MESSAGE HANDLING SYSTEMS	X.400-X.499
DIRECTORY	X.500-X.599
OSI NETWORKING AND SYSTEM ASPECTS	
Networking	X.600-X.649
Naming, Addressing and Registration	X.650-X.679
Abstract Syntax Notation One (ASN.1)	X.680-X.699
OSI MANAGEMENT	X.700-X.799
SECURITY	X.800-X.849
OSI APPLICATIONS	
Commitment, Concurrency and Recovery	X.850-X.859
Transaction Processing	X.860-X.879
Remote Operations	X.880-X.899
OPEN DISTRIBUTED PROCESSING	X.900-X.999

CONTENTS

		Page
1	Scope	1
2	Normative references	1
	2.1 Identical Recommendations | International Standards	2
	2.2 Paired Recommendations | International Standards	2
3	Definitions	3
	3.1 Basic reference model definitions	3
	3.2 Service convention definitions	3
	3.3 Management framework definitions	3
	3.4 Systems management overview definitions	3
	3.5 Common management information service definitions	3
	3.6 Management information model definitions	4
	3.7 OSI conformance testing definitions	4
	3.8 Implementation conformance statement proforma definitions	4
	3.9 Attributes for representing relationships definitions	4
	3.10 General relationship model definitions	4
	3.11 Additional definitions	5
4	Symbols and abbreviations	5
5	Conventions	5
6	Requirements	6
7	Model	6
	7.1 Change over relationship	6
	7.2 Conditions over the change over relationship	8
	7.3 Change over operations	9
8	Generic definitions	11
	8.1 Management information required for change over function	11
	8.2 Managed relationship classes	11
	8.3 Managed object classes	13
	8.4 Packages	14
	8.5 Attributes	16
	8.6 Action definitions	16
	8.7 Parameter definitions	19
9	Service definition	20
	9.1 Change over request service	20
	9.2 Change back request service	20
10	Functional units	22
11	Protocol	22
	11.1 Elements of procedure	22
	11.2 Negotiation of the functional unit	22
12	Relationship with other functions	23
13	Conformance	23
	13.1 Static conformance	23
	13.2 Dynamic conformance	23
13.3	Management implementation conformance statement requirements	23

Page

Annex A – Management information definitions 24

Annex B – Abstract syntax definitions 29

Annex C – MCS proforma 31

Annex D – MIS proforma 37

Annex E – MOCS proforma 41

Annex F – MRCS proforma for relationship model 49

Annex G – MIDS(action) proforma 51

Annex H – Introduction of change over relationship 52

Summary

This Recommendation | International Standard provides a model for characterizing the relationship between resources in terms of the way one or more resources may provide a back-up role for other resources. This includes the hot/cold standby concept and the associated aspects of primary and secondary back-up. The capability to manage the relationships is provided, for example, to allow a system to issue a request to another system to change over the resources acting in a back-up role or to change back. The relationships and requests are defined in terms of the managed objects representing the resources.

Introduction

This Recommendation | International Standard is developed according to ITU-T Rec. X.200 | ISO/IEC 7498-1 and ITU-T Rec. X.700 | ISO/IEC 7498-4. This Recommendation | International Standard is related to the following Recommendations | International Standards:

– CCITT Rec. 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 Rec. X.711 (1991), *Common management information protocol specification for CCITT applications.*

  ISO/IEC 9596-1:1991, *Information technology – Open Systems Interconnection – Common management information protocol – Part 1: Specification.*

– CCITT Rec. X.701 (1992) | ISO/IEC 10040:1992, *Information technology – Open Systems Interconnection – Systems management overview.*

– CCITT Rec. X.720-Series | ISO/IEC 10165, *Information technology – Open Systems Interconnection – Structure of management information.*

OSI management standardization inevitably involves coordinated work by a number of standards bodies. ITU-T SG 7 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 groups, in ITU-T, 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.

INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION – SYSTEMS MANAGEMENT: CHANGE OVER FUNCTION

1 Scope

This Recommendation | International Standard defines a systems management function which may be used by an application in a centralized or decentralized management environment to interact for the purpose of systems management as defined by CCITT Rec. X.700 | ISO/IEC 7498-4. This Recommendation | International Standard defines services for managing one to one back-up relationships and specifies a set of generic definitions. It is positioned in the application layer of 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 are described by CCITT Rec. X.701 | ISO/IEC 10040.

This Recommendation | International Standard:

- establishes user requirements for the service definition needed to support the change over function;
- establishes models that relate the service provided by the function to the user requirements;
- defines the services provided by the function;
- defines a managed relationship class documented in accordance with ITU-T Rec. X.725 | ISO/IEC 10165-7;
- defines managed object classes and associated management information in accordance with CCITT Rec. X.722 | ISO/IEC 10165-4;
- specifies the protocol that is necessary in order to provide the services;
- defines the relationship between the service and management operations;
- specifies the conformance requirements;
- specifies the ICS proforma for this function documented in accordance with ITU-T Rec. X.724 | ISO/IEC 10165-6 and ITU-T Rec. X.725 | ISO/IEC 10165-7.

This Recommendation | International Standard does not:

- define the nature of any implementation intended to provide this function;
- specify the manner in which management is accomplished by the user of this function;
- define the nature of any interactions that result in the use of this function;
- specify the services necessary for the establishment, normal and abnormal release of a management association;
- define relationship mappings that are dependent on the implementation of this function.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation and 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 listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunications Standardization Bureau of the ITU maintains a list of currently valid CCITT and ITU-T Recommendations.

2.1 Identical 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.*
- 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...[1)], *Information technology – Open Systems Interconnection – Structure of management information: General Relationship Model.*
- CCITT Recommendation X.730 (1992) | ISO/IEC 10164-1:1993, *Information technology – Open Systems Interconnection – Systems management: Object management function*.
- CCITT Recommendation X.731 (1992) | ISO/IEC 10164-2:1993, *Information technology – Open Systems Interconnection – Systems management: State management function.*
- CCITT Recommendation X.732 (1992) | ISO/IEC 10164-3:1993 *Information technology – Open Systems Interconnection – Systems management: Attributes for representing relationships.*
- CCITT Recommendation X.734 (1992) | ISO/IEC 10164-5:1993, *Information technology – Open Systems Interconnection – Systems management: Event report management function.*

2.2 Paired Recommendations | International Standards

- 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).*
- ITU-T Recommendation X.290 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – General concepts.*

  ISO/IEC 9646-1:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 1: General concepts.*
- ITU-T Recommendation X.291 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T 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.*

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1) To be published.

– CCITT Recommendation X.700 (1992), *Management framework for Open Systems Interconnection (OSI) for CCITT applications*.

  ISO/IEC 7498-4:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 4: Management framework*.

– CCITT Recommendation X.710 (1991), *Common management information service definition for CCITT applications.*

  ISO/IEC 9595:1991, *Information technology – Open Systems Interconnection – Common management information service definition.*

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 term defined in ITU-T Rec. X.200 | ISO 7498-1:

– systems management.

3.2 Service convention definitions

This Recommendation | International Standard makes use of the following term defined in ITU-T Rec. X.210 | ISO/IEC 10731:

– primitive.

3.3 Management framework definitions

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

– managed object.

3.4 Systems management overview definitions

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

a) managed object class;

b) Managed Object Conformance Statement (MOCS);

c) Management Information Conformance Statement (MICS);

d) MICS proforma;

e) MOCS proforma;

f) MIS-User;

g) notification;

h) (systems management) operation.

3.5 Common management information service definitions

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

– attribute.

3.6 Management information model definitions

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

a) behaviour;

b) characteristic;

c) inheritance;

d) invariant;

e) post-condition;

f) pre-condition;

g) specialization;

h) subclass;

i) superclass;

j) packages.

3.7 OSI conformance testing definitions

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

a) system conformance statement;

b) PICS proforma;

c) protocol implementation conformance statement.

3.8 Implementation conformance statement proforma definitions

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

a) Managed Relationship Conformance Statement (MRCS);

b) Management Conformance Summary (MCS);

c) Management Information Definition Statement (MIDS) proforma;

d) MCS proforma;

e) MRCS proforma.

3.9 Attributes for representing relationships definitions

This Recommendation | International Standard makes use of the following terms as defined in CCITT Rec. X.732 | ISO/IEC 10164-3:

a) fallback relationships;

b) back-up relationships.

3.10 General relationship model definitions

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

a) managed relationship;

b) managed relationship class;

c) relationship cardinality;

d) role;

e) role cardinality;

f) role cardinality constraint.

3.11 Additional definitions

3.11.1 change over relationship: A managed relationship that can control a managed object to back up another managed object and to terminate this back-up.

3.11.2 change over action: A management operation that causes a managed object to back up another managed object.

3.11.3 change back action: A management operation that causes a managed object backing up another managed object to terminate the back-up.

4 Symbols and abbreviations

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

ASN.1	Abstract Syntax Notation One
CMIS	Common Management Information Service
CMISE	Common Management Information Service Element
Cnf	Confirm
ICS	Implementation Conformance Statement
Ind	Indication
MAPDU	Management Application Protocol Data Unit
MCS	Management Conformance Summary
MICS	Management Information Conformance Statement
MIDS	Management Information Definition Statement
MOCS	Managed Object Conformance Statement
MRCS	Managed Relationship Conformance Statement
PICS	Protocol Implementation Conformance Statement
Req	Request
Rsp	Response
SMAPM	Systems Management Application Protocol Machine

5 Conventions

This Recommendation | International Standard defines services for establishing and terminating change over relationship following the descriptive conventions defined in ITU-T Rec. X.210 | ISO/IEC 10731.

The following notation is used in this Recommendation | International Standard service parameter tables:

M The parameter is mandatory

(=) The value of the parameter is equal to the value of the parameter in the column to the left

U The use of the parameter is a Service-user option

– The parameter is not present in the interaction described by the primitive concerned

C The parameter is conditional

P The parameter is subject to the constraints imposed by CCITT Rec. X.710 | ISO/IEC 9595

6 Requirements

There is a requirement:

- to standardize the management where the change over relationship is manageable;
- to provide for the identification of the change over relationship;
- to allow a managing system to control the change over relationship;
- to provide for control of the provision of the change over relationship.

7 Model

7.1 Change over relationship

The change over relationship is a composition of the fallback and back-up relationships described in CCITT Rec. X.732 | ISO/IEC 10164-3 that allow one managed object to back up another managed object and to release this back-up. A managed object participating in this relationship with back-up control functionality can initiate the back-up as a result of receiving a change over action and can release the back-up as a result of receiving a change back action.

7.1.1 Composition of fallback and back-up relationships

CCITT Rec. X.732 | ISO/IEC 10164-3 defines two types of relationships: fallback and back-up. As described in CCITT Rec. X.732 | ISO/IEC 10164-3, it is assumed that managed objects subject to back-up control are participating in a fallback relationship. When a managed object is backed up by another managed object, a back-up relationship is established. When the managed object is released from the back-up, the back-up relationship is terminated.

Resources are often configured to provide *back-up capability* to achieve availability goals. A *primary* resource may have one or more designated *secondary* resources, which can provide back-up capability for the primary resource. The back-up capability can be provided, for example, when the primary resource is administratively prohibited from use (i.e. the administrative state is locked) or when it becomes inoperable (i.e. the operational state is disabled).

A secondary resource that is able to provide back-up capability for a primary resource, without the need for initialization activity is defined as being in a *hot standby state*. A secondary resource that requires initialization activity before it can provide back-up capability is defined as being in a *cold standby state*.

The potential to provide back-up capability is represented by the *fallback* relationship. The primary object represents the resource that is to be *backed up*; the secondary object represents the resource that can provide *back-up* capability.

The fallback relationship may be one-way. A primary object could have an attribute that lists its secondary objects, but the secondary objects need not “point back” to the primary object. Similarly, a secondary object could have an attribute that lists its primary objects, but the primary objects need not point back to the secondary object. In some cases, neither the primary object nor the secondary object may have the knowledge of when back-up capability should be provided. A third object is needed that can be requested to establish the back-up relationship.

Considering that the existence of a fallback relationship is the precondition for establishing a back-up relationship, the change over relationship is defined as the composition of the fallback and back-up relationships.

7.1.2 Roles in change over relationship

A managed object being backed up participates in the primary role of the change over relationship and a managed object doing back-up participates in the secondary role of the relationship. These roles are characterized by the following managed object classes,

- primary-backed-up managed object class; and
- secondary-back-up managed object class, respectively.

Any other managed object class that is compatible with the above object classes could participate in the corresponding role.

A managed object in the primary role may have the secondary attribute containing names of managed objects (one of which does back-up). A managed object in the secondary role may have the primary attribute containing names of managed objects (one of which is backed-up). The role cardinality of primary role and secondary roles are (1..1) and (1..n), respectively. The relationship cardinality of primary role and secondary role are (1..1) and (1..n), respectively.

A backed-up managed object participates in the backed-up role, a back-up managed object participates in the back-up role, and a managed object controlling this back-up participates in the change over control role. These roles are characterized by the following compatible managed object classes:

- primary-backed-up managed object class;
- secondary-back-up managed object class; and
- change over control object class.

A managed object in the backed-up role may have the back-up object attribute to contain the name of a managed object which participates in the back-up role of this relationship. A managed object in the back-up role may have the backed-up object attribute to contain the name of a managed object which participates in the backed-up role of this relationship. A managed object in the backed-up role must fulfill the primary role while a managed object in the back-up role must fulfill the secondary role. The role cardinality of both the back-up and the backed-up roles is (0..1). The relationship cardinality of both the back-up and the backed-up roles is (0..1). When the role cardinalities of both the back-up and backed-up roles have the value of "0", it implies that this relationship is not backing up. The role cardinality of the change over control role is (1..1) and its relationship cardinality is constrained to (1..1) in order to avoid complexity of this model.

Figure 1 depicts the change over relationship among managed objects participating in the roles. Only a managed object in the primary role can participate in the backed-up role, while any of the managed objects in the secondary role can participate in the back-up role. The managed object in the change over control role is coordinating the change over relationship. Object entry to the backed-up and back-up roles and object departure from backed-up and back-up roles are controlled by the managed object in the change over control role. A managed object in the change over control role may also participate in other roles in the relationship.

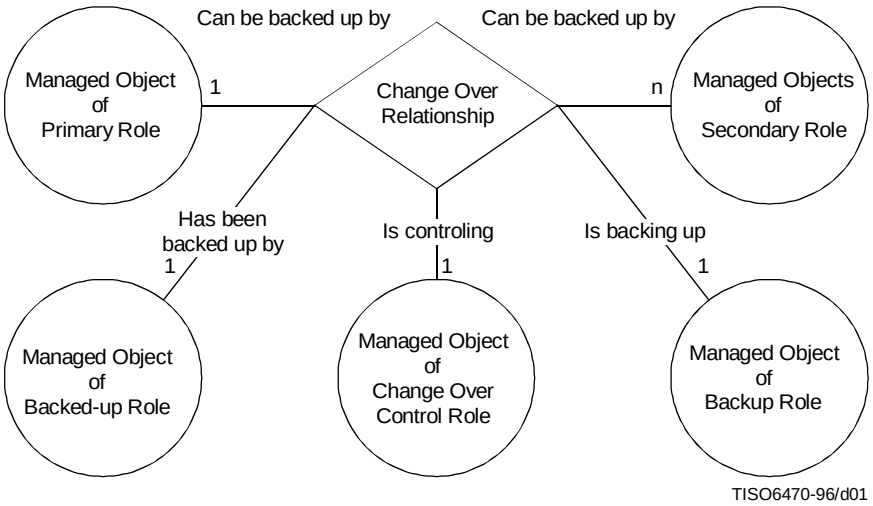

Figure 1 – Change over relationschip among managed objects

7.1.3 Attributes in change over relationship

The following attributes are used to represent the change over relationship in compatible managed objects characterizing roles of the relationship: 1) - 4) are defined in CCITT Rec. X.732 | ISO/IEC 10164-3.

1) *Primary Attribute:* This attribute lists the prioritized object instances which are primary objects from a managed object in the secondary role. Each value in this attribute list represents a distinct change over relationship instance (i.e. the relationship cardinality for a secondary object is the number of values in this list).

2) *Secondary Attribute:* This attribute lists the prioritized object instances which are secondary objects from a managed object in the primary role.

3) *Backed-up Object Attribute:* This attribute indicates the managed object which is backing up the managed object in the backed-up role. This attribute takes the value "NULL" or the name of an object instance.

4) *Back-up Object Attribute:* This attribute indicates the managed object which is backed up by the managed object in the back-up role. This attribute takes the value “NULL” or the name of an object instance.

5) *Primary Object Attribute:* This attribute indicates the managed object subject to change over control in the managed object in the change over control role. This attribute always takes the name of an object instance.

7.2 Conditions over the change over relationship

The change over relationship handles the nine possible combinations of one-way and reciprocal relationships of the fallback and back-up relationships as described in CCITT Rec. X.732 | ISO/IEC 10164-3. Table 1 indicates the possible relationship combinations. The attributes supported by role participants vary depending on combinations indicated in Table 1.

Table 1 – Possible combinations in the change over relationship

		Fallback relationship		
		Primary to secondary one-way	Secondary to primary one-way	Reciprocal
Back-up relationship	Backed-up to back-up one-way	Type 1	Type 4	Type 7
	Back-up to backed-up one-way	Type 2	Type 5	Type 8
	Reciprocal	Type 3	Type 6	Type 9

Table 2 depicts the requirements for participants to support the change over relationship related attributes. For each combination type, the participants fulfilling a role in the change over relationship must have the attributes indicated in the corresponding cell of the table.

Table 2 – Attribute support requirements for role participants

Combination type	Primary role	Secondary role	Backed-up role	Back-up role	Control role
1	Ss	–	B	–	P
2	Ss	–	–	Bd	P, B
3	Ss	–	B	Bd	P
4	–	Ps	B	–	P, Ss
5	–	Ps	–	Bd	P, B, Ss
6	–	Ps	B	Bd	P, Ss
7	Ss	Ps	B	–	P
8	Ss	Ps	–	Bd	P, B
9	Ss	Ps	B	Bd	P

Ss Secondary Attribute
Ps Primary Attribute
B Back-up Object Attribute
Bd Backed-up Object Attribute
P Primary Object Attribute

Table 3 indicates the attributes being supported by the compatible managed object class and whether the managed object in the primary role or the secondary role can also participate in the change over control role. Accordingly, when the fallback relationship is reciprocal or one-way from the primary to the secondary and the back-up relationship is reciprocal or one-way from backed-up to back-up, the managed object in the primary role is allowed to participate in the change over control role by fulfilling the role requirements. When the fallback relationship is reciprocal or one-way from the secondary to the primary and the back-up relationship is reciprocal or one-way from the back-up to the backed-up, the managed object in the secondary role is allowed to participate in the change over control role by fulfilling the role requirements.

Table 3 – Attribute support requirements for compatible object classes

Combination type	Primary-Backed-up Object	Secondary-Back-up Object	Control Object	Control role participation
1	Ss, B	–	P	Primary participant
2	Ss	Bd	P, B	–
3	Ss, B	Bd	P	Primary participant
4	B	Ps	P, Ss	–
5	–	Ps, Bd	P, B, Ss	Secondary participant
6	B	Ps, Bd	P, Ss	Secondary participant
7	Ss, B	Ps	P	Primary participant
8	Ss	Ps, Bd	P, B	Secondary participant
9	Ss, B	Ps, Bd	P	Primary participant Secondary participant

Ss Secondary Attribute
B Back-up Object Attribute
Bd Backed-up Object Attribute
Ps Primary Attribute
P Primary Object Attribute

7.3 Change over operations

7.3.1 Change over operations for change over relationship

7.3.1.1 Change over action

An MIS-User can request that back-up capability be provided via the *change over* action. This operation is directed to a managed object in the change over control role. The managed object participating in the change over control role must verify that the preconditions of the change over action are met, perform any necessary initialization activity, and ensure that the postconditions of the change over action will be met.

The change over action can be requested only in the confirmed mode. It has the following parameters:

– **primary**: The managed object that is in the primary role. This is the managed object that is to be backed up. This argument must be specified to confirm the managed object to be backed up. The managed object specified by this argument must be bound in the primary role. In addition, this parameter specifies any further changes that are to be made to the attributes of the specified managed object as part of the change over action as it assumes the backed-up object role.

– **secondary**: The managed object that is in the secondary role. If this argument is present, the specified object must be bound to the secondary role of the relationship with the primary resource. If this argument is not present, a managed object will be selected according to the priorities for objects in the secondary role, as specified in the “secondary” attribute in the object in the primary role or change over control role. In addition, this parameter specifies any further changes that are to be made to the attributes of the specified object as part of the change over action as it assumes the back-up role.

7.3.1.2 Change back action

An MIS-User can request that back-up capability be terminated via the change back action. This action is directed to the managed object participating in the change over control role. The managed object in the change over control role must verify that the preconditions of the change back action are met and perform any necessary initialization activity, ensuring that the postconditions of the change back action will be met.

The change back action can be requested only in the confirmed mode. It has the following parameters:

- **backedUpObject**: The managed object that is participating in the backed-up role. This argument must be specified. In addition, this parameter specifies any changes that are to be made to the attributes of the backed-up object as part of the change back action as it leaves the backed-up role.

- **backUpObject**: The managed object that is acting in the back-up role. This argument is optional. In addition, this parameter specifies any further changes that are to be made to the attributes of the back-up object as part of the change back action as it leaves the back-up role.

7.3.2 Change over function model

Figure 2 depicts a change over function model. The change over and change back actions are directed to the managed object compatible with the change over control managed object. The managed object compatible with the primary-backed-up managed object can fulfill the primary role and the backed-up role of the relationship. Managed objects compatible with the secondary-back-up managed object can fulfill the secondary role, any one of which can fulfill the back-up role. The managed object fulfills the back-up role back-ups the managed object of the primary role as a result of a change over action. The managed object fulfilling the back-up role terminates back-up of the managed object in the backed-up role as the result of a change back action.

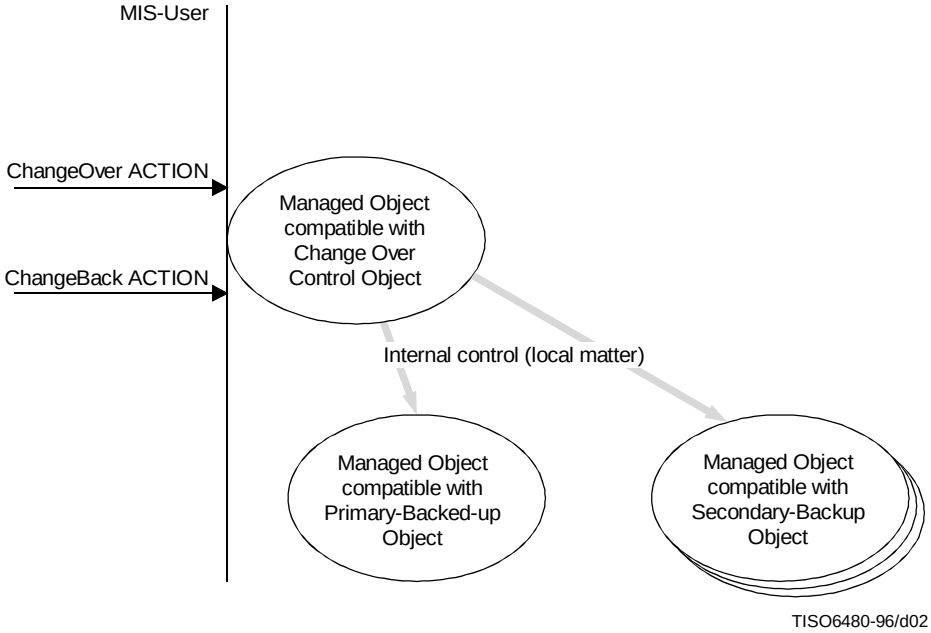

Figure 2 – Change over function model

Change over functions use instances of the change over relationship to perform the back-up. The following are relationship operations for the change over relationship.

ESTABLISH operation establishes an instance of the change over relationship. It does not have any preconditions. The postconditions of ESTABLISH operation are the existence of one managed object in the primary role, one managed object in the change over control and at least one managed object in the secondary role.

BIND to back-up role or BIND to backed-up role operation establishes the back-up. The preconditions of this relationship operation are that no object is fulfilling the back-up and backed-up roles, the managed object to be backed up fulfills the primary role and the managed object subject to back-up fulfills the secondary role. The postconditions of this relationship operation are that one managed object fulfills both the backed-up and secondary roles and another managed object fulfills both the back-up and secondary roles.

UNBIND from back-up role or UNBIND from backed-up role operation releases the back-up. The preconditions of this relationship operation are that one object is fulfilling the back-up role and one object is fulfilling the backed-up role. The postconditions of this relationship operation are that no object is fulfilling the back-up and backed-up roles.

BIND to secondary role operation binds at least one managed object to the secondary role. It does not have any preconditions. The postconditions of this relationship operation are that the number of managed objects fulfilling the secondary role is increased by at least one.

UNBIND from secondary role operation unbinds at least one managed object from the secondary role. The preconditions of this relationship operation are that at least two managed objects are participating in the secondary role. The postconditions of this relationship operation are that the unbound managed object does not exist in the secondary role and that at least one participant exists in the secondary role.

TERMINATE operation deletes an instance of change over relationship. It does not have any preconditions. The postconditions of this relationship operation are that the existence of the relationship instance ends.

The change over action defined in the change over control managed object class can be mapped to “BIND to backed-up” or “BIND to back-up” relationship operations.

The change back action conditionally defined in the change over control managed object class can be mapped to “UNBIND from backed-up” or “UNBIND from back-up” relationship operations.

8 Generic definitions

8.1 Management information required for change over function

To define management information for the change over function, a managed relationship, managed objects, packages, attributes and management actions are defined.

8.2 Managed relationship classes

8.2.1 Change over managed relationship class

8.2.1.1 Relationship description

The change over relationship is the composition of the fallback relationship and the back-up relationship and provides the back-up control function that makes a managed object that is fallbacked by one or more managed objects to be backed up by one of the fallbacking managed object based upon receiving the change over operation. The semantics of the fallback relationship and the back-up relationship is used to describe this relationship.

The semantics of fallback relationship is defined in 7.3.3 of CCITT Rec. X.732 | ISO/IEC 10164-3, as follows:

“A fallback relationship is an asymmetric relationship denoting that the second of a pair of managed objects (the secondary object) has been designated as a fallback or “next preferred choice” to the first managed object (the primary object). The existence of a fallback relationship implies that the secondary resource is capable of providing Back-up service to the primary resource if the latter is unable to fulfill its function. It does not necessarily imply that the secondary resource is currently active and performing its Back-up function in place of the primary resource.

Primary and secondary are two roles in a fallback relationship. A one-way fallback relationship exists if a managed object designates a second managed object to be in the secondary role, or if the second managed object designates the first managed object to be in the primary role. A reciprocal fallback relationship exists if both managed objects designate each other to be in the complementary roles.

The order of preference in which the secondary objects are selected to provide Back-up service to the primary object is expressed as a priority value attached to each secondary object.

The order of preference in which primary objects are selected for the provision of Back-up service by the secondary object is expressed as a priority value attached to each primary object."

The semantics of the back-up relationship is defined in 7.3.4 of CCITT Rec. X.732 | ISO/IEC 10164-3, as follows:

"A back-up relationship is an asymmetric relationship denoting that the second of a pair of managed objects (the back-up object) is currently active and performing a back-up function in place of the first managed object (the backed-up object).

Back-up object and backed-up object are two roles in a back-up relationship. A one-way back-up relationship exists if a managed object designates a second managed object to be in the back-up role, or if the second managed object designates the first managed object to be in the backed-up role. A reciprocal back-up relationship exists if both managed objects designate each other to be in the complementary roles.

A back-up relationship is created as a result of a pre-existing fallback relationship between two managed objects. The back-up relationship comes into existence when the backed-up resource is not fulfilling its function, and the back-up resource is activated to provide the same service. The back-up resource ceases to provide that service. Creation and deletion of the back-up relationship has no effect on the existence of the fallback relationship between the two managed objects.

A backed-up object may be in the disabled or enabled operational state. The administrative state of the back-up object must be unlocked to allow the back-up relationship to exist. When a managed object is being backed up for any reason (i.e. a back-up relationship exists), the back-up object is in use as long as it is not disabled. The operational and administrative states are defined in CCITT Rec. X.731 | ISO/IEC 10164-2."

The change over managed relationship class represents the managed change over relationship between managed object classes. This managed relationship class has the following roles:

- primary role;
- secondary role;
- backed-up role;
- back-up role;
- change over control role.

This managed relationship supports the following relationship management operations:

ESTABLISH operation establishes an instance of change over relationship. It does not have any preconditions. The postconditions of ESTABLISH operation are the existence of one managed object in the primary role, one managed object in the change over control and at least one managed object in the secondary role.

BIND to back-up role or BIND to backed-up role operation establishes the back-up. The preconditions of this relationship operation are that no object is fulfilling the back-up and backed-up roles, the managed object subject to be backed up fulfils the primary role and the managed object subject to back-up fulfils the secondary role. The postconditions of this relationship operation are that one managed object fulfills both the backed-up and secondary roles and one managed object fulfills both the back-up and secondary roles.

UNBIND from back-up role or UNBIND from backed-up role operation releases the back-up. The preconditions of this relationship operation are that one object is fulfilling the back-up role and one object is fulfilling the backed-up role. The postconditions of this relationship operation are that no object is fulfilling the back-up and backed-up roles.

BIND to secondary role operation binds at least one managed object to the secondary role. It does not have any preconditions. The postconditions of this relationship operation are that the number of managed objects fulfilling the secondary role is increased by at least one.

UNBIND from secondary role operation unbinds at least one managed object from the secondary role. The preconditions of this relationship operation are that at least two managed objects are participating in the secondary role. The postconditions of this relationship operation are that the unbound managed object does not exist in the secondary role and at least one participant exists in the secondary role.

TERMINATE operation deletes an instance of change over relationship. It does not have any preconditions. The postconditions of this relationship operation are the non-existence of the relationship instance.

QUERY operation obtains the information regarding the change over relationship. It does not have any preconditions and postconditions.

The change over action defined in the change over control managed object class can be mapped to “BIND to backed-up” or “BIND to back-up” relationship operation.

The change back action conditionally defined in the change over control managed object class can be mapped to "UNBIND from backed-up" or "UNBIND from back-up" relationship operation.

8.2.1.2 Primary role

The semantics of primary role is defined in 7.3.3 of CCITT Rec. X.732 | ISO/IEC 10164-3.

The primary role for the change over managed relationship is characterized by the following compatible object:

– primary-backed-up object.

The required role cardinality of this role is (1..1) and the permitted relationship cardinality of the participant is (1..1).

8.2.1.3 Secondary role

The semantics of secondary role is defined in 7.3.3 of CCITT Rec. X.732 | ISO/IEC 10164-3.

The secondary role for the change over managed relationship is characterized by the following compatible object:

– secondary-back-up object.

This role supports “bind secondary” and “unbind secondary” operations.

The required role cardinality of this role is (1..n) and the permitted relationship cardinality of the participant is (1..n).

8.2.1.4 Backed-up role

The semantics of backed-up role is defined in 7.3.4 of CCITT Rec. X.732 | ISO/IEC 10164-3.

The backed-up role for the change over managed relationship is characterized by the following compatible object:

– primary-backed-up object.

The participant in this role has to be the participant in the primary role.

This role supports “bind backed-up” and “unbind backed-up” operations.

The required role cardinality of this role is (1..1) and the permitted relationship cardinality of the participant is (1..1).

8.2.1.5 Back-up role

The semantics of back-up role is defined in 7.3.4 of CCITT Rec. X.732 | ISO/IEC 10164-3.

The back-up role for the change over managed relationship is characterized by the following compatible object:

– secondary-back-up object.

The participant in this role has to have been the participant in the secondary role.

This role supports “bind back-up” and “unbind back-up” operations.

The required role cardinality of this role is (1..1) and the permitted relationship cardinality of the participant is (1..1).

8.2.1.6 Change over control role

The change over control role represents the back-up control capabilities to BIND (changeOver) and UNBIND (changeBack) a managed object in the secondary role to the back-up role in the change over relationship.

The change over control role for the change over managed relationship is characterized by the following compatible object:

– change over control object.

The required role cardinality of this role is (1..1) and the permitted relationship cardinality of the participant is (1..1).

8.3 Managed object classes

8.3.1 Primary-backed-up object

The primary-backed-up object managed object class represents the primary-backed-up managed object that characterizes the primary and backed-up roles participant in the change over managed relationship as the compatible managed object.

This managed object class has the following mandatory package:

– primary-backedUpObjectPackage.

This managed object class has the following conditional packages:

– secondaryAttributePackage;

– backedUpObjectAttributePackage.

The secondaryAttributePackage is supported if the fallback is one-way from primary to secondary or reciprocal.

The backedUpObjectAttributePakage is supported if the back-up is one-way from backed-up to back-up or reciprocal.

8.3.2 Secondary-back-up object

The secondary-back-up object managed object class represents the secondary-back-up managed object that characterizes the secondary and back-up roles participant in the change over managed relationship as the compatible managed object.

This managed object class has the following mandatory package:

– secondary-backUpObjectPackage.

This managed object class has the following conditional packages;

– primaryAttributePackage;

– backUpObjectAttributePackage.

The primaryAttributePackage is supported if the fallback is one-way from secondary to primary or reciprocal.

The backUpObjectAttributePackage is supported if the back-up is one-way from back-up to backed-up or reciprocal.

8.3.3 Change over control object

The change over control object managed object class represents the change over control managed object that characterizes the change over control role participant in the change over managed relationship as the compatible managed object.

This managed object class has the following mandatory package:

– changeOverObjectPackage;

– changeOverActionPackage.

This managed object class has the following conditional packages:

– secondaryAttributePackage;

– backUpObjectAttributePackage;

– changeBackActionPackage.

The secondaryAttributePackage is supported if the primary-backed-up object does not support the secondary attribute.

The backUpObjectAttributePakage is supported if the primary-backed-up object does not support the back-up object attribute.

The changeBackActionPackage is supported if the managed object supports this action. But if it is not supported, the change back is a local matter.

8.4 Packages

8.4.1 Back-up object attribute package

The back-up object attribute package comprises the conditional characteristics of the primary-backed-up object. This package contains the following attribute:

– "Rec. X.721 (1992) | ISO/IEC 10165-2:1992": backUpObject.

Only the GET operation is allowed for this attribute.

8.4.2 Backed-up object attribute package

The backed-up object attribute package comprises the conditional characteristics of the secondary-back-up object. This package contains the following attribute:

– "Rec. X.721 (1992) | ISO/IEC 10165-2:1992": backedUpObject.

Only the GET operation is allowed for this attribute.

8.4.3 Change back action package

The change back action package comprises the conditional characteristics of the change over control object. This package contains the following action:

– change back action.

8.4.4 Change over action package

The change over action package comprises the mandatory characteristics of the change over control object. This package contains the following action:

– change over action.

8.4.5 Change over control object package

The change over control object package comprises the mandatory characteristics of the change over control object. This package contains the following attribute:

– primary object.

Only the GET operation is allowed for this attribute.

8.4.6 Primary attribute package

The primary attribute package comprises the conditional characteristics of the secondary-back-up object. This package contains the following attribute:

– "Rec. X.721 (1992) | ISO/IEC 10165-2:1992": primary.

The GET-REPLACE and ADD-REMOVE operations are allowed for this attribute.

8.4.7 Primary-backed-up object package

The primary-backed-up object package comprises the mandatory characteristics of the primary-backed-up object. This package contains the following attribute:

– "Rec. X.721 (1992) | ISO/IEC 10165-2:1992": operationalState.

Only the GET operation is allowed for this attribute.

8.4.8 Secondary-back-up object package

The secondary-back-up object package comprises the mandatory characteristics of the secondary-back-up object. This package contains the following attributes:

– "Rec. X.721 (1992) | ISO/IEC 10165-2:1992": administrativeState; and

– "Rec. X.721 (1992) | ISO/IEC 10165-2:1992": operationalState;

– "Rec. X.721 (1992) | ISO/IEC 10165-2:1992": standbyStatus.

The GET-REPLACE operation is allowed for the administrative state attribute.

Only the GET operation is allowed for the operational state attribute.

Only the GET operation is allowed for the standby status attribute.

8.5 Attributes

8.5.1 Primary object attribute

The primary object attribute contains a managed object name which is participating in the primary role.

8.6 Action definitions

This subclause specifies two actions that can be used to request the bind and unbind of a managed object to back up the managed object of primary role.

8.6.1 Change over action

In order to make a managed object back-up another managed object, the change over action binds a managed object in the secondary role and a corresponding managed object in the primary role to the back-up role and the backed-up role of the change over relationship, respectively.

8.6.1.1 Change over action behaviour

Invariant:

The change over action specifies the managed object to be backed up. The managed object being backed up may be specified in the action parameter, otherwise the managed object receiving the change over action chooses the managed object being backed up according to the priority condition listed in the secondary attribute. The selected secondary object has to be enabled to perform the back-up. The change over action causes the managed object specified in primary to be backed up by the managed object in the secondary role of the change over relationship.

The primaryChanges and secondaryChanges arguments allow additional changes to the primary and secondary objects. These changes are performed after the preconditions have been met.

Preconditions:

The managed object being backed up must be in the primary role of the change over relationship by identifying its name in the primaryObject attribute of change over control object.

Table 4 lists the preconditions for the change over action, in terms of attribute values in the primary-backed-up and secondary-back-up objects. A primary-backed-up object or a secondary-back-up object is not required to have all of these attributes. The conditions for having some of these attributes are described in Table 3.

Table 4 – Preconditions for change over action

Attribute	Value in primary-backed-up	Value in secondary-back-up
Primary	N/A	Must include specified primary
Secondary	Must include specified secondary, or must not be {} if a secondary is not specified in the Action	N/A
backUpObject	NULL	N/A
backedUpObject	N/A	NULL
operationalState	Enabled or disabled	Enabled or disabled
administrativeState	Any value	Unlocked
usageState*	Any value	Idle
availabilityStatus*	notInstalled must not be present	offLine must be present; if standbyStatus is hotStandby, failed, powerOff, offDuty, dependency and notInstalled must not be present
standbyStatus	N/A	hotStandby or coldStandby
NOTE – Attributes with "*" are not mandatory attributes. However, if managed objects in the role have those attributes, they must follow the conditions described in this table.		

Postconditions:

Table 5 lists the postconditions for the change over action, in terms of attribute values in the primary-backed-up and secondary-back-up objects. A primary object or a secondary object is not required to have all of these attributes (see Table 3).

Table 5 – Postconditions for change over action

Attribute	Value in primary-backed-up	Value in secondary-back-up
Primary	N/A	Must include specified primary
Secondary	Must include specified secondary, or must not be {} if a secondary is not specified in the Action	N/A
backUpObject	Name of specified secondary	N/A
backedUpObject	N/A	Name of specified primary
operationalState	Enabled or disabled	Enabled
administrativeState	Locked or unlocked	Any value
usageState*	Idle	Any value
availabilityStatus*	notInstalled must not be present, and offLine must be present	failed, powerOff, dependency, offLine, and notInstalled must not be present
standbyStatus	N/A	providingService
NOTES 1 Attributes with "*" are not mandatory attributes. However, if managed objects in the role have those attributes, they must follow the conditions described in this table. 2 As a result of change over action, no user exists in the primary-backed-up object, therefore, the administrative state of the primary-backed-up object excludes "shutting down" value, while the administrative state of the secondary-back-up object imports any value from the primary-backed-up object being backed-up.		

Errors in the change over action:

A "no such participant" error is returned if the specified primary object does not exist.

A "no such participant" error is returned if the specified secondary object does not exist.

An "already backed-up" error is returned if the specified primary object is involved in back-up.

A "change over capability absent" error is returned if the primary object has some secondary objects but the specified secondary object does not fallback the primary object.

A "no such relationships" error is returned if the secondary attribute has the empty set.

A "secondary instance unavailable" error is returned if no secondary object is able to provide back-up capability.

A "preconditions not met" error is returned if any of these preconditions are not met.

An "expected result unsatisfied" error is returned associated with the requested change information, if any of other attribute changes cannot be performed or the other attribute change violates the postconditions.

A "postconditions not met" error is returned with the information of managed objects which did not meet the postconditions, if any of these postconditions cannot be met.

Action Reply:

Since the secondary object is not always specified, the action reply identifies the secondary object.

8.6.2 Change back action

In order to terminate the back-up made between managed objects, the change back action unbinds a managed object in the backed-up role and a corresponding managed object in the back-up role of the change over relationship, respectively.

8.6.2.1 Change back action behaviour

Invariant:

The change back action specifies the managed object backed up to leave the back-up. The managed object backing up the backed-up object may be specified in the action parameter, otherwise the managed object receiving the change back action identifies the managed object backing up by the back-up object attribute. The selected back-up object terminates the back-up. The change back action causes the managed object specified in backed-up return to the non-backed-up state and the managed object departure in the back-up role.

The backedUpObjectChanges and backUpObjectChanges arguments allow additional changes to the backed-up and back-up objects. These changes are performed after the preconditions have been met.

Preconditions:

The managed object leaving the back-up must be in the backed-up role of the change over relationship by identifying its name in the primaryObject attribute of change over control object.

Table 6 lists the preconditions for the change back action, in terms of attribute values in the primary-backed-up and secondary-back-up objects. A backed-up object or a back-up object is not required to have all of these attributes. The conditions for having some of these attributes are described in Table 3.

Table 6 – Preconditions for change back action

Attribute	Value in backed-up object	Value in back-up object
backUpObject	Name of back-up object	N/A
backedUpObject	N/A	Name of backed-up object
operationalState	Enabled or disabled	Enabled
administrativeState	Locked or unlocked	Unlocked
usageState*	Idle	Any value
availabilityStatus*	notInstalled must not be present, and offLine must be present	failed, powerOff, dependency, offLine, and notInstalled must not be present
standbyStatus	N/A	providingService
NOTE – Attributes with "*" are not mandatory attributes. However, if managed objects in the role have those attributes, they must follow the conditions described in this table.		

Postconditions:

The postconditions for change back action do not include any aspects of the secondary role entry. Namely, a change back action does not imply re-entry of the back-up object in the secondary role as it was before the change over action was taken (i.e. the managed object in the back-up role may depart from the secondary role during performing the back-up).

Table 7 lists the preconditions for the change back action, in terms of attribute values in the primary-backed-up and secondary-back-up objects. A backed-up object or a back-up object is not required to have all of these attributes. The conditions for having some of these attributes are described in Table 3.

Table 7 – Postconditions for change back action

Attribute	Value in backed-up object	Value in back-up object
backUpObject	NULL	N/A
backedUpObject	N/A	NULL
operationalState	Enabled or disabled	Enabled or disabled
administrativeState	Any value	Unlocked
usageState*	Any value	Idle
availabilityStatus*	notInstalled must not be present	offLine must be present; if standbyStatus is hotStandby, failed, powerOff, offDuty, dependency and notInstalled must not be present
standbyStatus*	N/A	hotStandby or coldStandby
NOTE – Attributes with "*" are not mandatory attributes. However, if managed objects in the role have those attributes, they must follow the conditions described in this table.		

Errors in the change back action:

A "no such participant" error is returned if the backed-up object specified in the action does not exist.

A "no such participant" error is returned if the back-up object specified in the action does not exist.

A "change over capability absent" error is returned if the specified backed-up object and back-up object are not participating in the backed-up role and the back-up role of the change over relationship, respectively.

A "backed-up-back-up mismatch" error is returned with the information indicating the specified and the existing back-up and backed-up object names if the specified backed-up object and the back-up object do not correspond each other.

A "not backed-up" error is returned if the specified backed-up object is not backed up by other object.

A "preconditions not met" error is returned with the information indicating which object did not meet which preconditions, if any of preconditions are not met.

An "expected result unsatisfied" error is returned if any of other attribute changes cannot be performed or the change request violates a postcondition.

A "postconditions not met" error is returned if any of postconditions are not met. The information returned with this error specifies which objects did not meet which postconditions.

Action Reply:

No action reply information is returned for this action.

8.7 Parameter definitions

8.7.1 Already backed-up

The already backed-up parameter defines a specific error indicating that the managed object subject to backed-up is already backed up. This error returns the back-up object name.

8.7.2 Back-up-Backed-up mismatch

The back-up-backed-up mismatch parameter defines a specific error indicating that managed objects subject to change back are not in the back-up as specified. This error returns the specified and the existing back-up information.

8.7.3 Change over capability absent

The change over capability absent parameter defines a specific error indicating that the managed object specified in the change over action does not have the change over capability needed for the back-up control.

8.7.4 Expected result unsatisfied

The expected result unsatisfied parameter defines a specific error indicating that the requested action was not correctly performed. This error returns the unattainable attribute list.

8.7.5 No such participant

The no such participant parameter defines a specific error indicating that there is not a participant managed object instance specified by the action argument. This error returns the role identifier and managed object instance name specified in the action info.

8.7.6 No such relationships

The no such relationships parameter defines a specific error indicating that there is no relationships needed to control the relationship. This error returns the relationship class identifier and optionally the relationship binding identifier and relationship instance names.

8.7.7 Not backed-up

The not backed-up parameter defines a specific error indicating that the managed object subject to change back has not been backed up.

8.7.8 Postconditions not met

The postconditions not met parameter defines a specific error indicating that the postconditions needed to complete the action do not meet. This error returns the information of conditions that did not meet.

8.7.9 Preconditions not met

The preconditions not met parameter defines a specific error indicating that the preconditions needed to perform the action do not meet. This error returns the information of conditions that did not meet.

8.7.10 Secondary instance unavailable

The secondary instance unavailable parameter defines a specific error indicating that the secondary instance being a managed object in the back-up role is unable to function. This error returns the name of secondary instance that is unavailable.

9 Service definition

This clause defines services for requesting the binding and unbinding of managed objects in and from the back-up role and the backed-up role of the change over relationship.

9.1 Change over request service

The change over request service allows a manager to request that a managed object backs up other managed object.

The change over request service uses the parameters defined in clause 8 in addition to the general M-ACTION service parameters defined in CCITT Rec. X.710 | ISO/IEC 9595.

Table 8 lists the parameters of the change over request service.

9.2 Change back request service

The change back request service allows a manager to request that the back-up between managed object be terminated.

The change back request service uses the parameters defined in clause 8 in addition to the general M-ACTION service parameters defined in CCITT Rec. X.710 | ISO/IEC 9595.

Table 9 lists the parameters of the change back request service.

Table 8 – Change over request parameters

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	P
Action information	P	–
Primary	M	–
Secondary	U	–
Primary changes	U	–
Secondary changes	U	–
Current time	–	P
Action reply	–	C
Errors	–	P

Table 9 – Change back request parameters

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	P
Action information	P	–
Backed-up object	M	–
Back-up object	U	–
Backed-up object changes	U	–
Back-up object changes	U	–
Current time	–	P
Action reply	–	C
Errors	–	P

10 Functional units

Two functional units are defined in this Recommendation | International Standard for the management of change over function:

a) *Change over functional unit:* This functional unit supports only the change over request service.

b) *Change over/back functional unit:* This function unit supports both change over and change back request services.

11 Protocol

11.1 Elements of procedure

11.1.1 Manager role

11.1.1.1 Invocation

The change over (change back) procedures are initiated by the change over (change back) request primitive. On receipt of a change over (change back) request primitive, the SMAPM shall construct an MAPDU and issue a CMIS M-ACTION request service primitive with parameters derived from the change over (change back) request primitive.

11.1.1.2 Receipt of response

On receipt of a CMIS M-ACTION confirm service primitive containing an MAPDU responding to a change over (change back) action, the SMAPM shall issue a change over (change back) confirmation primitive to the change over (change back) service user with parameters derived from the CMIS M-ACTION confirm service primitive, thus completing the change over (change back) procedure.

11.1.2 Agent role

11.1.2.1 Receipt of request

On receipt of a CMIS M-ACTION indication service primitive containing an MAPDU requesting the change over (change back) service, the SMAPM shall, if the MAPDU is well formed, issue a change over (change back) indication primitive to the change over (change back) service user with parameters derived from the CMIS M-ACTION indication service primitive. Otherwise, the SMAPM shall construct an appropriate MAPDU containing action of the error, and shall issue a CMIS M-ACTION response service primitive with an error parameter present.

11.1.2.2 Response

The SMAPM shall accept a change over (change back) response primitive and shall construct an MAPDU confirming action and issue a CMIS M-ACTION response service primitive with parameters derived from the change over (change back) response primitive.

11.2 Negotiation of the functional unit

This Recommendation | International Standard assigns the following object identifier:

{joint-iso-ccitt ms(9) function(2) part17(17) functionalUnitPackage(1)}

as a value of the ASN.1 type FunctionalUnitPackageId defined in CCITT Rec. X.701 | ISO/IEC 10040 for negotiating the following functional units:

0 change over functional unit;

1 change over/back functional unit,

where the number identifies the bit position assigned to the functional unit, and the name references the functional unit defined in clause 10.

Within the Systems management application context, the mechanism for negotiating the change over functional units is described by CCITT Rec. X.701 | ISO/IEC 10040.

12 Relationship with other functions

Attributes used to define compatible managed object classes in this Recommendation | International Standard are defined in CCITT Rec. X.732 | ISO/IEC 10164-3.

13 Conformance

Implementations claiming to conform to this Recommendation | International Standard shall comply with the conformance requirements as defined in the following subclauses.

13.1 Static conformance

The implementation shall conform to the requirements of this Recommendation | International Standard in the manager role, the agent role, or both roles. A claim of conformance to at least one role shall be made in Table C.1.

If a claim of conformance is made for support in the manager role, the implementation shall support at least one management operation or action of the managed object specified by this Recommendation | International Standard. The conformance requirements in the manager role for those management operations are identified in Table C.3 and further tables referenced by Annex C.

If a claim of conformance is made for support in the agent role, the implementation shall support the change over action or one or more instances of the managed object classes identified in Table C.4 and further tables referenced by Annex C.

The implementation shall support the transfer syntax derived from the encoding rules specified in CCITT Rec. X.209 | ISO/IEC 8825 named {joint-iso-ccitt asn1(1) basicEncoding(1)} for the abstract data types referenced by the definitions for which support is claimed.

13.2 Dynamic conformance

Implementations claiming to conform to this Recommendation | International Standard shall support the elements of procedure and definitions of semantics corresponding to the definitions for which support is claimed.

13.3 Management implementation conformance statement requirements

Any MCS proforma, MICS proforma, MOCS proforma, and MRCS proforma which conforms to this Recommendation | International Standard shall be technically identical to the proformas specified in Annexes C, D, E and F preserving table numbering and the index numbers of items, and differing only in pagination and page headers.

The supplier of an implementation which is claimed to conform to this Recommendation | International Standard shall complete a copy of the Management Conformance Summary (MCS) provided in Annex C as part of the conformance requirements together with any other ICS proformas referenced as applicable from that MCS. An ICS which conforms to this Recommendation | International Standard shall:

- describe an implementation which conforms to this Recommendation | International Standard;
- have been completed in accordance with the instructions for completion given in ITU-T Rec. X.724 | ISO/IEC 10165-6;
- include the information necessary to uniquely identify both the supplier and the implementation.

Claims of conformance to the management information defined in this Recommendation | International Standard in managed object classes defined elsewhere shall include the requirements of the MIDS proforma in the MOCS for the managed object class.

Annex A

Management information definitions

(This annex forms an integral part of this Recommendation | International Standard)

A.1 Managed relationship definitions

```
changeOverRelationship  RELATIONSHIP CLASS
BEHAVIOUR changeOverRelationshipBehaviour BEHAVIOUR
DEFINED AS "See 8.2.1.1."
ROLE primaryRole
        COMPATIBLE-WITH primary-backedUpObject
        REQUIRED-ROLE-CARDINALITY-CONSTRAINT (1..1)
        PERMITTED-RELATIONSHIP-CARDINALITY-CONSTRAINT (1..1)
REGISTERED AS {part17Role 1};
ROLE secondaryRole
        COMPATIBLE-WITH secondary-backUpObject
        REQUIRED-ROLE-CARDINALITY-CONSTRAINT (1..n)
        BIND-SUPPORT            bindSecondary
        UNBIND-SUPPORT          unbindSecondary
        PERMITTED-RELATIONSHIP-CARDINALITY-CONSTRAINT (1..n)
REGISTERED AS {part17Role 2};
ROLE backedupRole
        COMPATIBLE-WITH primary-backedUpObject
        REQUIRED-ROLE-CARDINALITY-CONSTRAINT (0..1)
        BIND-SUPPORT            bindBackedup
        UNBIND-SUPPORT          unbindBackedup
        PERMITTED-RELATIONSHIP-CARDINALITY-CONSTRAINT (1..1)
REGISTERED AS {part17Role 3};
ROLE backupRole
        COMPATIBLE-WITH secondary-backUpObject
        REQUIRED-ROLE-CARDINALITY-CONSTRAINT (0..1)
        BIND-SUPPORT            bindBackup
        UNBIND-SUPPORT          unbindBackup
        PERMITTED-RELATIONSHIP-CARDINALITY-CONSTRAINT (1..1)
REGISTERED AS {part17Role 4};
ROLE changeOverControlRole
        COMPATIBLE-WITH changeOverControlObject
        REQUIRED-ROLE-CARDINALITY-CONSTRAINT (1..1)
REGISTERED AS {part17Role 5};
SUPPORTS ESTABLISH, TERMINATE, QUERY;
REGISTERED AS {part17MRelClass 1};
```

A.2 Managed object class definitions

primary-backedUpObject MANAGED OBJECT CLASS

DERIVED FROM top;

CHARACTERIZED BY primary-backedUpObjectPackage PACKAGE

BEHAVIOUR primary-backedUpObjectBehaviour BEHAVIOUR

DEFINED AS "INVARIANT: No specific characteristics are defined. POSTCONDITION: After participating in the change over relationship, this managed object plays the primary role and the backed-up role of change over managed relationship and composes the part of the managed relationship instance.";;

ATTRIBUTES

"Rec. X.721 (1992) | ISO/IEC 10165-2:1992": operationalState GET;;

CONDITIONAL PACKAGES

secondaryAttributePackage PRESENT IF " The fallback relationship is one-way from primary to secondary or reciprocal.",

backUpObjectAttributePackage PRESENT IF " The back-up relationship is one-way from backed-up to back-up or reciprocal.";

REGISTERED AS {part17MObjectClass 1};

secondary-backUpObject MANAGED OBJECT CLASS

DERIVED FROM top;

CHARACTERIZED BY secondary-backUpObjectPackage PACKAGE

BEHAVIOUR secondary-backUpObjectBehaviour BEHAVIOUR

DEFINED AS "INVARIANT: No specific characteristics are defined. POSTCONDITION: After participating in the change over relationship, this managed object plays the secondary role and the back-up role of change over managed relationship and composes the part of the managed relationship instance.";;

ATTRIBUTES

"Rec. X.721 (1992) | ISO/IEC 10165-2:1992": administrativeState GET-REPLACE,

"Rec. X.721 (1992) | ISO/IEC 10165-2:1992": operationalState GET,

"Rec. X.721 (1992) | ISO/IEC 10165-2:1992": standbyStatus GET;;

CONDITIONAL PACKAGE

primaryAttributePackage PRESENT IF " The fallback relationship is one-way from secondary to primary or reciprocal.",

backedUpObjectAttributePackage PRESENT IF " The back-up relationship is one-way from back-up to backed-up or reciprocal.";

REGISTERED AS {part17MObjectClass 2};

changeOverControlObject MANAGED OBJECT CLASS

DERIVED FROM top;

CHARACTERIZED BY changeOverControlObjectPackage PACKAGE

BEHAVIOUR changeOverControlObjectBehaviour BEHAVIOUR

DEFINED AS " INVARIANT: No specific characteristics are defined. POSTCONDITION: After participating in the change over relationship, this managed object plays the change over control role and controls the change over function by receiving change over operations.";;

ATTRIBUTES

primaryObject GET;;,

changeOverActionPackage;

CONDITIONAL PACKAGE

secondaryAttributePackage PRESENT IF "The primary-backed-up object does not have the secondary attribute.",

backUpObjectAttributePackage PRESENT IF "The primary-backed-up object does not have the backedUpObject attribute.";

changeBackActionPackage PRESENT IF "The managed object supports this action.";

REGISTERED AS {part17MObjectClass 3};

A.3 Package definitions

backedUpObjectAttributePackage PACKAGE

BEHAVIOUR backedupObjAttribPkgBeh BEHAVIOUR

DEFINED AS ! See CCITT Rec. X.732 | ISO/IEC 10164-3, 8.1.7 for definition of the backedUpObject attribute. The value of the attribute backedUpObject must be the managed object name of the object fulfilling the backed-up role. A back-up is absent if the value of the attribute backedUpObject is NULL.!;;

ATTRIBUTES

"Rec. X.721 (1992) | ISO/IEC 10165-2:1992": backedUpObject GET,

REGISTERED AS {part17Package 1};

backUpObjectAttributePackage PACKAGE

BEHAVIOUR backupObjAttribPkgBeh BEHAVIOUR

DEFINED AS ! See CCITT Rec. X.732 | ISO/IEC 10164-3, 8.1.6 for the definition of the backUpObject attribute. The value of the attribute backUpObject must be the managed object name of the object fulfilling the back-up role. A back-up is absent if the value of the attribute backUpObject is NULL.!;;

ATTRIBUTES

"Rec. X.721 (1992) | ISO/IEC 10165-2:1992": backUpObject GET,

REGISTERED AS {changeOverFunctionPackage 2};

changeBackActionPackage PACKAGE

BEHAVIOUR changeBackActionPackageBeh BEHAVIOUR

DEFINED AS ! See 8.6.2.1.!;;

ACTIONS

changeBack;

REGISTERED AS {part17Package 3};

changeOverActionPackage PACKAGE

BEHAVIOUR changeOverActionPackageBeh BEHAVIOUR

DEFINED AS ! See 8.6.1.1.!;;

ACTIONS

changeOver;

REGISTERED AS {part17Package 4};

primaryAttributePackage PACKAGE

ATTRIBUTES

"Rec. X.721 (1992) | ISO/IEC 10165-2:1992": primary GET-REPLACE ADD-REMOVE;

REGISTERED AS {part17Package 5};

secondaryAttributePackage PACKAGE

ATTRIBUTES

"Rec. X.721 (1992) | ISO/IEC 10165-2:1992": secondary GET-REPLACE ADD-REMOVE;

REGISTERED AS {part17Package 6};

A.4 Attribute definition

```
primaryObject ATTRIBUTE
        WITH ATTRIBUTE SYNTAX      ChangeOverASN1Productions.PrimaryObject
        MATCHES FOR EQUALITY
REGISTERED AS {part17Attribute 1}
```

A.5 Action definitions

```
changeOver ACTION
 BEHAVIOUR changeOverBehaviour          BEHAVIOUR
        DEFINED AS "See 8.6.1.1.";;
 MODE CONFIRMED;
 PARAMETERS
        noSuchParticipant,
        changeOverCapabilityAbsent,
        noSuchRelationships,
        expectedResultUnsatisfied,
        alreadyBackedUp,
        secondaryInstanceUnavailable,
        preconditionsNotMet,
        postconditionsNotMet;
 WITH INFORMATION SYNTAX ChangeOverASN1Productions.ChangeOverInfo;
 WITH RESULT SYNTAX ChangeOverASN1Productions.ObjectInstance;
REGISTERED AS {part17Action 1};
changeBack ACTION
 BEHAVIOUR changeBackBehaviour          BEHAVIOUR
        DEFINED AS "See 8.6.2.1.";
 MODE CONFIRMED;
 PARAMETERS
        noSuchParticipant,
        backup-backedup-Mismatch,
        notBackedUp,
        preconditionsNotMet,
        postconditionsNotMet;
 WITH INFORMATION SYNTAX ChangeOverASN1Productions.ChangeBackInfo;
REGISTERED AS {part17Action 2};
```

A.6 Parameter definitions

```
alreadyBackedUp   PARAMETER
 CONTEXT SPECIFIC-ERROR;
 WITH SYNTAX  ChangeOverASN1Productions.BackUpObject;
REGISTERED AS {part17Parameter 1};
```

```
backup-backedup-Mismatch  PARAMETER
  CONTEXT SPECIFIC-ERROR;
  WITH SYNTAX   ChangeOverASN1Productions.BackUpInfo;
REGISTERED AS {part17Parameter 2};
changeOverCapabilityAbsent    PARAMETER
  CONTEXT SPECIFIC-ERROR;
  WITH SYNTAX  ChangeOverASN1Productions.PrimaryObjectSpecified;
REGISTERED AS {part17Parameter 3};
expectedResultUnsatisfied    PARAMETER
  CONTEXT SPECIFIC-ERROR;
  WITH SYNTAX ChangeOverASN1Productions.UnattainableAttributeList;
REGISTERED AS {part17Parameter 4};
noSuchParticipant  PARAMETER
  CONTEXT SPECIFIC-ERROR;
  WITH SYNTAX  ChangeOverASN1Productions.NoSuchParticipant;
REGISTERED AS {part17Parameter 5};
noSuchRelationships    PARAMETER
  CONTEXT SPECIFIC-ERROR;
  WITH SYNTAX  ChangeOverASN1Productions.NoSuchRelationship;
 REGISTERED AS {part17Parameter 6};
notBackedUp   PARAMETER
  CONTEXT SPECIFIC-ERROR;
   WITH SYNTAX  ChangeOverASN1Productions.BackUpInfo;
REGISTERED AS {part17Parameter 7};
postconditionsNotMet    PARAMETER
  CONTEXT SPECIFIC-ERROR;
  WITH SYNTAX ChangeOverASN1Productions.Conditions;
REGISTERED AS {part17Parameter 8};
preconditionsNotMet    PARAMETER
  CONTEXT SPECIFIC-ERROR;
  WITH SYNTAX ChangeOverASN1Productions.Conditions;
REGISTERED AS {part17Parameter 9};
secondaryInstanceUnavailable    PARAMETER
  CONTEXT SPECIFIC-ERROR;
  WITH SYNTAX   ChangeOverASN1Productions.ObjectInstance;
REGISTERED AS {part17Parameter 10};
```

Annex B

Abstract syntax definitions

(This annex forms an integral part of this Recommendation | International Standard)

```
ChangeOverASN1Productions  {joint-iso-ccitt ms(9) function(2) part17(17) asn1Module(2) 0}
DEFINITIONS ::=
BEGIN
IMPORTS ObjectInstance, Attribute, AttributeId, ModifyOperator
  FROM CMIP-1 {joint-iso-ccitt ms(9) cmip(1) version(1) protocol(3)};

part17Action            OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part17(17) action(9)}
part17Attribute         OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part17(17) attribute(7)}
part17MObjectClass      OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part17(17) managedObjectClass(3)}
part17Package           OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part17(17) package(4)}
part17Parameter         OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part17(17) parameter(5)}
part17MRelClass         OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part17(17) relationshipClass(11)}
part17Role              OBJECT IDENTIFIER ::= {joint-iso-ccitt ms(9) function(2) part17(17) relationshipRole(13)}

BackUpInfo ::= SEQUENCE{
  backedUpObjectSpecified       [0] IMPLICIT OptionalObject DEFAULT noObject:NULL,
  backUpObjectSpecified         [1] IMPLICIT OptionalObject DEFAULT noObject:NULL,
  backedUpObjectExisting        [2] IMPLICIT OptionalObject DEFAULT noObject:NULL,
  backUpObjectExisting          [3] IMPLICIT OptionalObject DEFAULT noObject:NULL}

BackUpObject::= OptionalObject DEFAULT NULL

ChangeBackInfo ::= SEQUENCE{
  backedUpObject          [0] IMPLICIT ObjectInstance,
  backUpObject            [1] IMPLICIT OptionalObject DEFAULT noObject:NULL,
  backedUpObjectChanges   [2] IMPLICIT ExpectedAttributeList OPTIONAL,
  backUpObjectChanges     [3] IMPLICIT ExpectedAttributesList OPTIONAL}

ChangeOverInfo ::= SEQUENCE{
  primary                 [0] IMPLICIT ObjectInstance,
  secondary               [1] IMPLICIT OptionalObject DEFAULT noObject:NULL,
  primaryChanges          [2] IMPLICIT ExpectedAttributeList OPTIONAL,
  secondaryChanges        [3] IMPLICIT ExpectedAttributesList OPTIONAL}

Condition ::= SEQUENCE{
  object    ObjectInstance,
  details   SET OF Attribute}

-- At least one of the two components of Conditions must be present

Conditions ::= SEQUENCE{
  primary [0] IMPLICIT Condition OPTIONAL,
  secondary     [1] IMPLICIT Condition OPTIONAL}

ExpectedAttributeList ::= SET OF SEQUENCE{
  modifyOperator  [0] IMPLICIT ModifyOperator       DEFAULT replace,
  attributeId     AttributeId,
  attributeValue    ANY DEFINED BY attributeId OPTIONAL}

NoSuchParticipant::= SEQUENCE{
  role      [0] OBJECT IDENTIFIER,
  objectInstance      [1] ObjectInstance}

NoSuchRelationship::= SEQUENCE{
  relationshipClass         [0] OBJECT IDENTIFIER,
  relationshipBinding       [0] OBJECT IDENTIFIER OPTIONAL,
  relationshipInstance      [0] RelationshipInstance OPTIONAL}
```

```
OptionalObject ::= CHOICE{
 noObject       NULL,
 object     ObjectInstance}

PrimaryObject ::= ObjectInstance

PrimaryObjectSpecified ::= OptionalObject
-- At least one of the two components of UnattainableAttributeList must be present

RelationshipInstance::= SET OF ObjectInstance

UnattainableAttributeList ::= SEQUENCE{
 primaryChanges          [0] IMPLICIT ExpectedAttributeList   OPTIONAL,
 secondaryChanges        [1] IMPLICIT ExpectedAttributeList   OPTIONAL}

END
```

Annex C

MCS proforma[2)]

(This annex forms an integral part of this Recommendation | International Standard)

C.1 Introduction

C.1.1 Purpose and structure

The Management Conformance Summary (MCS) is a statement by a supplier that identifies an implementation and provides information on whether the implementation claims conformance to any of the listed set of documents that specify conformance requirements to OSI management.

The MCS proforma is a document, in the form of a questionnaire that when completed by the supplier of an implementation becomes the MCS.

C.1.2 Instructions for completing the MCS proforma to produce an MCS

The supplier of the implementation shall enter an explicit statement in each of the boxes provided. Specific instruction is provided in the text which precedes each table.

C.1.3 Symbols, abbreviations and terms

For all annexes of this Recommendation | International Standard, the following common notations, defined in ITU-T Rec. X.291 | ISO/IEC 9646-2 and ITU-T Rec. X.296 | ISO/IEC 9646-7, are used for the Status column:

m Mandatory;

o Optional;

c Conditional;

x Prohibited;

– Not applicable or out of scope.

NOTES

1 'c', 'm', and 'o' are prefixed by "c:" when nested under a conditional or optional item of the same table.

2 'o' may be suffixed by ".N" (where N is a unique number) for selectable options among a set of status values. Support of at least one of the choices (from the items with the same value of N) is required.

For all annexes of this Recommendation | International Standard, the following common notations, defined in ITU-T Rec. X.291 | ISO/IEC 9646-2 and ITU-T Rec. X.296 | ISO/IEC 9646-7, are used for the Support column:

Y Implemented;

N Not implemented;

– No answer required;

Ig The item is ignored (i.e. processed syntactically but not semantically).

C.1.4 Table format

Some of the tables in this Recommendation | International Standard have been split because the information is too wide to fit on the page. Where this occurs, the index number of the first block of columns are the index numbers of the corresponding rows of the remaining blocks of columns. A complete table reconstructed from the constituent parts should have the following layout:

Index	First block of columns	Second block of columns	Etc.

2) Users of this Recommendation | International Standard may freely reproduce the MCS proforma in this annex so that it can be used for its intended purpose, and may further publish the completed MCS. Instructions for the MCS proforma are specified in ITU-T Rec. X.724 | ISO/IEC 10165-6.

In this Recommendation | International Standard the constituent parts of the table appear consecutively, starting with the first block of columns.

When a table with sub-rows is too wide to fit on a page, the continuation table(s) have been constructed with index numbers identical to the index numbers in the corresponding rows of the first table, and with sub-index numbers corresponding to the sub-rows within each indexed row. For example, if Table X.1 has 2 rows and the continuation of Table X.1 has 2 sub-rows for each row, the tables are presented as follows:

Table X.1 – Title

					Support		
Index	A	B	C	D	E	F	G
1	a	b	–				
2	a	b	–				

Table X.1 *(continued)* – Title

Index	Sub-index	H	I	J	K	L
1	1.1	h	i	j		
	1.2	h	i	j		
2	2.1	h	i	j		
	2.1	h	i	j		

A complete table reconstructed from the constituent parts should have the following layout:

					Support								
Index	A	B	C	D	E	F	G	Sub-index	H	I	J	K	L
1	a	b	–					1.1	h	i	j		
								1.2	h	i	j		
2	a	b	–					2.1	h	i	j		
								2.2	h	i	j		

References made to cells within tables shall be interpreted as references within reconstructed tables. In the example, above, the reference X.1/1d corresponds with the blank cell in column G for row with Index 1, and X.1/1.2b corresponds with the blank cell in column L for row with sub-index 1.2.

C.2 Identification of the implementation

C.2.1 Date of statement

The supplier of the implementation shall enter the date of this statement in the box below. Use the format DD-MM-YYYY.

Date of statement

C.2.2 Identification of the implementation

The supplier of the implementation shall enter information necessary to uniquely identify the implementation and the system(s) in which it may reside, in the box below.

C.2.3 Contact

The supplier of the implementation shall provide information on whom to contact if there are any queries concerning the content of the MCS, in the box below.

C.3 Identification of the document in which the management information is defined

The supplier of the implementation shall enter the title, reference number and date of the publication of the document which specifies the management information to which conformance is claimed, in the box below.

Document to which conformance is claimed

C.3.1 Technical corrigenda implemented

The supplier of the implementation shall enter the reference numbers of implemented technical corrigenda which modify the specification in the identified document, in the box below.

C.3.2 Amendments implemented

The supplier of the implementation shall state the titles and reference numbers of implemented addenda to the identified document, in the box below.

C.4 Management conformance summary

The supplier of implementations shall state the capabilities and features supported and provide summary of conformance claims to Recommendations | International Standards using the tables in this annex.

The supplier of the implementation shall specify the roles that are supported, in Table C.1.

Table C.1 – Roles

Index	Roles supported	Status	Support	Additional information
1	Manager role support	o.1		
2	Agent role support	o.1		

The supplier of the implementation shall specify support for the systems management functional units, in Table C.2.

Table C.2 – Systems management functional units

		Manager		Agent		
Index	Capability	Status	Support	Status	Support	Additional information
1	Change over functional unit	c1		c2		
2	Change over/back functional unit	c1		c2		
c1: if C.1/1a then o else –. c2: if C.1/2a then o else –.						

The supplier of the implementation shall specify support for management information in the manager role, in Table C.3.

Table C.3 – Manager role minimum conformance requirement

Index	Item	Status	Support	Additional information
1	Operations on managed objects	c3		
2	Change over action	c4		
3	Change back action	c5		
c3: if C.1/1a then o.2 else –. c4: if (C.2/1a or C.2/2a) then m else (if C.1/1a then o.2 else –). c5: if C.2/2a then m else (if C.1/1a then o.2 else –).				

The supplier of the implementation shall specify support for management information in the agent role, in Table C.4.

Table C.4 – Agent role minimum conformance requirement

Index	Item	Status	Support	Table reference	Additional information
1	Change over action	c6			
2	Change back action	c7			
3	Primary-backed-up object	c6			
4	Secondary-back-up object	c6			
5	Change over control object	c6			
6	Change over relationship	c8			

c6: if C.1/2a then m else –.

c7: if C.2/2b then m elseM (if C.1/2a then o else –).

c8: if C.1/2a then o else –.

NOTE – The Table reference column in the above table is the managed object reference of the MOCS supplied by the supplier of the managed object which claims to conform to this Recommendation | International Standard.

The supplier of the implementation shall provide information on claims of conformance to any of the Recommendation | International Standards summarized in Tables C.5 to C.8. For each Recommendation | International Standard that the supplier of the implementation claims conformance to, the corresponding statement(s) shall be completed, or referenced by the MCS. The supplier of the implementation shall complete the Support, Table number and Additional information columns.

In Tables C.5 to C.8, the Status column is used to indicate whether the supplier of the implementation is required to complete the referenced tables or referenced items. Conformance requirements are as specified in the referenced tables or referenced items and are not changed by the value of the MCS status column. Similarly, the Support column is used by the supplier of the implementation to indicate completion of the referenced tables or referenced items.

Table C.5 – PICS support summary

Index	Identification of the document that includes the PICS proforma	Table numbers of PICS proforma	Description	Constraints and values	Status	Support	Table numbers of PICS	Additional information
1	CCITT Rec. X.730 | ISO/IEC 10164-1	Annex E, all tables	SM application context	OBJECT IDENTIFIER	m			

Table C.6 – MOCS support summary

Index	Identification of the document that includes the MOCS proforma	Table numbers of MOCS proforma	Description	Constraints and values	Status	Support	Table numbers of MOCS	Additional information
1	ITU-T Rec. X.751 | ISO/IEC 10164-17	Annex E, Tables E.1-E.4	Primary-backed-up object	–	c9			
2	ITU-T Rec. X.751 | ISO/IEC 10164-17	Annex E, Tables E.5-E.8	Secondary-back-up object	–	c10			
3	ITU-T Rec. X.751 | ISO/IEC 10164-17	Annex E, Tables E.9-E.13	Change over control object	–	c11			
c9: if C.4/3a then m else –. c10: if C.4/4a then m else –. c11: if C.4/5a then m else –.								

Table C.7 – MRCS support summary

Index	Identification of the document that includes the MRCS proforma	Table numbers of MRCS proforma	Description	Constraints and values	Status	Support	Table numbers of MRCS	Additional information
1	ITU-T Rec. X.751 | ISO/IEC 10164-17	Annex F, all tables	Change over relationship	–	c12			
c12: if C.4/6a then m else –.								

Table C.8 – MICS support summary

Index	Identification of the document that includes the MICS proforma	Table numbers of MICS proforma	Description	Constraints and values	Status	Support	Table numbers of MICS	Additional information
1	ITU-T Rec. X.751 | ISO/IEC 10164-17	Annex D, Table D.2	Management operations	–	c13			
2	ITU-T Rec. X.751 | ISO/IEC 10164-17	Annex D, Table D.1	Change over action	–	c14			
3	ITU-T Rec. X.751 | ISO/IEC 10164-17	Annex D, Table D.1	Change back action	–	c15			
c13: if C.3/1a then m else –. c14: if C.3/2a then m else –. c15: if C.3/3a then m else –.								

Annex D

MICS proforma[3)]

(This annex forms an integral part of this Recommendation | International Standard)

D.1 Introduction

The purpose of this MICS proforma is to provide a mechanism for a supplier of an implementation which claims conformance, in the manager role, to management information specified in this Recommendation | International Standard, to provide conformance information in a standard form.

D.2 Instructions for completing the MICS proforma to produce a MICS

The MICS proforma contained in this annex is comprised of information in tabular form, in accordance with ITU-T Rec. X.724 | ISO/IEC 10165-6. In addition to the general guidance given in ITU-T Rec. X.724 | ISO/IEC 10165-6, the Additional information column shall be used to identify the object classes for which the management operations are supported. The supplier of the implementation shall state which items are supported in the tables below and if necessary, provide additional information.

D.3 Symbols, abbreviations and terms

The following abbreviations are used throughout the MICS proforma:

dmi-att	joint-iso-ccitt ms(9) smi(3) part2(2) attribute(7)
part17-act	joint-iso-ccitt ms(9) function(2) part17(17) action(9)
part17-att	joint-iso-ccitt ms(9) function(2) part17(17) attribute(7)

The notations used for the Status and Support columns are specified in A.1.3.

D.4 Statement of conformance to the management information

D.4.1 Action

The specifier of a manager role implementation that claims to support the actions specified in this Recommendation | International Standard shall import a copy of Table D.1 and complete it.

Table D.1 – Action support

Index	Action type template label	Value of object identifier for the action type	Sub-index	Information/ Reply	Constraints and values	Status	Support	Additional information
1	changeOver	{part17-act 1}	1.1	Information	–	c1		
			1.2	reply	–	c1		
2	changeBack	{part17-act 2}	2.1	Information	–	c2		
			2.2	reply	No reply syntax	–		
c1: if C.8/2a then m else –. c2: if C.8/3a then m else –.								

3) Users of this Recommendation | International Standard may freely reproduce the MICS proforma in this annex so that it can be used for its intended purpose, and may further publish the completed MICS.

Table D.1 *(continued)* – Action support

Index	Sub-index	Action field name label	Value of object identifier for the attribute type associated with the field	Constraints and values	Status	Support	Additional information
1.1	1.1.1	primary	{dmi-att 45}	–	m		
	1.1.1.1	distinguishedName	–	–	o.3		
	1.1.1.2	nonSpecificForm	–	–	o.3		
	1.1.1.3	localDistinguishedName	–	–	o.3		
	1.1.2	secondary	{dmi-att 47}	–	o		
	1.1.2.1	noObject	–	NULL	c:o.4		
	1.1.2.2	object	–	–	c:o.4		
	1.1.2.2.1	distinguishedName	–	–	c:o.5		
	1.1.2.2.2	nonSpecificForm	–	–	c:o.5		
	1.1.2.2.3	localDistinguishedName	–	–	c:o.5		
	1.1.3	primaryChanges	–	–	o		
	1.1.3.1	modifyOperator	–	–	c:m		
	1.1.3.2	attributeId	–	–	c:m		
	1.1.3.2.1	globalForm	–	–	c:o.6		
	1.1.3.2.2	localForm	–	–	c:o.6		
	1.1.3.3	attributeValue	–	–	c:o		
	1.1.4	secondaryChanges	–	–	o		
	1.1.4.1	modifyOperator	–	–	c:m		
	1.1.4.2	attributeId	–	–	c:m		
	1.1.4.2.1	globalForm	–	–	c:o.7		
	1.1.4.2.2	localForm	–	–	c:o.7		
	1.1.4.3	attributeValue	–	–	c:o		
1.2	1.2.1	objectInstance	–	–	m		
	1.2.1.1	distinguishedName	–	–	o.8		
	1.2.1.2	nonSpecificForm	–	–	o.8		
	1.2.1.3	localDistinguishedName	–	–	o.8		

Table D.1 *(concluded)* – Action support

Index	Sub-index	Action field name label	Value of object identifier for the attribute type associated with the field	Constraints and values	Status	Support	Additional information
2.1	2.1.1	backedUpObject	{dmi-att 41}	–	m		
	2.1.1.1	distinguishedName	–	–	o.9		
	2.1.1.2	nonSpecificForm	–	–	o.9		
	2.1.1.3	localDistinguishedName	–	–	o.9		
	2.1.2	backUpObject	{dmi-att 40}	–	o		
	2.1.2.1	noObject	–	NULL	c:o.10		
	2.1.2.2	object	–	–	c:o.10		
	2.1.2.2.1	distinguishedName	–	–	c:o.11		
	2.1.2.2.2	nonSpecificForm	–	–	c:o.11		
	2.1.2.2.3	localDistinguishedName	–	–	c:o.11		
	2.1.3	backedUpObjectChanges	–	–	o		
	2.1.3.1	modifyOperator	–	–	c:m		
	2.1.3.2	attributeId	–	–	c:m		
	2.1.3.2.1	globalForm	–	–	c:o.12		
	2.1.3.2.2	localForm	–	–	c:o.12		
	2.1.3.3	attributeValue	–	–	c:o		
	2.1.4	backUpObjectChanges	–	–	o		
	2.1.4.1	modifyOperator	–	–	c:m		
	2.1.4.2	attributeId	–	–	c:m		
	2.1.4.2.1	globalForm	–	–	c:o.13		
	2.1.4.2.2	localForm	–	–	c:o.13		
	2.1.4.3	attributeValue	–	–	c:o		

D.4.2 Attributes

The specifier of a manager role implementation that claims to support management operations on the attributes specified in this Recommendation | International Standard shall import a copy of Table D.2 and complete it.

Table D.2 – Attribute support

				Set by create		Get	
Index	Attribute template label	Value of object identifier for the attribute	Constraints and values	Status	Support	Status	Support
1	objectClass	{dmi-att 65}	–	–		o.14	
2	nameBinding	{dmi-att 63}	–	–		o.14	
3	packages	{dmi-att 66}	–	–		o.14	
4	allomorphs	{dmi-att 50}	–	–		o.14	
5	administrativeState	{dmi-att 31}	–	–		o.14	
6	operationalState	{dmi-att 35}	–	–		o.14	
7	standbyState	{dmi-att 37}	–	–		o.14	
8	primaryObject	{part17-att 1}	–	–		o.14	
9	primary	{dmi-att 45}	–	–		o.14	
10	secondary	{dmi-att 47}	–	–		o.14	
11	backedUpObject	{dmi-att 41}	–	–		o.14	
12	backUpObject	{dmi-att 40}	–	–		o.14	

Table D.2 *(concluded)* – Attribute support

	Replace		Add		Remove		Set to default		
Index	Status	Support	Status	Support	Status	Support	Status	Support	Additional information
1	–		–		–		–		
2	–		–		–		–		
3	–		–		–		–		
4	–		–		–		–		
5	o.14		–		–		–		
6	–		–		–		–		
7	–		–		–		–		
8	–		–		–		–		
9	o.14		o.14		o.14		–		
10	o.14		o.14		o.14		–		
11	–		–		–		–		
12	–		–		–		–		

Annex E

MOCS proforma[4)]

(This annex forms an integral part of this Recommendation | International Standard)

E.1 Introduction

The purpose of this MOCS proforma is to provide a mechanism for a supplier of an implementation which claims conformance to a managed object class to provide conformance information in a standard form.

E.2 Instructions for completing the MOCS proforma to produce a MOCS

The supplier of the implementation shall state which items are supported in the tables below and if necessary provide additional information.

E.3 Symbols, abbreviations and terms

The following abbreviations are used throughout the proformas:

dmi-pkg	joint-iso-ccitt ms(9) smi(3) part2(2) package(4)
dmi-att	joint-iso-ccitt ms(9) smi(3) part2(2) attribute(7)
part17-act	joint-iso-ccitt ms(9) function(2) part17(17) action(9)
part17-att	joint-iso-ccitt ms(9) function(2) part17(17) attribute(7)
part17-moc	joint-iso-ccitt ms(9) function(2) part17(17) managedObjectClass(3)
part17-pkg	joint-iso-ccitt ms(9) function(2) part17(17) package(4)
part17-par	joint-iso-ccitt ms(9) function(2) part17(17) parameter(5)

E.4 Primary-backed-up object managed object class

E.4.1 Statement of conformance to the managed object class

See Table E.4.1.

Table E.1 – Managed object class support

Index	Managed object class template label	Value of object identifier for the managed object class	Support of all mandatory features (Y/N)	Is the actual class the same as the managed object class to which conformance is claimed? (Y/N)
1	primary-backedUpObject	{part17-moc 1}		

If the answer to the actual class question in the managed object class support table is no, the supplier of the implementation shall fill in the actual class support Table E.2.

Table E.2 – Actual class support

Index	Managed object class template label for actual class	Value of object identifier for managed object class definition of actual class	Additional information
1			

4) Users of this Recommendation | International Standard may freely reproduce the MOCS proforma in this annex so that it can be used for its intended purpose, and may further publish the completed MOCS. Instructions for completing the MOCS proforma are specified in ITU-T Rec. X.724 | ISO/IEC 10165-6.

E.4.2 Packages

See Table E.3.

Table E.3 – Packages support

Index	Package template label	Value of object identifier for the package	Constraints and values	Status	Support	Additional information
1	topPackage	–	–	m		
2	packagesPackage	{dmi-pkg 16}	–	c1		
3	allomorphicPackage	{dmi-pkg 17}	–	c2		
4	primary-backedUpObjectPackage	–	–	m		
5	secondaryAttributePackage	{part17-pkg 6}	–	o		
6	backUpObjectAttributePackage	{part17-pkg 2}	–	o		
c1: if E.3/3a or E.3/5a or E.3/6a then m else –. c2: if E.1/1b then – else m.						

E.4.3 Attributes

See Table E.4.

Table E.4 – Attribute support

				Set by create		Get	
Index	Attribute template label	Value of object identifier for the attribute	Constraints and values	Status	Support	Status	Support
1	objectClass	{dmi-att 65}	–	–		m	
2	nameBinding	{dmi-att 63}	–	–		m	
3	packages	{dmi-att 66}	–	–		c3	
4	allomorphs	{dmi-att 50}	–	–		c4	
5	operationalState	{dmi-att 35}	–	–		m	
6	secondary	{dmi-att 47}	–	–		c5	
7	backUpObject	{dmi-att 40}	–	–		c6	
c3: if E.3/2a then m else –. c4: if E.3/3a then m else –. c5: if E.3/5a then m else –. c6: if E.3/6a then m else –.							

Table E.4 *(concluded)* – Attribute support

	Replace		Add		Remove		Set to default		
Index	Status	Support	Status	Support	Status	Support	Status	Support	Additional information
1	x		–		–		–		
2	x		–		–		–		
3	c7		c7		c7		c7		
4	–		–		–		–		
5	x		–		–		x		
6	c5		c5		c5		c8		
7	c9		–		–		c9		
c7: if E.3/2a then x else –. c8: if E.1/1b then x else –. c9: if E.3/6a then x else –.									

E.5 Secondary back-up object managed object class

E.5.1 Statement of conformance to the managed object class

See Table E.5.

Table E.5 – Managed object class support

Index	Managed object class template label	Value of object identifier for the managed object class	Support of all mandatory features (Y/N)	Is the actual class the same as the managed object class to which conformance is claimed? (Y/N)
2	secondary-backUpObject	{part17-moc 2}		

If the answer to the actual class question in the managed object class support table is no, the supplier of the implementation shall fill in the actual class support Table E.6.

Table E.6 – Actual class support

Index	Managed object class template label for actual class	Value of object identifier for managed object class definition of actual class	Additional information
1			

E.5.2 Packages

See Table E.7.

Table E.7 – Packages support

Index	Package template label	Value of object identifier for the package	Constraints and values	Status	Support	Additional information
1	topPackage	–	–	m		
2	packagesPackage	{dmi-pkg 16}	–	c10		
3	allomorphicPackage	{dmi-pkg 17}	–	c11		
4	secondary-backUpObjectPackage	–	–	m		
5	primaryAttributePackage	{part17-pkg 5}	–	o		
6	backedUpObjectAttributePackage	{part17-pkg 1}	–	o		
c10: if E.7/3a or E.7/5a or E.7/6a then m else –. c11: if E.5/1b then – else m.						

E.5.3 Attributes

See Table E.8.

Table E.8 – Attribute support

				Set by create		Get	
Index	Attribute template label	Value of object identifier for the attribute	Constraints and values	Status	Support	Status	Support
1	objectClass	{dmi-att 65}	–	–		m	
2	nameBinding	{dmi-att 63}	–	–		m	
3	packages	{dmi-att 66}	–	–		c12	
4	allomorphs	{dmi-att 50}	–	–		c13	
5	administrativeState	{dmi-att 31}	–	–		m	
6	operationalState	{dmi-att 35}	–	–		m	
7	standbyState	{dmi-att 37}	–	–		m	
8	primary	{dmi-att 45}	–	–		c14	
9	backedUpObject	{dmi-att 41}	–	–		c15	
c12: if E.7/2a then m else –. c13: if E.7/3a then m else –. c14: if E.7/5a then m else –. c15: if E.7/6a then m else –.							

Table E.8 *(concluded)* – Attribute support

	Replace		Add		Remove		Set to default		
Index	Status	Support	Status	Support	Status	Support	Status	Support	Additional information
1	x		–		–		–		
2	x		–		–		–		
3	c16		c16		c16		c16		
4	–		–		–		–		
5	m		–		–		–		
6	x		–		–		–		
7	x		–		–		–		
8	c14		c14		c14		c17		
9	c18		–		–		c18		
c16: if E.7/2a then x else –. c17: if E.5/1b then x else –. c18: if E.7/6a then x else –.									

E.6 Change over control object managed object class

E.6.1 Statement of conformance to the managed object class

See Table E.9.

Table E.9 – Managed object class support

Index	Managed object class template label	Value of object identifier for the managed object class	Support of all mandatory features (Y/N)	Is the actual class the same as the managed object class to which conformance is claimed? (Y/N)
1	changeOverControlObject	{part17-moc 3}		

If the answer to the actual class question in the managed object class support table is no, the supplier of the implementation shall fill in the actual class support Table E.10.

Table E.10 – Actual class support

Index	Managed object class template label for actual class	Value of object identifier for managed object class definition of actual class	Additional information

E.6.2 Packages

See Table E.11.

Table E.11 – Packages support

Index	Package template label	Value of object identifier for the package	Constraints and values	Status	Support	Additional information
1	topPackage	–	–	m		
2	packagesPackage	{dmi-pkg 16}	–	m		
3	allomorphicPackage	{dmi-pkg 17}	–	c19		
4	changeOverControlObjectPackage	–	–	m		
5	changeOverActionPackage	{part17-pkg 4}	–	m		
6	secondaryAttributePackage	{part17-pkg 6}	–	c20		
7	backUpObjectAttributePackage	{part17-pkg 2}		c21		
8	changeBackActionPackage	{part17-pkg 3}	–	o		

c19: if E.9/1b then – else m.
c20: if E.3/5a then – else m.
c21: if E.3/6a then – else m.

E.6.3 Attributes

See Table E.12.

Table E.12 – Attribute support

				Set by create		Get	
Index	Attribute template label	Value of object identifier for the attribute	Constraints and values	Status	Support	Status	Support
1	objectClass	{dmi-att 65}	–	–		m	
2	nameBinding	{dmi-att 63}	–	–		m	
3	packages	{dmi-att 66}	–	–		m	
4	allomorphs	{dmi-att 50}	–	–		c22	
5	secondary	{dmi-att 47}	–	–		c23	
6	backUpObject	{dmi-att 40}	–	–		c24	

c22: if E.11/3a then m else –.
c23: if E.11/6a then m else –.
c24: if E.11/7a then m else –.

Table E.12 *(concluded)* – Attribute support

	Replace		Add		Remove		Set to default		
Index	Status	Support	Status	Support	Status	Support	Status	Support	Additional information
1	x		–		–		–		
2	x		–		–		–		
3	c25		c25		c25		c25		
4	–		–		–		–		
5	c23		c23		c23		c26		
6	c27		–		–		c27		
c25: if E.11/2a then x else –. c26: if E.9/1b then x else –. c27: if E.11/7a then x else –.									

E.6.4 Actions

See Table E.13.

Table E.13 – Action support

Index	Action type template label	Value of object identifier for the action type	Sub-index	Information/ Reply	Constraints and values	Status	Support	Additional information
1	changeOver	{part17-act 1}	1.1	Information	–	m		
			1.2	reply	–	m		
2	changeBack	{part17-act 2}	2.1	Information	–	c28		
			2.2	reply	No reply synatx	–		
c28: if E.11/8a then m else –.								

The detailed requirements for the change over action are given in Table D.1 (Index 1 Sub-index). That proforma can be used to indicate changeOver action support.

The detailed requirements for the change back action are given in Table D.1 (Index 2 Sub-index). That proforma can be used to indicate changeBack action support.

E.6.5 Parameters

See Table E.14.

Table E.14 – Parameter support

Index	Parameter template label	Value of object identifier for parameter	Constraints and values	Status	Support	Additional information
1	alreadyBackedUp	{part17-par 1}	–	m		
2	backup-backedup-Mismatch	{part17-par 2]	–	c29		
3	changeOverCapabilityAbsent	{part17-par 3}	–	m		
4	expectedResultUnsatisfied	{part17-par 4}	–	m		
5	noSuchParticipant	{part17-par 5}	–	m		
6	noSuchRelationships	{part17-par 6}	–	m		
7	notBackedUp	{part17-par 7}	–	c29		
8	postconditionsNotMet	{part17-par 8}	–	m		
9	preconditionsNotMet	{part17-par 9}	–	m		
10	secondaryInstanceUnavailable	{part17-par 10}	–	m		
c29: if E.13/2a then m else –.						

Annex F

MRCS proforma for relationship model[5)]

(This annex forms an integral part of this Recommendation | International Standard)

F.1 MRCS Proforma

F.1.1 Instructions for completing the MRCS proforma

The MRCS proforma contained in this annex is comprised of information in tabular form. The supplier of the implementation shall state which items are supported in the tables below and if necessary provide additional information.

F.1.2 Symbols, abbreviations and terms

The following common notations defined in ITU-T Rec. X.291 | ISO/IEC 9646-2 are used for the Status column:

- m Mandatory
- o Optional
- c Conditional
- x Prohibited
- – Not applicable

The following common notations, defined in ITU-T Rec. X.291 | ISO/IEC 9646-2 and ITU-T Rec. X.296 | ISO/IEC 9646-7 are used for the Support column:

- Y Implemented;
- N Not implemented;
- – No answer required;
- Ig The item is ignored (i.e. processed syntactically but not semantically).

The following abbreviations are used throughout the proformas:

part17-rel joint-iso-ccitt ms(9) function(2) part17(17) relationshipClass(11)

part17-rol joint-iso-ccitt ms(9) function(2) part17(17) relationshipRole(13)

F.1.3 Managed relationship support

The supplier of the implementation shall state the relationship class and the role binding supported using Table F.1.

Table F.1 – Managed relationship support

Index	Relationship class template label	Value of object identifier for relationship class	Relationship mapping template label	Value of object identifier for relationship mapping	Status	Support	Additional information
1	changeOverRelationship	{part17-rel 1}					

5) Users of this Recommendation | International Standard may freely reproduce the MRCS proforma in this annex so that it can be used for its intended purpose, and may further publish the completed MRCS. Instructions for completing the MRCS proforma are specified in ITU-T Rec. X.724 | ISO/IEC 10165-6.

F.1.4 Roles support

For each role identified in the role binding, the supplier of the implementation shall indicate support using Table F.2.

If there are packages specified for the role, the supplier of the implementation shall indicate support using Table F.3.

Table F.2 – Roles support

Index	Role label	Constraints and values	Status	Support	Value of object identifier for actual participants managed object class	MOCS reference for actual participants managed object class	Additional information
1	primaryRole		m				
2	secondaryRole		m				
3	backedupRole		o				
4	backupRole		o				
5	changeOver ControlRole		m				

F.1.5 Relationship management operations, notifications, and parameters support

The supplier of the implementation shall indicate the relationship management operations and notifications supported by Table F.3.

Table F.3 – Relationship management operations and notification support

Index	Relationship management operation or notification	Systems management operation or notification	Constrains and values	Status	Support	Additional information
1	bind secondary					
2	unbind secondary					
3	bind backed-up					
4	unbind backed-up					
5	bind back-up					
6	unbind back-up					
7	ESTABLISH					
8	TERMINATE					
9	QUERY					
NOTE – Systems management operation or notification column to be filled in by proforma specifier of each specific relationship mapping defined.						

F.1.6 Relationship object support

The supplier of the implementation shall indicate support for the relationship object class, if any, specified in the relationship mapping template by using the MOCS proforma defined in ITU-T Rec. X.724 | ISO/IEC 10165-6 and MIDS proforma defined in Annex D. The relationship object class shall be a subclass of genericRelationshipObject.

Annex G

MIDS(action) proforma[6)]

(This annex forms an integral part of this Recommendation | International Standard)

Table G.1 – Action support

Index	Action type template label	Value of object identifier for the action type	Sub-index	Information/ Reply	Constraints and values	Status	Support	Additional information
1	changeOver	{part17-act 1}	1.1	Information	–	c1		
			1.2	reply	–	c1		
2	changeBack	{part17-act 2}	2.1	Information	–	c2		
			2.2	reply	No reply syntax	–		
c1: if C.8/1a then m else –. c2: if C.8/2a then m else –.								

The detailed requirements for the change over action are given in Table D.1 (Index 1 Sub-index). That proforma can be used to indicate changeOver action support.

The detailed requirements for the change back action are given in Table D.1 (Index 2 Sub-index). That proforma can be used to indicate changeBack action support.

6) Users of this Recommendation | International Standard may freely reproduce the MIDS proforma in this annex so that it can be used for its intended purpose. Instructions for completing the MIDS proforma are specified in ITU-T Rec. X.724 | ISO/IEC 10165-6.

Annex H

Introduction of change over relationship

(This annex does not form an integral par of this Recommendation | International Standard)

This annex describes the rationale of the change over relationship introduction which combines the fallback and the back-up relationship.

H.1 Fallback relationship and back-up relationship

As described in CCITT Rec. X.732 | ISO/IEC 10164-3, the existence of the fallback relationship is the precondition for back-up relationship establishment. The fallback relationship is defined by two roles, the primary role and the secondary role. Though each role cardinality is equal to one, each relationship cardinality is more than one. This implies that establishment of the back-up relationship consists of two phases, one to find the appropriate managed object pair and the other to make them enter the roles of back-up relationship. These two phases shall be realized by the managed object in the relationship control role which establishes the back-up and terminates the back-up.

Thus, the back-up relationship exists while the back-up is taking place. This implies that the back-up is established from a fallback relationship and that the back-up is terminated from a back-up relationship. Therefore, the managed object in charge of controlling the back-up has to participate in both the fallback and back-up relationships (i.e. establishing and terminating).

There was a National Body Comment asking to use a single managed relationship to perform the change over function in order to remove the complexity of the control object.

H.2 Change over relationship derivation

Considering that the purpose of the change over function is that a managed object unable to function properly can be backed up by other managed object, the aggregation of fallback and back-up relationships with the same primary object composes the change over relationship. In addition, the back-up relationship is semantically established within the change over relationship using one of the members participating in the change over relationship.

This derivation enables definition of the relationship operations within a single relationship and eliminates an implicit relationship between back-up and fallback relationship participants to find an appropriate managed object pair from existing fallback relationships.

H.3 Constraint on change over function

As the change over relationship is established in terms of a primary object, both the change over and the change back actions require that the primary object name is a parameter. Furthermore, in order to simplify the change over control function, the managed object in the change over control role shall only control one back-up.