INTERNATIONAL STANDARD

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Information technology — Open Systems Interconnection — Common management information protocol —

Part 1:
Specification

Technologies de l'information — Interconnexion de systèmes ouverts (OSI) — Protocole commun d'information de gestion —

Partie 1: Spécification

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 9596-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 33, *Distributed application services,* in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.711.

This third edition cancels and replaces the second edition (ISO/IEC 9596-1:1991), which has been technically revised. It also incorporates Technical Corrigendum 1:1992, Technical Corrigendum 2:1992, Technical Corrigendum 3:1992, Technical Corrigendum 4:1993 and Technical Corrigendum 5:1994.

ISO/IEC 9596 consists of the following parts, under the general title *Information technology — Open Systems Interconnection — Common management information protocol*:

— *Part 1: Specification*

— *Part 2: Protocol Implementation Conformance Statement (PICS) proforma*

Annexes A to D of this part of ISO/IEC 9596 are for information only.

INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION – COMMON MANAGEMENT INFORMATION PROTOCOL: SPECIFICATION

1   Scope

This Recommendation | International Standard specifies a protocol which is used by application layer entities to exchange management information.

This Recommendation | International Standard specifies:

– procedures for the transmission of management information between application entities;

– the abstract syntax of the Common Management Information Protocol (CMIP) and the associated encoding rules to be applied;

– procedures for the correct interpretation of protocol control information;

– the conformance requirements to be met by implementation of this Recommendation | International Standard.

This Recommendation | International Standard does not specify:

– the structure or meaning of the management information that is transmitted by means of CMIP;

– the manner in which management is accomplished as a result of CMIP exchanges;

– the interactions which result in the use of CMIP.

2   Normative references

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

2.1   Identical 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.215 (1995) | ISO/IEC 8326:1996, *Information technology – Open Systems Interconnection – Session service definition*.

– ITU-T Recommendation X.216 (1994) | ISO/IEC 8822:1994, *Information technology – Open Systems Interconnection – Presentation service definition*.

– ITU-T Recommendation X.217 (1995) | ISO/IEC 8649:1996, *Information technology – Open Systems Interconnection – Service definition for the Association Control Service Element.*

– ITU-T Recommendation X.226 (1994) | ISO/IEC 8823-1:1994, *Information technology – Open Systems Interconnection – Connection-oriented presentation protocol: Protocol specification*.

– ITU-T Recommendation X.227 (1995) | ISO/IEC 8650-1:1996, *Information technology – Open Systems Interconnection – Connection-oriented protocol for the Association Control Service Element: Protocol specification.*

– ITU-T Recommendation X.710 (1997) | ISO/IEC 9595:1998, *Information technology – Open Systems Interconnection – Common management information service*.

– CCITT Recommendation X.712 (1992) | ISO/IEC 9596-2:1993, *Information technology – Open Systems Interconnection – Common management information protocol: Protocol Implementation Conformance Statement (PICS) proforma*.

2.2 Paired Recommendations | International Standards equivalent in technical content

– CCITT Recommendation X.208 (1988), *Specification of Abstract Syntax Notation One (ASN.1)*.

ISO/IEC 8824:1990, *Information technology – Open Systems Interconnection – Specification of Abstract Syntax Notation One (ASN.1)*.

– CCITT Recommendation X.209 (1988), *Specification of basic encoding rules for Abstract Syntax Notation One (ASN.1)*.

ISO/IEC 8825:1990, *Information technology – Open Systems Interconnection – Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1)*.

– CCITT Recommendation X.219 (1988), *Remote operations: Model, notation and service definition*.

ISO/IEC 9072-1:1989, *Information processing systems – Text communication – Remote Operations – Part 1: Model, notation and service definition*.

– CCITT Recommendation X.229 (1988), *Remote operations: Protocol specification*.

ISO/IEC 9072-2:1989, *Information processing systems – Text communication – Remote Operations – Part 2: Protocol specification*.

– 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*.

3 Definitions

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

3.1 Basic Reference Model definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.200 | ISO/IEC 7498-1:

a) application-service-element;

b) application-process;

c) real open system;

d) systems-management.

3.2 Management Framework definitions

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

a) managed object;

b) management information;

c) management information base;

d) systems management application-entity.

3.3 Remote Operations definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.219 | ISO/IEC 9072-1:

a) association-initiator;

b) association-responder;

c)   linked-operations;

d)   Remote Operations;

e)   Remote Operation Service Element;

f)   invoker;

g)   performer;

h)   Association Class;

i)   Operation Class.

3.4   CMIS definitions

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

a)   attribute;

b)   common management information service element;

c)   common management information services;

d)   CMISE-service-provider;

e)   CMISE-service-user;

f)   invoking CMISE-service-user;

g)   performing CMISE-service-user.

3.5   ACSE definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.217 | ISO/IEC 8649:

a)   application context;

b)   application-association;

c)   association.

3.6   Presentation definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.216 | ISO/IEC 8822:

a)   abstract syntax;

b)   transfer syntax.

4   Symbols and abbreviations

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

ACSE	Association Control Service Element
APDU	Application Protocol Data Unit
ASE	Application Service Element
ASN.1	Abstract Syntax Notation One
CMIP	Common Management Information Protocol
CMIPM	Common Management Information Protocol Machine
CMIS	Common Management Information Services
CMISE	Common Management Information Service Element
DCS	Defined Context Set
PCI	Protocol Control Information
PDU	Protocol Data Unit

> PICS   Protocol Implementation Conformance Statement
>
> RO   Remote Operations
>
> ROSE   Remote Operations Service Element
>
> SMAE   Systems Management Application-Entity

5   Overview

The Common Management Information Protocol (CMIP) specifies protocol elements that may be used to provide the operation and notification services described in ITU-T Rec. X.710 | ISO/IEC 9595, which defines the Common Management Information Services (CMIS).

5.1   Service provided

The protocol specified in this Recommendation | International Standard supports the services defined in ITU-T Rec. X.710 | ISO/IEC 9595. These services are summarized in Table 1.

Table 1 – Common management information services

Service	Type
M-CANCEL-GET	confirmed
M-EVENT-REPORT	confirmed/non-confirmed
M-GET	confirmed
M-SET	confirmed/non-confirmed
M-ACTION	confirmed/non-confirmed
M-CREATE	confirmed
M-DELETE	confirmed

5.2   Underlying services

This Recommendation | International Standard uses the RO-INVOKE, RO-RESULT, RO-ERROR and RO-REJECT-U services of the Remote Operations Service Element (ROSE) defined in CCITT Rec. X.219 | ISO/IEC 9072-1. ROSE assumes the use of the presentation service defined in ITU-T Rec. X.216 | ISO/IEC 8822. The confirmed operations of CMIP are operation class 2 (asynchronous) or operation class 1 (synchronous) as required by the application. The choice of operation class is a local matter. The unconfirmed operations of CMIP are operation class 5 (asynchronous, outcome not reported). CMIP uses association class 3.

If the extended service functional unit is successfully negotiated, ROSE APDUs may be mapped on to presentation services other than the P-DATA service.

> NOTE – For example, it may be necessary to modify the presentation Defined Context Set (DCS) when the CMIP operation is sent to the peer CMISE-service-user. In this case, the ROSE APDU which carries the CMIP operation will be mapped onto the P-ALTER-CONTEXT service which is also used to perform the changes to the DCS.

Details of which other presentation services are required and how they are used, are described in the description of the application context in use on the association.

5.2.1   Service assumed from the ACSE

This Recommendation | International Standard assumes the use of the A-ASSOCIATE, A-RELEASE, A-ABORT, and A-P-ABORT services of the Association Control Service Element.

5.2.2   Service assumed from the presentation layer

CCITT Rec. X.229 | ISO/IEC 9072-2 assumes the use of the P-DATA service of the presentation layer for the transfer of the RO-INVOKE, RO-RESULT, RO-ERROR and RO-REJECT APDUs.

5.3   Management information definitions

This Recommendation | International Standard defines the abstract syntax of the Common Management Information Protocol. The definitions of management information to be carried by the protocol are not specified in this Recommendation | International Standard.

5.4   Protocol version

This Recommendation International Standard defines version 2 of CMIP. Version 2 replaces version 1. This Recommendation | International Standard does not define any interworking between version 2 and version 1.

6   Elements of procedure

This clause provides definition for the procedural elements of the CMIP. The procedures define the transfer of CMIP PDUs whose structure, coding and relationship with the CMIS service primitives is specified in clause 7.

The Common Management Information Protocol Machine (CMIPM) accepts CMIS request and response service primitives, and issues CMIP PDUs initiating specific elements of procedure as specified in this clause.

A CMIPM shall accept any well-formed CMIP PDU, and pass it to the performing CMISE-service-user for processing, by means of CMIS indication and confirmation service primitives. If the received PDU is not well formed or does not contain a supported notification or operation, a PDU is returned indicating that the received PDU has been rejected.

The procedures indicate only how to interpret the various fields in the CMIP PDU, not what an invoking CMISE-service-user should do with the information it requests nor how a performing CMISE-service-user should process the invocation.

6.1   Association establishment

The establishment of an association involves two CMISE-service-users, one that is the association-initiator and one that is the association-responder.

A CMISE-service-user may initiate an association establishment by using the A-ASSOCIATE service of ITU-T Rec. X.217 | ISO/IEC 8649.

The application context specifies, among other things, the rules required for the coordination of initialization information corresponding to different ASEs. The association rules for CMISE are specified in Annex A.

6.2   Remote operations

6.2.1   RO elements of procedure

The CMIP elements of procedure rely on the following underlying remote operations elements of procedure:

    a)   invocation;

    b)   return-result;

    c)   return-error;

    d)   user-reject;

    e)   provider-reject.

These elements of procedure are described fully in CCITT Rec. X.229 | ISO/IEC 9072-2.

Table 2 specifies the correspondence between CMIS and ROSE parameters.

**Table 2 – Correspondence between CMIS
and ROSE parameters**

CMIS parameter	ROSE parameter
Invoke identifier	InvokeID
Linked identifier	Linked-ID

The correspondence between other CMIS and ROSE parameters is specified in clause 7.

6.2.2 RO-Reject problem parameters

The RO-Reject problem parameters are mapped or processed as follows.

6.2.21 RO-Reject-User.Invoke-problem mapping to CMIS error codes is specified in Table 3.

**Table 3 – Mapping RO-Reject-User.Invoke-problem
to CMISE error codes**

RO-REJECT parameter	CMISE error code
duplicate-invocation	duplicate invocation
mistyped-argument	mistyped argument
resource-limitation	resource limitation
unrecognized-operation	unrecognized operation

Other Invoke-problem parameters are a local matter.

6.2.2.2 Other RO-Reject parameters will be handled as a local matter.

6.3 Event reporting procedure

6.3.1 Invocation

The event reporting procedures are initiated by the M-EVENT-REPORT request primitive.

On receipt of the M-EVENT-REPORT request primitive, the CMIPM shall:

a) in the confirmed mode, construct an APDU requesting the m-EventReport-Confirmed operation, otherwise, construct an APDU requesting the m-EventReport operation;

b) send the APDU using the RO-INVOKE procedure.

6.3.2 Receipt

On receipt of an APDU requesting either the m-EventReport or m-EventReport-Confirmed operation, the CMIPM shall, if the APDU is well formed, issue an M-EVENT-REPORT indication primitive to the CMISE-service-user with the mode parameter indicating whether or not confirmation is requested, otherwise, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.

6.3.3 Response

In the confirmed mode, the CMIPM shall accept an M-EVENT-REPORT response primitive and shall:

a) construct an APDU confirming the M-EVENT-REPORT notification;

b) if the parameters in the M-EVENT-REPORT response primitive indicate that the notification was accepted, send the APDU using the RO-RESULT procedure, otherwise, send the APDU using the RO-ERROR procedure.

6.3.4 Receipt of response

On receipt of an APDU responding to an M-EVENT-REPORT notification, the CMIPM shall, if the APDU is well formed, issue an M-EVENT-REPORT confirmation primitive to the CMISE-service-user, thus completing the notification procedure, otherwise, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.

6.4 Get procedure

6.4.1 Invocation

The Get procedures are initiated by the M-GET request primitive.

On receipt of the M-GET request primitive, the CMIPM shall:

a) construct an APDU requesting the m-Get operation;

b) send the APDU using the RO-INVOKE procedure.

6.4.2 Receipt

On receipt of an APDU requesting the m-Get operation, the CMIPM shall, if the APDU is well formed, issue an M-GET indication primitive to the CMISE-service-user, otherwise, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.

6.4.3 Response

The CMIPM shall:

a) accept zero or more M-GET response primitives containing a linked-ID followed by a single M-GET response primitive without a linked-ID;

b) for each M-GET response primitive containing a linked-ID:

– construct an APDU requesting the m-Linked-Reply operation with LinkedReplyArgument set appropriately as either getListError, getResult or processingFailure;

– send each APDU using the RO-INVOKE procedure;

c) for the M-GET response primitive not containing a linked-ID:

– construct an APDU confirming the m-Get operation;

– if the parameters in the M-GET response primitive indicate that the operation was performed correctly, send the APDU using the RO-RESULT procedure. If the parameters in the M-GET response primitive indicate that the operation was performed with partial success or was not performed because of an error, the CMIPM shall send the APDU using the RO-ERROR procedure.

6.4.4 Receipt of response

On receipt of an APDU responding to an m-Get operation, the CMIPM shall:

a) if the APDU included a linked-ID and is well formed, issue an M-GET confirmation primitive to the CMISE-service-user;

b) if the APDU is the last response (i.e. not containing a linked-ID) and is well formed, issue an M-GET confirmation primitive to the CMISE-service-user, thus completing the M-GET procedure;

c) if the APDU is not well formed, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.

6.4.5 CancelGet procedure

6.4.5.1 Invocation

The CancelGet procedures are initiated by the M-CANCEL-GET request primitive.

On receipt of the M-CANCEL-GET request primitive, the CMIPM shall:

a) construct an APDU requesting the m-CancelGet operation;

b) send the APDU using the RO-INVOKE procedure.

6.4.5.2 Receipt

On receipt of an APDU requesting the m-CancelGet operation, the CMIPM shall, if the APDU is well formed, issue an M-CANCEL-GET indication primitive to the CMISE-service-user, otherwise, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.

6.4.5.3 Response

The CMIPM shall:

a) construct an APDU confirming the m-CancelGet operation;

b) if the parameters in the M-CANCEL-GET response primitive indicate that the operation was performed correctly, send the APDU using the RO-RESULT procedure otherwise, send the APDU using the RO-ERROR procedure. If the m-CancelGet operation is successful, the performing CMISE-service-user shall cease from sending linked replies to the m-Get operation and shall issue an M-GET response primitive which shall contain the "operation cancelled" error.

6.4.5.4 Receipt of response

On receipt of an APDU responding to an m-CancelGet operation, the CMIPM shall, if the APDU is well formed, issue an M-CANCEL-GET confirmation primitive to the CMISE-service-user, otherwise, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.

6.5 Set procedure

6.5.1 Invocation

The Set procedures are initiated by the M-SET request primitive.

On receipt of the M-SET request primitive, the CMIPM shall:

    a) in the confirmed mode, construct an APDU requesting the m-Set-Confirmed operation, otherwise, construct an APDU requesting the m-Set operation;

    b) send the APDU using the RO-INVOKE procedure.

6.5.2 Receipt

On receipt of an APDU requesting the m-Set or m-Set-Confirmed operation, the CMIPM shall, if the APDU is well formed, issue an M-SET indication primitive to the CMISE-service-user, with the mode parameter indicating whether or not confirmation is requested, otherwise, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.

6.5.3 Response

In the confirmed mode, the CMIPM shall:

    a) accept zero or more M-SET response primitives containing a linked-ID followed by a single M-SET response primitive without a linked-ID;

    b) for each M-SET response primitive containing a linked-ID:

        – construct an APDU requesting the m-Linked-Reply operation with LinkedReplyArgument set appropriately as either setListError, setResult or processingFailure;

        – send each APDU using the RO-INVOKE procedure;

    c) for the M-SET response primitive not containing a linked-ID:

        – construct an APDU confirming the m-Set operation;

        – if the parameters in the M-SET response primitive indicate that the operation was performed correctly, send the APDU using the RO-RESULT procedure. If the parameters in the M-SET response primitive indicate that the operation was performed with partial success or was not performed because of an error, the CMIPM shall send the APDU using the RO-ERROR procedure.

6.5.4 Receipt of response

On receipt of an APDU responding to an m-Set-Confirmed operation, the CMIPM shall:

    a) if the APDU included a linked-ID and is well formed, issue an M-SET confirmation primitive to the CMISE-service-user;

    b) if the APDU is the last response (i.e. not containing a linked-ID) and is well formed, issue an M-SET confirmation primitive to the CMISE-service-user, thus completing the M-SET procedure;

    c) if the APDU is not well formed, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.

6.6 Action procedure

6.6.1 Invocation

The Action procedures are initiated by the M-ACTION request primitive.

On receipt of the M-ACTION request primitive, the CMIPM shall:

    a) in the confirmed mode, construct an APDU requesting the m-Action-Confirmed operation otherwise, construct an APDU requesting the m-Action operation;

    b) send the APDU using the RO-INVOKE procedure.

6.6.2   Receipt

On receipt of an APDU requesting the m-Action or m-Action-Confirmed operation, the CMIPM shall, if the APDU is well formed, issue an M-ACTION indication primitive to the CMISE-service-user, with the mode parameter indicating whether or not confirmation is requested, otherwise, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.

6.6.3   Response

In the confirmed mode, the CMIPM shall:

a)   accept zero or more M-ACTION response primitives containing a linked-ID followed by a single M-ACTION response primitive without a linked-ID;

b)   for each M-ACTION response primitive containing a linked-ID:

–   construct an APDU requesting the m-Linked-Reply operation with LinkedReplyArgument set appropriately as either actionError, actionResult or processingFailure;

–   send each APDU using the RO-INVOKE procedure;

c)   for the M-ACTION response primitive not containing a linked-ID:

–   construct an APDU confirming the m-Action operation;

–   if the parameters in the M-ACTION response primitive indicate that the operation was performed correctly, send the APDU using the RO-RESULT procedure, otherwise, send the APDU using the RO-ERROR procedure.

6.6.4   Receipt of response

On receipt of an APDU responding to an m-Action-Confirmed operation, the CMIPM shall:

a)   if the APDU included a linked-ID and is well formed, issue an M-ACTION confirmation primitive to the CMISE-service-user;

b)   if the APDU is the last response (i.e. not containing a linked-ID) and is well formed, issue an M-ACTION confirmation primitive to the CMISE-service-user, thus completing the M-ACTION procedure;

c)   if the APDU is not well formed, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.

6.7   Create procedure

6.7.1   Invocation

The Create procedures are initiated by the M-CREATE request primitive.

On receipt of the M-CREATE request primitive, the CMIPM shall:

a)   construct an APDU requesting the m-Create operation;

b)   send the APDU using the RO-INVOKE procedure.

6.7.2   Receipt

On receipt of an APDU requesting the m-Create operation, the CMIPM shall, if the APDU is well formed, issue an M-CREATE indication primitive to the CMISE-service-user, otherwise, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.

6.7.3   Response

The CMIPM shall accept an M-CREATE response primitive and shall:

a)   construct an APDU confirming the m-Create operation;

b)   if the parameters in the M-CREATE response primitive indicate that the operation was performed correctly, send the APDU using the RO-RESULT procedure, otherwise, send the APDU using the RO-ERROR procedure.

6.7.4   Receipt of response

On receipt of an APDU responding to an m-Create operation, the CMIPM shall, if the APDU is well formed, issue an M-CREATE confirmation primitive to the CMISE-service-user, thus completing the M-CREATE procedure, otherwise, construct an APDU containing notification of the error and send it using the RO-REJECT-U procedure.