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

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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 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

Annex A forms an integral part of this International Standard. Annexes B and C are for information only.

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

1 Scope

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

This International Standard specifies

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

— the abstract syntax of the Common Management Information Protocol 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 International Standard.

This 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 International Standards contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 7498 : 1984, *Information processing systems - Open Systems Interconnection - Basic Reference Model.*

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

ISO 8326 : 1987, *Information processing systems - Open Systems Interconnection - Basic connection oriented session service definition.*

ISO 8649 : 1987, *Information processing systems - Open Systems Interconnection - Service definition for the Association Control Service Element.*

ISO 8650 : 1987, *Information processing systems - Open Systems Interconnection - Protocol specification for the Association Control Service Element.*

ISO 8822 : 1987, *Information processing systems - Open Systems Interconnection - Connection oriented presentation service definition.*

ISO 8823 : 1987, *Information processing systems - Open Systems Interconnection - Connection oriented presentation protocol specification.*

ISO 8824 : 1987, *Information processing systems - Open Systems Interconnection - Specification of Abstract Syntax Notation One (ASN.1).*

ISO 8825 : 1987, *Information processing systems - Open Systems Interconnection - Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1).*

ISO/IEC 9072-1 : 1989, *Information processing systems - Text Communication - Remote Operations - Part 1: Model, Notation and Service Definition.*

ISO/IEC 9072-2 : 1989, *Information processing systems - Text Communication - Remote Operations - Part 2: Protocol Specification.*

ISO/IEC 9595 : 1989, *Information technology - Open Systems Interconnection - Common Management Information Service Definition.*

3 Definitions

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

3.1 Basic Reference Model definitions

This International Standard makes use of the following terms defined in ISO 7498.

a) application-service-element;
b) application-process;
c) real open system;
d) systems-management.

3.2 Management Framework definitions

This International Standard makes use of the following terms defined in ISO/IEC 7498-4.

a) managed object;
b) management information;
c) management information base;
d) systems management application-entity.

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3.3 Remote Operations definitions

This International Standard makes use of the following terms defined in ISO/IEC 9072-1.

a) association-initiator;
b) association-responder;
c) linked-operations;
d) Remote Operations;
e) Remote Operation Service Element.

3.4 CMIS definitions

This International Standard makes use of the following terms defined in 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) invoker;
g) invoking CMISE-service-user;
h) performer;
i) performing CMISE-service-user.

3.5 ACSE definitions

This International Standard makes use of the following terms defined in ISO 8649.

a) application context;
b) application-association;
c) association.

3.6 Presentation definitions

This International Standard makes use of the following terms defined in ISO 8822.

a) abstract syntax;
b) transfer syntax.

4 Symbols and abbreviations

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 Service

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 ISO/IEC 9595, which defines the Common Management Information Services (CMIS).

5.1 Service provided

The protocol specified in this International Standard supports the services defined in ISO/IEC 9595. These services are summarized in table 1.

Table 1 — Common Management Information Services

Service	Type
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 International Standard uses the RO-INVOKE, RO-RESULT, RO-ERROR and RO-REJECT-U services of the Remote Operations Service Element (ROSE) defined in ISO/IEC 9072-1. ROSE assumes the use of the presentation service defined in ISO 8822. The confirmed operations of CMIP are class 2 (asynchronous) or class 1 (synchronous) as required by the application. The unconfirmed operations of CMIP are Class 5 (synchronous, outcome not reported). CMIP uses association class 3.

If the extended service functional unit is successfully negotiated, ROSEapdus 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 International Standard assumes the use of the A-ASSOCIATE, A-RELEASE, A-ABORT, and A-P-ABORT services of the Association Control Service Element.

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5.2.2 Service assumed from the presentation layer

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 PDUs.

5.3 Management information definitions

This International Standard defines the abstract syntax of the Common Management Information Protocol. Attributes specific to a particular managed object are specified by the International Standard which defines that object.

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 ISO 8649.

The application context specifies, among other things, the rules required for the coordination of initialisation 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 ISO/IEC 9072-2.

6.2.2 RO-Reject problem parameters

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

6.2.2.1 RO-Reject-User.Invoke-problem mapping to CMIS error codes is as follows

Table 2 —
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

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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 the CMIPM shall

— 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 the CMIPM shall

— 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, 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 confirm 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.

6.5 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 the CMIPM shall

— 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 the CMIPM shall

— 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, 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 confirm 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

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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 the CMIPM shall

— 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 the CMIPM shall

— 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 confirm 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.

6.8 Delete procedure

6.8.1 Invocation

The Delete procedures are initiated by the M-DELETE request primitive.

On receipt of the M-DELETE request primitive, the CMIPM shall

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

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

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6.8.2 Receipt

On receipt of an APDU requesting the m-Delete operation, the CMIPM shall, if the APDU is well formed, issue an M-DELETE 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.

6.8.3 Response

The CMIPM shall

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

b) for each M-DELETE response primitive containing a linked-ID the CMIPM shall

— construct an APDU requesting the m-Linked-Reply operation with LinkedReplyArgument set appropriately as either deleteError, deleteResult or processingFailure;

—send each APDU using the RO-INVOKE procedure.

c) for the M-DELETE response primitive not containing a linked-ID the CMIPM shall

— construct an APDU confirming the m-Delete operation;

— if the parameters in the M-DELETE 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.

6.8.4 Receipt of response

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

a) if the APDU included a linked-ID and is well formed, issue an M-DELETE confirm 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-DELETE confirmation primitive to the CMISE-service-user, thus completing the M-DELETE 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.

6.9 Association orderly release

Either CMISE-service-user may initiate an orderly release of the association by using the A-RELEASE service of ISO 8649.

NOTE — This specification is different from the ROSE use of the BIND operation in which only the association-initiator may use the A-RELEASE procedure.

6.10 Association abrupt release

Either CMISE-service-user may initiate an abrupt release of the association using the A-ABORT service of ISO 8649.

The CMISE-service-provider may initiate an abrupt release of the association using the A-P-ABORT service of ISO 8649.

7 Abstract syntax

This clause specifies the abstract syntax for the CMIP PDUs.

7.1 Conventions

The abstract syntax is defined using the notation specified in ISO 8824. The ASN.1 MACRO productions used or referenced by this International Standard do not exercise the ambiguous aspects of the grammar.

For each of the CMISE service parameters which is to be transferred by a CMIP PDU, there is a PDU field (an ASN.1 NamedType) with the same name as the corresponding service parameter (see ISO/IEC 9595), except for the differences required by the use of ASN.1, which are that blanks between words are removed and the first letter of the following word is capitalized, e.g. "managed object class" becomes "managedObjectClass". To make some of the names shorter, some words are abbreviated as follows

ack = acknowledgement
arg = argument
id = identifier
info = information
sync = synchronization

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