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Information technology — Remote Operations: OSI realizations — Remote Operations Service Element (ROSE) protocol specification

Technologies de l'information — Opérations à distance: Réalisations OSI — Spécification du protocole pour l'élément de service des opérations à distance (ROSE)

Reference number
ISO/IEC 13712-3:1995(E)

Contents

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 13712-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 21, *Open Systems Interconnection, data management and open distributed processing*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.882.

This part of ISO/IEC 13712 is a partial revision of ISO/IEC 9072-2:1989.

ISO/IEC 13712 consists of the following parts, under the general title *Information technology — Remote operations*:

— *Part 1: Concepts, model and notation*

— *Part 2: OSI realizations — Remote Operations Service Element (ROSE) service definition*

— *Part 3: OSI realizations — Remote Operations Service Element (ROSE) protocol specification*

Annexes A and B form an integral part of this part of ISO/IEC 13712. Annexes C and D are for information only.

Introduction

Remote operations (ROS) is a paradigm for interactive communication between objects. As such it can be used in the design and specification of distributed applications. The basic interaction involved is the invocation of an operation by one object (the invoker), its performance by another (the performer), possibly followed by a report of the outcome of the operation being returned to the invoker.

The concepts of ROS, as specified in ITU-T Rec. X.880 | ISO/IEC 13712-1, are abstract, and may be realized in many ways. For example, objects whose interactions employ ROS concepts may be separated by a software interface or by an OSI network.

ITU-T Rec. X.881 | ISO/IEC 13712-2 provides the framework for the realization of an association contract as an OSI application context. Such an application context is specified primarily in terms of a collection of application service elements. From a ROS perspective, these ASEs fall into three broad categories:

a) operation-specific ASEs, which embody knowledge of the definitions of the operations in the contract;

b) the Remote Operations ASE (ROSE) which drives the general-purpose protocol required to invoke and report returns of arbitrary operations;

c) information transfer ASEs concerned with the establishment and release of associations where necessary, and the communication of the ROSE protocol information.

This Recommendation | International Standard describes the behaviour of ROSE itself, and the way in which different collections of information transfer ASEs (specifically, the Reliable Transfer Service Element (RTSE) and the Association Control Service Element (ACSE)) are employed to transfer its protocol control information (PCI) in an OSI realization.

This Recommendation | International Standard is a revision of CCITT Rec. X.229 | ISO/IEC 9072-2. The existing usage of ROSE in conjunction with ACSE, RTSE and the Presentation layer as defined in CCITT Rec. X.229 | ISO/IEC 9072-2 remains valid after this revision. In addition, this revision makes no change to the ROSE PCI.

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ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – REMOTE OPERATIONS: OSI REALIZATIONS – REMOTE OPERATIONS SERVICE ELEMENT (ROSE) PROTOCOL SPECIFICATION

1 Scope

This Recommendation | International Standard specifies the protocol (abstract syntax) and procedures for the Remote Operation Service Element. The terms, definitions and mechanisms defined in ITU-T Rec. X.880 | ISO/IEC 13712-1 apply here and are specialized for an OSI realization as specified in this Recommendation | International Standard. The ROSE services, defined in ITU-T Rec. X.881 | ISO/IEC 13712-2, are provided in conjunction with the Association Control Service Element (ACSE) services (ITU-T Rec. X.217 | ISO 8649) and the ACSE protocol (ITU-T Rec. X.227 | ISO 8650), optionally the Reliable Transfer Service Element (RTSE) services (ITU-T Rec. X.218 | ISO/IEC 9066-1) and the RTSE protocol (ITU-T Rec. X.228 | ISO/IEC 9066-2), and the Presentation service (ITU-T Rec. X.216 | ISO/IEC 8822).

The ROSE procedures are defined in terms of:

a) the interactions between peer ROSE protocol machines through the use of RTSE services or the Presentation service;

b) the interactions between the ROSE protocol machine and its service-user.

This Recommendation | International Standard specifies conformance requirements for systems implementing these procedures.

2 Normative references

The following ITU-T Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Specification. 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 Specification are encouraged to investigate the possibility of applying the most recent editions of the Recommendations and Standards indicated 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 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.210 (1993) | ISO/IEC 10731:1994, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definitions of OSI services.*
- ITU-T Recommendation X.215 (1994) | ISO 8326:—[1], *Information processing systems — Open Systems Interconnection — Basic connection oriented 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 8649:—[2], *Information processing systems — Open Systems Interconnection — Service definition for the Association Control Service Element.*
- ITU-T Recommendation X.227 (1995) | ISO 8650:—[3], *Information processing systems — Open Systems Interconnection — Protocol specification for the Association Control Service Element.*
- ITU-T Recommendation X.680 (1994) | ISO/IEC 8824-1:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Specification of basic notation.*

1) To be published. (Revision of ISO 8326:1987)
2) To be published. (Revision of ISO 8649:1988)
3) To be published. (Revision of ISO 8650:1988)

- ITU-T Recommendation X.681 (1994) | ISO/IEC 8824-2:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Information object specification.*
- ITU-T Recommendation X.682 (1994) | ISO/IEC 8824-3:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Constraint specification.*
- ITU-T Recommendation X.683 (1994) | ISO/IEC 8824-4:1995, *Information technology – Abstract Syntax Notation One (ASN.1): Parametrization of ASN.1 specifications.*
- ITU-T Recommendation X.690 (1994) | ISO/IEC 8825-1:1995, *Information technology – ASN.1 encoding rules: Specification of Basic Encoding Rules (BER), Canonical Encoding Rules (CER) and Distinguished Encoding Rules (DER).*
- ITU-T Recommendation X.880 (1994) | ISO/IEC 13712-1:1995, *Information technology – Remote Operations: Concepts, model and notation.*
- ITU-T Recommendation X.881 (1994) | ISO/IEC 13712-2:1995, *Information technology – Remote Operations: OSI realizations – Remote Operations Service Element (ROSE) service definition.*

2.2 Paired Recommendations | International Standards equivalent in technical content

- ITU-T Recommendation X.218 (1993), *Reliable transfer: Model and service definition.*

  ISO/IEC 9066-1:1989, *Information processing systems – Text communication – Reliable transfer – Part 1: Model and service definition.*
- ITU-T Recommendation X.228 (1988), *Reliable transfer: Protocol specification.*

  ISO/IEC 9066-2:1989, *Information processing systems – Text communication – Reliable transfer – Part 2: Protocol specification.*
- 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.*

2.3 Additional references

- CCITT Recommendation X.410 (1984), *Message handling systems: Remote operations and reliable transfer service*

3 Definitions

3.1 Reference model definitions

This Recommendation | International Standard is based on the concepts developed in ITU-T Rec. X.200 | ISO/IEC 7498-1 and makes use of the following terms defined in it:

a) application layer;

b) application-process;

c) application-entity;

d) application-service-element;

e) application-protocol-data-unit;

f) application-protocol-control-information;

g) presentation-service;

h) presentation-connection;

i) session-service;

j) session-connection; and

k) transfer syntax.

3.2 Service conventions definitions

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

a) service-provider;

b) service-user;

c) confirmed service;

d) non-confirmed service;

e) provider-initiated service;

f) primitive;

g) request (primitive);

h) indication (primitive);

i) response (primitive); and

j) confirm (primitive).

3.3 Presentation service 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) abstract syntax name;

c) presentation context;

d) defined context set.

3.4 Association control definitions

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

a) application-association; association;

b) application context;

c) association control service element.

3.5 Reliable transfer definitions

This Recommendation | International Standard makes use of the following terms defined in CCITT Rec. X.218 | ISO/IEC 9066-1:

– Reliable Transfer Service Element.

3.6 ROSE service definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.881 | ISO/IEC 13712-2:

a) association-initiating-application-entity; association-initiator;

b) association-responding-application-entity; association-responder;

c) invoking-application-entity; invoker;

d) performing-application-entity; performer;

e) requestor;

f) acceptor;

g) linked-operations;

h) parent-operation;

i) child-operation;

j) remote operation service element;

k) ROSE-provider;

l) ROSE-user;

m) RTSE-user.

3.7 Remote operation protocol specification definitions

For the purpose of this Recommendation | International Standard the following definitions apply:

3.7.1 remote-operation-protocol-machine: The protocol machine for the remote operation service element specified in this Recommendation | International Standard.

3.7.2 requesting-remote-operation-protocol-machine: The remote-operation-protocol-machine whose service-user is the requestor of a particular remote operation service element service.

3.7.3 accepting-remote-operation-protocol-machine: The remote-operation-protocol-machine whose service-user is the acceptor for a particular remote operation service element service.

4 Abbreviations

4.1 Data units

APDU	Application-protocol-data-unit
PCI	Protocol control information
PDV	Presentation data value

4.2 Types of application-protocol-data-units

The following abbreviations have been given to the application-protocol-data-units defined in this Recommendation | International Standard:

Invoke	RO-INVOKE service application-protocol-data-unit
ReturnResult	RO-RESULT service application-protocol-data-unit
ReturnError	RO-ERROR service application-protocol-data-unit
Reject	RO-REJECT-U/P service application-protocol-data-unit

4.3 Other abbreviations

The following abbreviations are used in this Recommendation | International Standard:

AE	Application entity
ACSE	Association control service element
ASE	Application service element
ASN.1	Abstract Syntax Notation One
RO (or ROS)	Remote Operations
ROPM	Remote Operations Protocol Machine
ROSE	Remote Operations Service Element
RT (or RTS)	Reliable Transfer
RTSE	Reliable Transfer Service Element

5 Conventions

This Recommendation | International Standard employs a tabular presentation of the parameters of its pseudo-primitives and for the fields of its APDUs. In clause 7, tables are presented for each pseudo-primitive and each ROSE APDU. Each parameter or field is summarized using the following notation:

blank	Not applicable
M	Presence is mandatory
U	Presence is a ROSE-user option
C	Conditional
req	Source is related request primitive
ind	Sink is related indication primitive
resp	Source is related response primitive
conf	Sink is related confirm primitive
sp	Source or sink is the ROPM

In addition, the notation (=) indicates that a parameter value is semantically equal to the value to its left in the table.

This Recommendation | International Standard employs ASN.1, as specified in ITU-T Rec. X.681 | ISO/IEC 8824-2, to define the **REALIZATION** information object class. It also provides notation by which designers of ROS realizations can specify particular instances of the class.

The structure of each ROSE APDU is specified in ITU-T Rec. X.880 | ISO/IEC 13712-1 using ASN.1.

6 Overview

6.1 Service provision

The protocol specified in this Recommendation | International Standard provides the ROSE services defined in ITU-T Rec. X.881 | ISO/IEC 13712-2. These services are listed in Table 1 reproduced from Table 1 of ITU-T Rec. X.881 | ISO/IEC 13712-2.

Table 1 – ROSE services

Service	Type
RO-INVOKE	Non-confirmed
RO-RESULT	Non-confirmed
RO-ERROR	Non-confirmed
RO-REJECT-U	Non-confirmed
RO-REJECT-P	Provider-initiated
RO-BIND	Confirmed
RO-UNBIND	Confirmed

6.2 Association and transfer services

The ROSE protocol specified herein needs a transfer service to pass information in the form of ROSE APDUs between peer application-entities, and, if a connection package is involved in the association contract, an association service to establish and release associations between the application-entities. These services are provided by use of various ASEs together with the OSI Presentation service.

This specification is structured into the description of a generic protocol (see clause 7), together with a number of specific realizations of the association service (see clause 8) and of the transfer service (see clause 9). The generic protocol is independent of the particular realizations chosen.

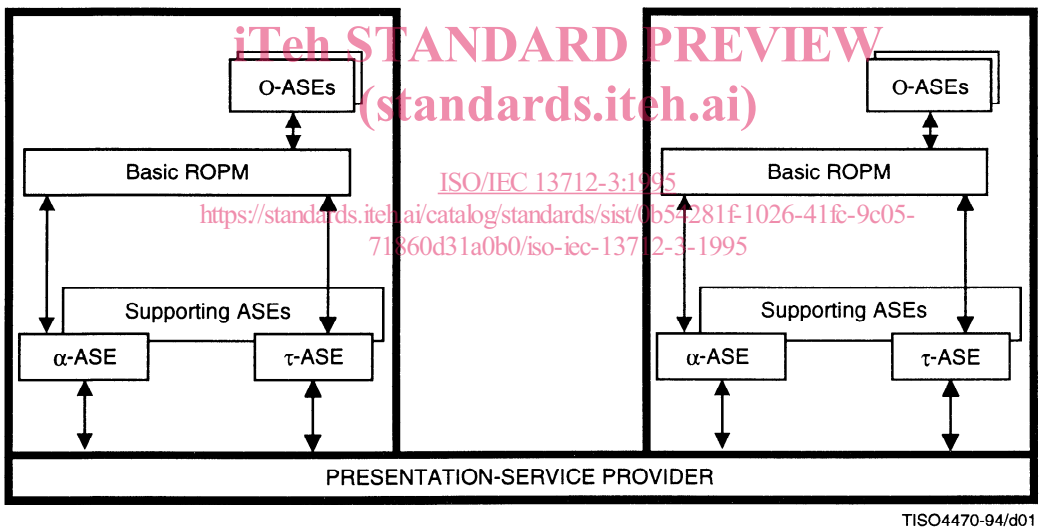
NOTE – It is envisaged that other association and transfer realizations may be defined, both as future extensions to this standard, and on a proprietary basis.

Two specific association realizations are included, one based upon ACSE and one on RTSE. Two specific transfer realizations are included, based respectively on the use of P-DATA and RT-DATA to transfer the APDUs.

6.3 Protocol model

The services of ROSE, as defined in ITU-T Rec. X.881 | ISO/IEC 13712-2, are provided by the Remote Operations Protocol Machine (ROPM). The ROPM uses the services provided by the OSI Presentation service provider, together with a collection of ASEs which shall include an α-ASE, may include a τ-ASE, and may also include ASEs supporting these. The collection always includes ACSE. Different OSI realizations of ROS result from the use of different collections.

This model is depicted in Figure 1.



α-ASE	ASE providing association establishment and release
τ-ASE	ASE providing information transfer
ROPM	Remote Operations protocol machine
O-ASEs	Operation-specific ASEs

Figure 1 – Protocol model

In general, ROSE does not assume that it has exclusive use of the services of the α-ASE, τ-ASE, supporting ASEs, or the Presentation layer. Furthermore, the use of service parameters whose values are unconstrained by the ROSE protocol specification can be specified as appropriate by the application context designer. Any exceptions to this are indicated in the specification of the appropriate realization.

7 Basic ROSE elements of procedure

The basic ROSE protocol consists of the following elements of procedure:

a) association-establishment;

b) association-release;

c) association-abort;

d) invocation;

e) return-result;

f) return-error;

g) user-reject;

h) provider-reject.

In the following subclauses, a specification of each of these elements of procedure is presented. In so doing, a number of pseudo-primitives are used to describe the use of the association and transfer services. Each realization of these services in clauses 8 and 9 describes the actual primitives which are used if that realization is employed.

For the association services, the pseudo-primitives are shown in Table 2.

Table 2 – Pseudo-primitives for association realizations

Assumed service	Pseudo-primitive	req.	ind.	resp.	conf.
Association establishment	*ESTABLISH*				
	application context	M	M(=)		
	release can fail		M	C	C(=)
	user data	U	C(=)	U	C(=)
	result			M	M(=)
Association release	*RELEASE*				
	user data	U	C(=)	U	C(=)
	result			M	M(=)
Association abort-user	*ABORT*				
	source		M		
	user data	U	C(=)		
Association abort-provider	*ABORT-P*				
	provider reason		C		

The result parameter of *ESTABLISH* takes the symbolic values “accepted” and “rejected”.

The release can fail parameter takes the symbolic values “true” and “false”. In successive primitives of this service, the value of the parameter can change from “true” to “false” but not vice versa. This parameter is present on the response or confirm if and only if the result parameter takes the value “accepted”.

The result parameter of *RELEASE* takes the three symbolic values “accepted”, “rejected-released” and “rejected-not-released”.

The source parameter of the *ABORT* takes the symbolic values "association-control service-user" or "association-control-service-provider.

The value of user information parameter depends on the application context in place.

The provider-reason parameter of the *ABORT-P* takes the symbolic values defined in ITU-T Rec. X.216 | ISO/IEC 8822.

For the transfer services, the pseudo-primitives are shown in Table 3.

Table 3 – Assumed primitives for transfer realizations

Assumed service	Pseudo-primitive	req.	ind.
Information transfer	*TRANSFER*		
	user-data	M	M(=)

The use of the components of the various APDUs are described in this clause. In ITU-T Rec. X.880 | ISO/IEC 13712-1, the data types corresponding to these APDUs are specified using ASN.1.

7.1 Association-establishment

7.1.1 Purpose

The attempted establishment of an association through the invocation of a bind operation.

7.1.2 APDUs used

The association-establishment procedure uses the BindInvoke, BindResult, and BindError APDUs. These APDUs are defined if and only if, respectively, the **&ArgumentType**, **&ResultType** and **&ParameterType** fields are defined for the **bind** operation and its associated error used in the **connection package** that is used for dynamic association control (see ITU-T Rec. X.880 | ISO/IEC 13712-1 for a definition of the corresponding information object classes).

7.1.2.1 BindInvoke

The BindInvoke APDU is used in the request to establish an association. The fields of this APDU are listed in Table 4.

Table 4 – BindInvoke APDU fields

Field name	Presence	Source	Sink
Argument	U	req.	ind.

The Argument field is derived from the **&ArgumentType** field of the **bind** operation.

7.1.2.2 BindResult

The BindResult APDU is used to indicate the successful establishment of an association. The fields of this APDU are listed in Table 5.

The Result field is derived from the **&ResultType** field of the **bind** operation.

Table 5 – BindResult APDU fields

Field name	Presence	Source	Sink
Result	U	resp.	conf.

7.1.2.3 BindError

The BindErrorAPDU is used to indicate that the attempt to establish an association was unsuccessful. The fields of this APDU are listed in Table 6.

The Error-Parameter field is derived from the **&ParameterType** field of the error associated with the **bind** operation.

Table 6 – BindError APDU fields

Field name	Presence	Source	Sink
Error-Parameter	U	resp.	conf.

7.1.3 Association-establishment procedure

This procedure is driven by the following events:

a) an RO-BIND request;

b) a BindInvoke APDU as user data on an *ESTABLISH* indication primitive;

c) an RO-BIND response with outcome of "result";

d) a BindResult APDU as user data on an *ESTABLISH* confirm primitive with result of "accepted".

e) an RO -BIND response with outcome of "error";

f) a BindError APDU as user data on an *ESTABLISH* confirm primitive with result of "rejected".

Sending the BindInvoke APDU or BindResult APDU or BindError APDU is optional when, respectively, the **&argumentTypeOptional** or **&resultTypeOptional** or **&parameterTypeOptional** fields of the **bind** operation and error are set to **TRUE**.

7.1.3.1 RO-BIND request

The requesting ROPM forms a BindInvoke APDU from the Argument parameter of the RO-BIND request, and conveys it in the user-data parameter of an *ESTABLISH* request. The release can fail parameter takes its settings from the **&unbindCanFail** field of the connection package identified by the application context parameter.

7.1.3.2 BindInvoke APDU

The accepting ROPM issues an RO-BIND indication, whose Argument parameter is derived from the BindInvoke APDU.

7.1.3.3 RO-BIND response with outcome of "result"

The accepting ROPM forms a BindResult APDU from the Bind-Result parameter of the RO-BIND response, and conveys it in the user-data parameter of an *ESTABLISH* response whose result parameter takes the value "accepted". The unbind can fail parameter of the RO-BIND response governs the setting of the release can fail parameter of the *ESTABLISH* response.

7.1.3.4 BindResult APDU

The requesting ROPM issues an RO-BIND confirm, whose Bind-Result parameter is derived from the BindResult APDU.

7.1.3.5 RO-BIND response with outcome of "error"

The accepting ROPM forms a BindError APDU from the Bind-Error parameter of the RO-BIND response, and conveys it in the user-data parameter of an *ESTABLISH* response.