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Part 1 :
Model, notation and service definition

Systèmes de traitement de l'information — Communication de texte — Opérations à distance —

Partie 1 : Modèle, notation et définition du service

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) together form a system for worldwide standardization as a whole. 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 approval before their acceptance as International Standards. They are approved in accordance with procedures requiring at least 75 % approval by the national bodies voting.

International Standard ISO/IEC 9072-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology.*

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Introduction

This part of ISO/IEC 9072 defines a notation and the services provided by an application-service-element - the Remote Operations Service Element (ROSE) - to support interactive applications in a distributed open systems environment. This part of ISO 9072 is one of a set of International Standards defining sets of application-service-elements commonly used by a number of applications.

Interactions between entities of a distributed application are modeled as Remote Operations, and defined using a Remote Operations notation. A Remote Operation is requested by one entity; the other entity attempts to perform the Remote Operation and then reports the outcome of the attempt. Remote Operations are supported by the ROSE.

This part of ISO/IEC 9072 is technically aligned with CCITT Recommendation X.219.

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Information processing systems -Text communication - Remote Operations - Part 1: Model, notation and service definition

1 Scope

This part of ISO/IEC 9072 defines a Remote Operation (RO-) notation for defining the services provided to interactive applications. This part of ISO/IEC 9072 also defines the services provided by the Remote Operation Service Element (ROSE) services. The ROSE services are provided by the use of the ROSE protocol (part 2 of ISO/IEC 9072) in conjunction with the Association Control Service Element (ACSE) services (ISO 8649) and the ACSE protocol (ISO 8650), optionally the Reliable Transfer Service Element (RTSE) services (ISO/IEC 9066-1) and the RTSE protocol (ISO/IEC 9066-2), and the presentation-service (ISO 8822).

No requirement is made for conformance to this part of ISO/IEC 9072.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 9072. At the time of publication, the editions were valid. All Standards are subject to revision, and parties to agreement based on this part of ISO/IEC 9072 are encouraged to investigate the possibility of applying the most recent editions of the standards listed below. Members of ISO and IEC maintain Registers of currently valid International Standards.

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

ISO/TR 8509: 1987, *Information processing systems - Open Systems Interconnection - Service Conventions.*

ISO 8649: 1988, *Information processing systems - Open Systems Interconnection - Service definition for the Association Control Service Element.*

ISO 8650: 1988, *Information processing systems - Open Systems Interconnection - Protocol specification for the Association Control Service Element.*

ISO 8822: 1988, *Information processing systems - Open Systems Interconnection - Connection oriented presentation service definition.*

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 9066-1: 1989, *Information processing systems - Text communication - Reliable Transfer - Part 1: Model and service definition.*

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

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

3 Definitions

3.1 Reference Model definitions

This part of ISO/IEC 9072 is based on the concepts developed in ISO 7498 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 Layer;

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h) presentation-service;

i) presentation-connection;

j) session-service;

k) session-connection

l) transfer syntax; and

m) user-element.

3.2 Service conventions definitions

This part of ISO/IEC 9072 makes use of the following terms defined in ISO/TR 8509:

a) service-provider;

b) service-user;

c) confirmed service;

d) non-confirmed service;

e) provider-initiated service;

f) service-primitive; primitive;

g) request (primitive);

h) indication (primitive);

i) response (primitive); and

j) confirm (primitive).

3.3 Presentation service definitions

This part of ISO/IEC 9072 makes use of the following terms defined in ISO 8822:

a) abstract syntax;

b) abstract syntax name;

c) transfer syntax name;

d) presentation context.

3.4 Association control definitions

This part of ISO/IEC 9072 makes use of the following terms defined in ISO 8649:

a) application-association; association;

b) application context;

c) Association Control Service Element.

3.5 Reliable Transfer definitions

This part of ISO/IEC 9072 makes use of the following terms defined in ISO/IEC 9066-1:

a) Reliable Transfer Service Element.

3.6 ROSE definitions

For the purpose of this part of ISO/IEC 9072 the following definitions apply:

3.6.1 association-initiating-application-entity; association-initiator: The application-entity that initiates the application-association.

3.6.2 association-responding-application-entity; association-responder: The application-entity that responds to the initiation of an application-association by another AE.

3.6.3 invoking-application-entity; invoker: The application-entity that invokes the Remote Operation.

3.6.4 performing-application-entity; performer: The application-entity that performs a Remote Operation invoked by the other application-entity.

3.6.5 requestor: The part of an application-entity that issues a request primitive for a particular ROSE service.

3.6.6 acceptor: The part of an application-entity that receives the indication primitive for a particular ROSE service.

3.6.7 linked-operations: A set of operations formed by one parent-operation and one or more child-operations.

3.6.8 parent-operation: An operation during the execution of which the performer may invoke linked child-operations to be performed by the invoker of the parent-operation.

3.6.9 child-operation: An operation which might be invoked by the performer of the linked parent-operation during the execution of the parent-operation, and which is performed by the invoker of the parent-operation.

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3.6.10 Remote Operations:

(1) A concept and notation supporting the specification of interactive communication between application-entities. This includes the Remote Operation Service Element and the mapping of the notation onto the service primitives of used application-service-elements.

(2) The set of bind-operations, unbind-operations and operations.

3.6.11 RO-notation: The notation used for the specification of Remote Operations, defined in this part of ISO/IEC 9072.

3.6.12 ACSE-user: The application-specific function that performs the mapping of the bind-operation and unbind-operation of the RO-notation onto ACSE.

3.6.13 Remote Operation Service Element: The application-service-element defined in this part of ISO/IEC 9072.

3.6.14 ROSE-provider: The provider of the Remote Operations Service Element services.

3.6.15 ROSE-user: The application-specific function that performs the mapping of the operations and errors of the RO-notation onto ROSE.

3.6.16 RTSE-user: The application-specific function that performs the mapping of the bind-operation and unbind-operation of the RO-notation onto RTSE.

3.6.17 operation-interface: The interface within an application entity between the user element and the application service elements, defined as a set of application service element services (Remote Operations) available to the user element in RO-notation.

4 Abbreviations

AE	application-entity
ACSE	Association Control Service Element
ASE	application-service-element
APDU	application-protocol-data-unit
OSI	Open Systems Interconnection
RO (or ROS)	Remote Operations
ROSE	Remote Operations Service Element
RT (or RTS)	Reliable Transfer
RTSE	Reliable Transfer Service Element

5 Conventions

This part of ISO/IEC 9072 defines services for the ROSE following the descriptive conventions defined in ISO/TR 8509. In clause 10, the definition of each ROSE service includes a table that lists the parameters of its primitives. For a given primitive, the presence of each parameter is described by one of the following values.

blank	not applicable
M	mandatory
U	user option
C	conditional
O	presence is an ROSE service-provider option

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

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6 Remote Operations Model

In the OSI environment, communication between application processes is represented in terms of communication between a pair of application entities (AEs) using the presentation service. Communication between some application-entities are inherently interactive. Typically, one entity requests that a particular operation be performed; the other entity attempts to perform the operation and then reports the outcome of the attempt. This clause introduces the concept of Remote Operations as a vehicle for supporting interactive applications.

The generic structure of an operation is an elementary request/reply interaction. Operations are carried out within the context of an application-association.

Figure 1 models this view.

Operations invoked by one AE (the invoker) are performed by the other AE (the performer). Operations may be classified according to whether the performer of an operation is expected to report its outcome:

- in case of success or failure (a result reply is returned if the operation is successful, an error reply is returned if the operation is unsuccessful);
- in case of failure only (no reply is returned if the operation is successful, an error reply is returned if the operation is unsuccessful);
- in case of success only (a result reply is returned if the operation is successful, no reply is returned if the operation is unsuccessful);
- or not at all (neither a result nor an error reply is returned, whether the operation was successful or not).

Operations may also be classified according to two possible operation modes: synchronous, in which the invoker requires a reply from the performer before invoking another operation; and asynchronous, in which the invoker may continue to invoke further operations without awaiting a reply.

The following Operation Classes are defined:

Operation Class 1: Synchronous, reporting success or failure (result or error).

Operation Class 2: Asynchronous, reporting success or failure (result or error).

Operation Class 3: Asynchronous, reporting failure (error) only, if any.

Operation Class 4: Asynchronous, reporting success (result) only.

Operation Class 5: Asynchronous, outcome not reported.

The Operation Class of each operation has to be agreed between application entities (e.g. in an Application Protocol International Standard).

In some cases it is useful to group operations into a set of linked-operations which is formed by one parent-operation and one or more child-operations. The performer of the parent-operation may invoke none, one, or more child-operations

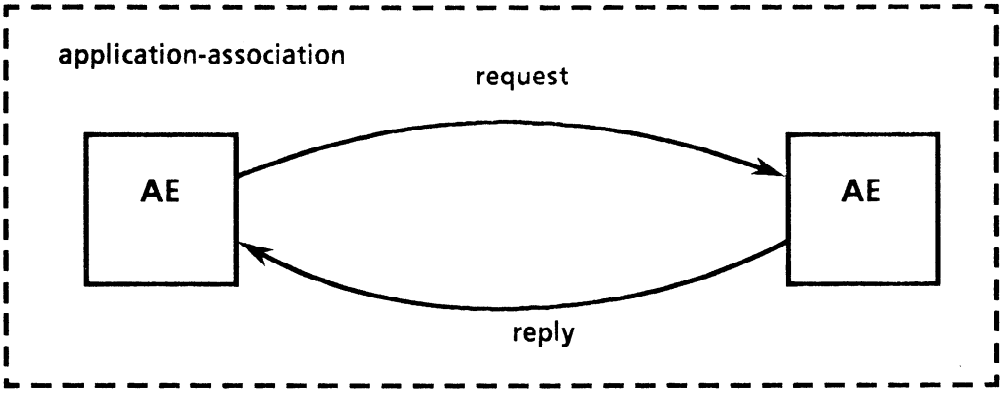

Figure 1 - Remote Operations Model

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during the execution of the parent-operation. The invoker of the parent-operation is the performer of the child-operations. A child-operation may be a parent-operation of another set of linked-operations in a recursive manner. Figure 2 models this concept.

An application-association defines the relationship between a pair of AEs, and is formed by the exchange of application-protocol-control-information through the use of presentation-services. The AE that initiates an application-association is called the association-initiating AE, or the association-initiator, while the AE that responds to the initiation of an application-association by another AE is called the association-responding AE, or the association-responder. Only the association-initiating AE may release an established application-association.

Application-associations are classified by which application-entity is allowed to invoke operations:

Association Class 1: Only the association-initiating application entity can invoke operations.

Association Class 2: Only the association-responding application entity can invoke operations.

Association Class 3: Both the association-initiating and the association-responding application entities can invoke operations.

Linked-operations require Association Class 3.

The Association Class has to be agreed between application-entities (e.g. in an Application Protocol International Standard).

The functionality of an AE is factored into one user-element and a set of application-service-elements (ASEs). Each ASE may itself be factored into a set of (more primitive) ASEs. The interaction between AEs is described in terms of their use of ASEs.

The specific combination of a user-element and the set of ASEs which comprise an AE defines the application-context.

Figure 3 illustrates an example of an application-context involving the Remote Operations Service Element (ROSE). Note that this figure is not meant to imply that the application is symmetric. Interactive applications are often inherently asymmetric, that is, either one or both AEs may be permitted to invoke operations, and the operations that either AE may invoke may be different. The rules governing which AE may invoke operations, and which operations an AE may invoke, is defined using the RO-notation in an Application Protocol International Standard, and determines the application-context.

The set of ASEs available to the user element of the AE at the operation-interface is defined using

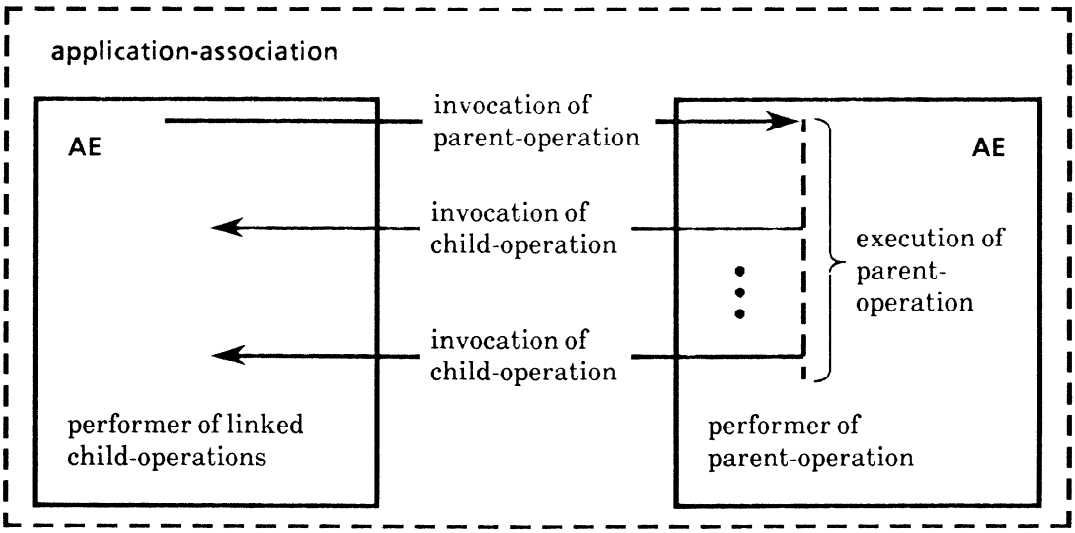

Figure 2 - Linked-operations

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the Remote Operations (RO-) notation. The RO-notation is based on the macro concept defined in ISO 8824. The complexity of a particular set of ASEs is dependent upon the needs of the application, and is not limited by the Remote Operations concept.

An important characteristic of Remote Operations is that they provide applications with independence from OSI communication services. Since the notation is based on established object-oriented programming principles, automatic tools can be developed to bind Remote Operations into the execution environment of applications.

The ASEs available to the user-element require communication over an application-association. The control of that application-association (establishment, release, abort) is performed either by the Association Control Service Element (ACSE) defined in ISO 8649, or the Reliable Transfer Service Element defined in ISO/IEC 9066-1 and the Association Control Service Element (ACSE). Communication over the application-association is performed by the Remote Operations Service Element (ROSE) defined in this part of ISO/IEC 9072.

An application-specific function performs the mapping of the operations available to the user-element onto either the ACSE services, or the RTSE services; and the ROSE services. The mapping is defined in this part of ISO/IEC 9072. The function that performs the mapping of the operations onto the ACSE services, or the RTSE services, and the ROSE services is said to be the user of ACSE, RTSE and ROSE, or the ACSE-user, the RTSE-user, and the ROSE-user.

If the RTSE is included in the application-context, the mapping function is an RTSE-user and a ROSE-user, the ROSE is an RTSE-user, the RTSE is an ACSE-user and a presentation service-user, and the ACSE is a presentation service-user.

If the RTSE is excluded from the application-context, the mapping function is an ACSE-user and a ROSE-user, the ROSE is a presentation service-user, and the ACSE is a presentation service-user.

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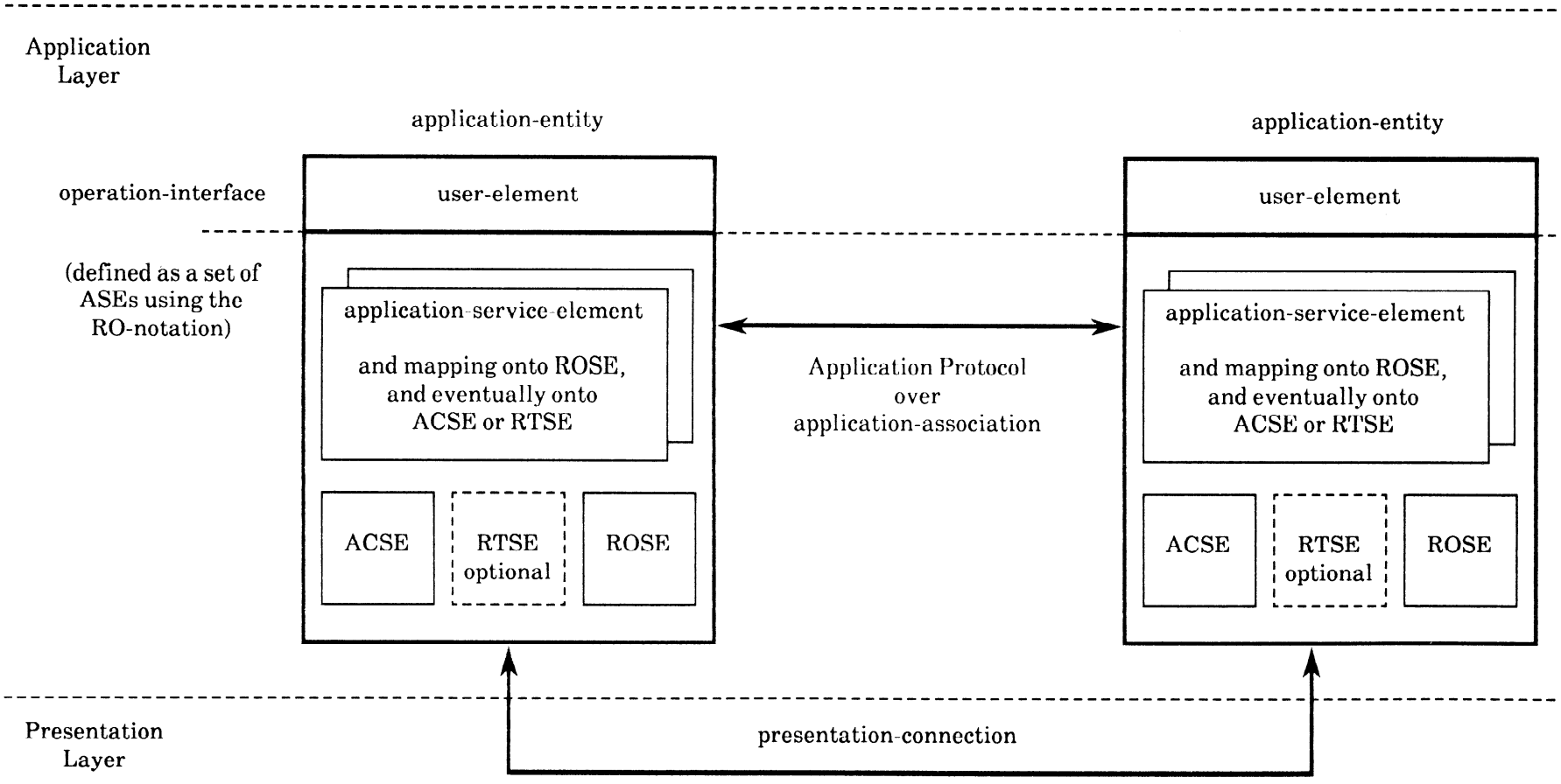

Figure 3 - Model of an application context involving Remote Operations

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7 Overview of notation and service

7.1 Notation Overview

This part of ISO/IEC 9072 defines the RO-notation for the specification of an application-context and the related abstract syntax component of the presentation context.

The functionality of an application-context is provided to the user-element by means of Remote Operations and errors which form the operation-interface.

The following types of Remote Operations form an operation interface:

- a bind-operation to establish an application-association;
- a set of operations and, for each operation, a list of error (negative reply) situations;
- an unbind-operation to release an application-association.

The abstract syntax notation of ISO 8824 is used for the definition of the following macros:

a) BIND;

b) UNBIND;

c) OPERATION; and

d) ERROR.

These macros provide both a type notation and a value notation for Remote Operations and errors.

The type notation of the BIND macro enables the specification of a bind-operation type and the types for user data values (if any) to be exchanged in the establishment phase of an application-association. The value notation of the BIND macro enables the specification of user data values (if any) to be exchanged in the establishment phase of an application-association. The type notation of the UNBIND macro enables the specification of an unbind-operation type and types for user data values (if any) to be exchanged in the release phase of an application-association. The value notation of the UNBIND macro enables the specification of user data values (if any) to be exchanged in the release phase of an application-association.

The type notation of the OPERATION macro enables the specification of an operation and user data types to be exchanged for a request and a positive reply. In addition , the type notation enables the specification of a list of valid negative reply situations. If the operation is a parent-operation, the type notation enables the specification of the list of linked child-operations. The value notation of the OPERATION macro enables the specification of the identifier of an operation.

The type notation of the ERROR macro enables the specification of user data types to be exchanged in a negative reply situation. The value notation of the ERROR macro enables the specification of the identifier of an error.

Additional macros supporting the notation for the specification of application-service-elements and application contexts are defined in annex A.

7.2 Service overview

This part of ISO/IEC 9072 defines the following ROSE services:

a) RO-INVOKE

b) RO-RESULT

c) RO-ERROR

d) RO-REJECT-U

e) RO-REJECT-P

The RO-INVOKE service enables an invoking AE to request an operation to be performed by the performing AE.

The RO-RESULT service enables the performing AE to return the positive reply of a successfully performed operation to the invoking AE.

The RO-ERROR service enables the performing AE to return the negative reply of an unsuccessfully performed operation to the invoking AE.

The RO-REJECT-U service enables one AE to reject the request or reply of the other AE if the ROSE-user has detected a problem.

The RO-REJECT-P service enables the ROSE-user to be informed about a problem detected by the ROSE-provider.

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