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Information technology — Open Systems Interconnection — Distributed Transaction Processing —

Part 3: Protocol specification

Technologies de l'information — Interconnexion de systèmes ouverts (OSI) — Traitement transactionnel réparti —

Partie 3: Spécification du protocole

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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 10026-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

ISO/IEC 10026 consists of the following parts, under the general title *Information technology — Open Systems Interconnection — Distributed Transaction Processing*:

— *Part 1: OSI TP Model*

— *Part 2: OSI TP Service*

— *Part 3: Protocol specification*

— *Part 4: Protocol implementation conformance statement (PICS) proforma*

— *Part 5: Application context proforma*

— *Part 6: Unstructured data transfer*

Annexes A and B form an integral part of this part of ISO/IEC 10026. Annexes C, D, E, F, G and H are for information only.

Introduction

ISO/IEC 10026, Distributed Transaction Processing (OSI TP), is one of a set of standards produced to facilitate the interconnection of computer systems. It is related to other International Standards in the set as defined by the Reference Model for Open Systems Interconnection (ISO 7498). The Reference Model subdivides the area of standardization for interconnection into a series of layers of specification, each of manageable size.

The aim of Open Systems Interconnection (OSI) is to allow, with a minimum of technical agreement outside the interconnection standards, the interconnection of computer systems:

a) from different manufacturers;

b) under different management;

c) of different levels of complexity; and

d) of different technologies.

ISO/IEC 10026 defines an OSI TP Model, an OSI TP Service and specifies an OSI TP Protocol available within the Application Layer of the OSI Reference Model.

The OSI TP Service is an Application Layer service. It is concerned with identifiable information which can be related as transactions, which may involve two or more Open Systems.

ISO/IEC 10026 provides sufficient facilities to support transaction processing, and establishes a framework for coordination across multiple TP resources in separate open systems.

ISO/IEC 10026 does not specify the interface to local resources, nor does it specify an application programming interface within the local system.

Information technology — Open Systems Interconnection — Distributed Transaction Processing — Part 3: Protocol specification

1 Scope

This part of ISO/IEC 10026 provides

a) a statement (clauses 6 to 11) of the nature of the automaton giving the necessary behaviour of each of the participating entities which are providing the OSI TP Service, covering

1) the actions to be taken on receiving request and response primitives issued by a TP Service user invocation;

2) the actions to be taken on receiving indication and confirm primitives issued by the presentation service-provider;

3) the actions to be taken as a result of certain events within the local system;

4) the actions to be taken as a result of interactions with other ASEs;

b) the definition (clause 12) of the abstract syntax required to convey the TP protocol control information;

c) the conformance requirements to be met by implementations of this protocol (clause 13).

The scope of this part of ISO/IEC 10026 is limited to the interconnection of systems; it does not specify or restrict the implementation of possible interfaces within a computer system.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO/IEC 10026. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO/IEC 10026 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated 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 7498-2 : 1989, *Information processing systems - Open Systems Interconnection - Basic Reference Model - Part 2: Security architecture.*

ISO 7498-3 : 1989, *Information processing systems - Open Systems Interconnection - Basic Reference Model - Part 3: Naming and addressing.*

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

ISO 8326 : 1987/Amd 4: —[1], *Information technology - Open Systems Interconnection - Basic connection oriented session service definition - Amendment 4: Additional synchronization functionality.*

ISO 8327 : 1987/Amd 3: —[1], *Information processing systems - Open Systems Interconnection - Basic connection oriented session protocol specification. - Amendment 3:*

1) To be published.

Additional synchronization functionality.

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 8822 : 1988/Amd 5: —[1], *Information technology - Open Systems Interconnection - Connection oriented presentation service definition - Amendment 5: Additional synchronization functionality.*

ISO 8823 : 1988/Amd 5: —[1], *Information technology - Open Systems Interconnection - Connection oriented presentation protocol specification - Amendment 5: Additional synchronization functionality.*

ISO/IEC 8824 : 1990, *Information technology - Open Systems Interconnection - Specification of 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).*

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 9545 : 1989, *Information technology - Open Systems Interconnection - Application Layer Structure.*

ISO/IEC 9579-1 : —[1], *Information technology - Open Systems Interconnection - Remote database access - Part 1: Generic model, service, and protocol.*

ISO/IEC 9579-2 : —[1], *Information technology - Open Systems Interconnection - Remote database access - Part 2: SQL specialization.*

ISO/IEC 9594-2 : 1990, *Information technology - Open Systems Interconnection - The Directory - Part 2: Models.*

ISO/IEC 9594-6 : 1990, *Information technology - Open Systems Interconnection - The Directory - Part 6: Selected Attribute Types.*

ISO/IEC 9646-1 : 1991, *Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts.*

ISO/IEC 9804 : 1990, *Information technology - Open Systems Interconnection - Service definition for the Commitment, Concurrency and Recovery service element.*

ISO/IEC 9804/Amd 2: —[1], *Information technology - Open Systems Interconnection - Service definition for the Commitment, Concurrency and Recovery service element - Amendment 2: Session mapping changes.*

ISO/IEC 9805 : 1990, *Information technology - Open Systems Interconnection - Protocol specification for the Commitment, Concurrency and Recovery service element.*

ISO/IEC 9805/Amd 2: —[1], *Information technology - Open Systems Interconnection - Protocol specification for the Commitment, Concurrency and Recovery service element - Amendment 2: Session mapping changes.*

3 Definitions

For the purposes of this part of ISO/IEC 10026, the definitions given in ISO/IEC 10026-1 (TP Model) and ISO/IEC 10026-2 (TP Service), in addition to those given in 7.3 of this part of ISO/IEC 10026, apply.

Definitions of terms specific to the OSI TP protocol specification are contained in 7.3.

4 Abbreviations

Abbreviations used in the OSI TP protocol specifications are defined in ISO/IEC 10026-1 (OSI TP model), except for the following, which are used in some tables:

cnf confirm primitive

ind indication primitive

req request primitive

rsp response primitive

and for the following, which are used as prefixes to auxiliary facilities services:

1) To be published.

AF Auxiliary Facility

CAF Channel Auxiliary Facility

SAF SACF Auxiliary Facility

5 Conventions

ISO/IEC 10026-2 defines services for Distributed Transaction Processing guided by the descriptive conventions defined in ISO/TR 8509.

However, the terms "request" and "indication" are sometimes used in the following ways:

a) a single request may result in multiple indications (an example is that a single TP-COMMIT request can result in TP-PREPARE indications to each direct subordinate TPSUI);

b) several requests may result in a single indication (an example is that a single TP-COMMIT-COMPLETE indication may be issued to a superior TPSUI only after TP-DONE requests have been issued by the TPSUI and all subordinate TPSUIs in the transaction tree);

c) the convention that a request primitive results in an indication primitive of the same name is not always followed (for example, a TP-COMMIT request will cause a TP-PREPARE indication to be issued).

For a given primitive or APDU, the presence of each parameter or field is described by one of the following values:

Blank: not applicable
M: presence is mandatory
U: presence is a user option
O: presence is a provider option
C: presence is conditional

In addition, the notation (=) indicates that a parameter or field value is semantically equal to the value of the parameter or field of the preceding primitive or APDU in the table. This notation is in some instances combined with another value above, e.g. "(=)/M", and signifies that in some cases the primitive follows as a result of a preceding primitive or APDU (that is, "(=)" applies) and in other cases (when "M" applies), either (i) there is no preceding primitive or APDU, or (ii) the value from the preceding primitive or APDU can be changed.

6 Model of the PM

6.1 Overview

This clause provides an overview of those aspects of the TPPM which are specific to this part of ISO/IEC 10026. These include association usage and management, the details of dialogue establishment and channel management, the use of the Session synchronize-minor token, concatenation, and embedding.

6.1.1 Principles of association usage

An association is used by a TPPM to support either a

— TP dialogue; or

— TP Channel.

An association may be established at any time, according to a local decision. The setting up of an association may be done in parallel with the actions of the PM. An association that has been established and is not currently being used is considered to be in a pool of free associations.

On receipt of a dialogue request, the PM needs to be assigned an association to support this dialogue. Any association that is assigned must have attributes compatible with the dialogue it is to be used for, as described in 8.5.2 (dialogues) and 8.5.3 (channels).

An association may be assigned to the PM from the pool of free associations, or attempts may be made to establish a new association for use with this dialogue or channel. If, as a local decision, it is decided that a compatible association cannot be assigned, the begin dialogue request will be rejected.

Associations may be released at any time they are not in use by the TPPM. The point at which an association becomes unused, and therefore may be released, is defined in the SACF procedures in clause 10.

On the establishment of an association, one AEI is assigned to be the "contention-winner" and the other as the "contention-loser". The assignment of contention-winner and contention-loser remains for the duration of the association. An AEI may be the contention-winner on some associations and contention-loser on others.

The direction from the contention-winner to the contention-loser is the preferred direction of dialogue establishment because the contention-winner has the right of use of the association. The contention-winner may grant to the contention-loser the use of the association for the purpose of establishment of a dialogue, if it is not using or has not reserved this association. The contention-winner may also deny the use of the association by the contention-loser for the purpose of dialogue establishment.

The contention-loser may formally request the rights of the contention-winner temporarily in order to attempt establishment of a single dialogue. This is done using the bid mechanism. The use of the bid mechanism is declared to be either optional or mandatory at association

establishment time. This declaration does not change for the life of the association.

6.1.2 Dialogue establishment

When a TPSUI attempts to establish a new dialogue, a compatible association must first be assigned for use with this dialogue as described above in 6.1.1.

Should two TPPMs (at different AEIs) attempt to establish a dialogue over the same association (without using the bid mechanism), the TPPM at the contention-winner AEI will succeed, disrupting the attempt from the contention-loser.

Use of the bid mechanism affects dialogue establishment. The contention-loser may request the right to establish a single dialogue without the possibility of a conflict by issuing a bid request. The contention-winner may accept or reject the bid request. If accepted, the contention-loser issues the dialogue establishment request. If rejected, the contention-loser may not issue a dialogue establishment request until after the receipt of a dialogue establishment request from the contention-winner.

Bidding by the contention-loser before attempting to establish a dialogue is mandatory in either of the following cases:

a) if bidding is mandatory for the association;

b) if the condition exists where an unexpected C-BEGIN indication may appear (see 10.3.1).

A dialogue establishment request may be rejected for the following reasons:

a) the TPPM is unable to select or establish an association which meets the requirements of the dialogue;

b) the TPPM is a contention-loser on the association and its dialogue establishment or bid request collides with a dialogue establishment request from the contention-winner. It is worthwhile to distinguish two types of collisions:

1) the contention-winner is still within a dialogue;

2) the contention-winner is not within a dialogue. This can happen if the contention-winner begins a dialogue and ends it with no response required from the partner;

c) the partner TPPM or TPSUI rejects the dialogue. This can happen for a variety of reasons: TPSU title not found, insufficient resources, etc. The reason for the rejection is carried on a TP APDU.

NOTE — Although this part of ISO/IEC 10026 specifies that the dialogue establishment is rejected, this does not preclude an implementation from attempting to retry the dialogue establishment.

Because of the use of unconfirmed dialogue or channel termination, it may happen that "stray APDUs" arrive from the partner after a dialogue establishment request. To detect and discard these stray APDUs, a correlator value is sent on the dialogue establishment request, which is returned by the partner at dialogue establishment confirmation time. As dialogue establishment confirmation always precedes any other request issued by the partner, APDUs received before that confirmation are discarded. (The same mechanism is used during channel establishment.)

The mechanism for detecting the dialogue reject situation described in "b) 2)" above is the use of a "last partner identifier" (LPI). When the contention-loser issues a bid request or a dialogue establishment request without a bid request, the request carries the correlator of the previous dialogue establishment indication received from the contention-winner. If the contention-winner receives an LPI with a value different from that of the correlator on the previously issued dialogue establishment request, the bid (or dialogue establishment) request is rejected. The LPI is not provided if there was no previous dialogue establishment indication from the contention-winner.

6.1.3 Channel management

After a node crash or a communications failure, a TPPM may (depending on the transaction state as recorded in a log record found for that transaction) be responsible for recovery. In order to meet this requirement, the TPPM needs a channel for the purpose of recovery. The establishment of channels is in most respects similar to the establishment of dialogues; there is, however, one essential difference: unlike dialogues, channels are not established by the TPPMs themselves, but rather they are established and managed by a channel protocol machine (CPM). There is only a single CPM per AEI and this CPM deals with the channels requested and used by all the TPPMs residing at this AEI.

The interactions between a TPPM and the CPM are modeled by the CAF-service (CAF for Channel Auxiliary Facility). A TPPM uses a CAF service request to request the CPM to establish a channel to a specific partner TPPM. Upon receipt of this request, the CPM either selects an existing channel or establishes a new channel using a procedure similar to that of dialogue establishment (see 6.1.2).

When recovery has been performed, i.e., when a TPPM either has issued a C-RECOVER response or received a C-RECOVER confirm, the TPPM uses another CAF service request in order to inform the CPM that it has no further use for the channel. The CPM then may either terminate the channel or keep it for subsequent use.

Besides satisfying the requests for channels that are issued by TPPMs residing at its AEI, the CPM is also responsible

for responding to all channel establishment indications addressed to its AEI and issued by other CPMs. Moreover, the CPM receives all recovery initiating indications on a channel and directs them to the TPPMs to which they are addressed; whenever no such TPPM may be located, the CPM must respond to the recovery initiating indication.

6.1.4 Channel utilization

A channel is established as either a one-way-recovery channel or a two-way-recovery channel. With either type of channel, due to restrictions in ISO/IEC 9804, only a single C-RECOVER request is allowed to be outstanding on a channel until it has been responded to; moreover the issuer of a C-RECOVER request must own the token unless the C-RECOVER request is issued in response to a C-RECOVER indication (C-RECOVER (commit) request in response to a C-RECOVER (ready) indication) or in some circumstances on a two-way-recovery channel.

On a one-way-recovery channel, only the initiator of the channel has the right to initiate recovery. The token, once owned by the initiator, is never transferred to the partner.

On a two-way-recovery channel, either side of the channel may initiate recovery, provided that it owns the token. The token is transferred to the partner after each C-RECOVER request or AF-RECOVER request; this allows interleaving of recovery exchanges over the channel. When a CPM does not need to initiate recovery any longer, it may transfer the token to its partner; on the other hand, if the side that does not own the token wants to initiate recovery on a channel, it may issue an AF-TOKEN-PLEASE request.

6.1.5 Token control

NOTE 1 See annex B for U-ASE use of tokens.

CCR requires the Session Layer synchronize-minor token (hereinafter called the token—see 7.3) to be owned when beginning a transaction, committing a transaction, or initiating recovery. The TPPM guarantees that the token will be available at the appropriate times in the absence of the movement of the token by the TPSUI or U-ASE. The TPPM uses the following rules for moving the token:

a) the token is owned by the contention-winner when an association is established;

b) the token is returned to the contention-winner at the termination of the dialogue;

c) if the token is received by a contention-loser while the association is not assigned to a dialogue it is returned to the contention-winner. This rule does not hold if the contention-loser is attempting to establish a dialogue and has received a confirmation that a bid request was accepted;

NOTE 2 This happens when a U-ASE request to move the token collides with an unconfirmed dialogue termination request.

d) the token is moved to the contention-loser upon acceptance of a bid request carrying a parameter requesting the token;

e) the token is moved to the contention-loser upon receipt of a dialogue establishment indication (without prior bidding) selecting the Commit functional unit if the contention-winner owns the token and has not reserved the association for other use. If the token is not owned by the contention-winner, it will eventually arrive and then be sent back to the contention-loser;

NOTE 3 This mechanism ensures that the token is always at the dialogue superior when the Commit functional unit is selected to enable the dialogue superior to begin a transaction.

f) if the token is owned by the subordinate after the receipt of the prepare request, the token is sent to the superior when sending the commitment offer.

g) on a two-way-recovery channel, the token is sent to the partner after initiating each recover request.

There are some cases where the token may not be immediately available when required for beginning a transaction or initiating recovery due to the movement of tokens by previous dialogues or other factors. In these cases, except for the case when the U-ASE moves the token within the same dialogue and the token is needed for beginning a transaction, the rules guarantee that the token will eventually arrive, so the TPPM simply waits until it does. A U-ASE that moved the token prior to beginning a transaction is responsible for getting it if it does not have it.

6.1.6 Concatenation/separation

Concatenation is an optional feature which allows multiple APDUs generated by the TPPM (this includes TP, CCR, ACSE, and U-ASE APDUs) to be mapped onto a single PSDU, reducing the number of PSDUs and optimizing performance. Concatenation is performed by the concatenator part of the SACF and is not included in action sequences (the remainder of the SACF is included in action sequences—see 7.1.3).

When concatenation is not used, the state of the supporting layers is always synchronized with the state of the TPPM because of the one-to-one correspondence between PSDUs (which affect the state of the supporting layers) and APDUs (which affect the state of the TPPM). When concatenation is used, it is important to maintain this synchronization between the TPPM and the supporting layers. Therefore, the concatenation rules are constructed such that the APDU directly related to the PSDU causing a state change in the