BRITISH STANDARD

BS ISO/IEC 10026-3:1998

Information technology — Open Systems Interconnection — Distributed Transaction Processing —

Part 3: Protocol specification

ICS 35.100.70

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The UK participation in its preparation was entrusted to Technical Committee IST/6, Data communications, which has the responsibility to:

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— present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;

— monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

Cross-references

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Summary of pages

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Partie 3: Spécification du protocole

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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 10026-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 21, *Open systems interconnection*, *data management and open distributed processing.*

This third edition is a technical revision of the second edition (ISO/IEC 10026-3:1996).

This part of ISO/IEC 10026 is technically aligned with ITU-T Recommendation X.862, but is not published as identical text.

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* (aligned to second edition)

— *Part 5: Application context proforma and guidelines when using OSI TP*

— *Part 6: Unstructured Data Transfer*

Annexes A and B form an integral part of this part of ISO/IEC 10026. Annexes C to G are for information only.

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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 distributed transactions, which 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.

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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/IEC 7498-1:1994, *Information technology — Open Systems Interconnection — Basic Reference Model: The Basic Model.*

ISO/IEC 7498-3:1997, *Information technology — Open Systems Interconnection — Basic Reference Model: Naming and addressing*.

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ISO/IEC 8326:1996, *Information technology — Open Systems Interconnection — Session service definition.*

ISO/IEC 8649:1996, *Information technology — Open Systems Interconnection — Service definition for the Association Control Service Element.*

ISO/IEC 8650-1:1996, *Information technology — Open Systems Interconnection — Connection-oriented protocol for the Association Control Service Element: Protocol specification.*

ISO/IEC 8822:1994, *Information technology — Open Systems Interconnection — Presentation service definition.*

ISO/IEC 8824-1:1995, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation.*

ISO/IEC 8824-1:1995/Amd.1:1996, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation — Amendment 1: Rules of extensibility.*

ISO/IEC 8824-1:1995/Cor.1:1996, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation — Technical Corrigendum 1.*

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).*

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

ISO/IEC 9545:1994, *Information technology — Open Systems Interconnection — Application Layer structure.*

ISO/IEC 9594-6:1995, *Information technology — Open Systems Interconnection — The Directory: Selected attribute types.*

ISO/IEC 9646-1:1994, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 1: General concepts.*

ISO/IEC 9646-7:1995, *Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 7: Implementation Conformance Statements.*

ISO/IEC 9804:1997, *Information technology — Open Systems Interconnection — Service definition for the commitment, concurrency and recovery service element.*

ISO/IEC 9805-1:1997, *Information technology — Open Systems Interconnection — Protocol specification for the commitment, concurrency and recovery service element: Protocol specification.*

ISO/IEC 10731:1994, *Information technology — Open Systems Interconnection — Basic Reference Model — Conventions for the definition of OSI services.*

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.

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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:

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/IEC 10731.

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.

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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 Functional unit capabilities and selection

At association establishment, the TPPMs negotiate which of the TP functional units are supported by both of them. The extensibility rules for the TP-INITIALIZE-RI and TP-INITIALIZE-RC APDUs are such that this negotiation can succeed, and the association be established, even if one TPPM proposes the use of a functional unit that is not recognised by the other. Using this shared knowledge of joint capabilities, subsequent dialogue and channel establishment attempts are constrained to propose only functional units that are known to be supported by both TPPMs. There is no negotiation of functional units at dialogue establishment other than the ability for the responder to reject the attempt and suggest different functional units. that would be acceptable. Dialogue establishment may fail because the TPSU addressed is unable to support the functional units, but the TPPM is assumed to at least recognise the functional units proposed on at dialogue establishment.

In addition to the functional units that are visible in the TP service, and described in ISO/IEC 10026-2, the following functional units affect only the TP protocol:

a) **Solicit Dialogue**: The Solicit Dialogue functional unit allows an AEI to request the peer to establish a dialogue on an existing association to a TPSU at the first AEI. If successful, the dialogue will be established with the TPSU at the AEI that solicited the dialogue as the subordinate;

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b) **RCH-on-dialogue**: The RCH-on-dialogue functional unit permits the recovery-context-handles to be varied independently for each dialogue on an association; and

c) **Cancel**: The Cancel functional unit makes use of the CCR functional unit to rapidly pass the rollback semantic through a transaction tree, allowing release of resources from the ready state, without waiting for heuristic or completion messages from lower down the tree. The normal rollback messages are used subsequently.

6.1.3 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

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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.

6.1.4 Soliciting dialogue establishment

If the solicit-dialogue functional unit is selected on an association, the contention-loser can solicit the establishment of a dialogue on that association, asking that the dialogue be initiated from the peer. The dialogue, if established, will be between a superior TPSUI at the peer system (the solicited system), and a subordinate TPSUI at the system which solicited the dialogue (the soliciting system). The dialogue solicitation identifies the acceptable TPSU-titles (or set of TPSU-titles) at each side.

If the solicited system is prepared to establish an appropriate dialogue, a TPPM at the peer will receive a dialogue request from an appropriate TPSUI. This will invoke the procedures to assign a compatible association which will assign the association on which the solicitation was received. All subsequent procedures then operate as specified for an unsolicited dialogue, including either the creation of a new TPSUI at the soliciting system or the rejection of the dialogue.

If the solicited system is not prepared to establish a solicited dialogue, it replies rejecting the solicitation.

The solicitation of the dialogue can collide with the establishment of a dialogue or channel on the same association. If it collides with a dialogue request that meets the requirements of the solicitation, the collision is ignored; the solicitation will be considered successful from the viewpoint of the soliciting system and the solicitation message is ignored at the solicited system, without affecting the dialogue. If the collision is with a dialogue request that does not meet the requirements of the solicitation or a channel establishment request, the solicitation is considered to be rejected from the viewpoint of the soliciting system, although no additional service primitive is issued. The solicitation message is ignored at the solicited system, without affecting the dialogue or channel.

A dialogue solicitation cannot be made on an association on which a bid has been accepted.

6.1.5 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 modelled 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 6.1.3).

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.

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6.1.6 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, unless the C-RECOVER request is issued in response to a C-RECOVER indication or an AF-RECOVER indication; this allows interleaving of recovery exchanges over the channel. If the side that does not have control of the channel wants to initiate recovery on a channel, it may issue an AF-TOKEN-PLEASE request.

6.1.7 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 when a commitment offer is about to be made, the token is sent when sending the commitment offer.

NOTE 4 When, with the dynamic commitment functional unit, there is a collision of commitment offers, the TPPM receiving the token after sending the commitment offer does not transfer it again. When it (almost immediately) receives the commitment offer, since it now has the token, it will make the decision to commit and order commitment on this dialogue.

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

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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.

6.1.8 Collisions of Ready Signals

The resolution of collisions of ready signals is used to continue in a consistent manner at both nodes without exchanging any further messages. This mechanism is primarily based on the observation that a commit decision is reachable without taking both signals into account i.e. one of these signals can be ignored.

A tie-break mechanism is used for the resolution of the collision of ready signals on a dialogue. The consistent continuation of processing at a single node depends on the ownership of the token:

a) the node which owns the token acts as if no ready signal was sent; the node becomes the commitment coordinator after writing the log-commit record,

b) the node which does not own the token acts as if no ready signal was received; the node is a commit slave and stays in the ready-state until the decision is received.

Following this rule, exactly one of the ready signals will be ignored by both nodes.

The following collisions are not resolved by the tie-break:

a) The collision of ready signals on different channels for a specific transaction branch always leads to rollback.

b) In case of the collision of a ready signal with a one-phase signal or a read-only signal, the ready signal is ignored by both nodes.

c) The collision of a one-phase signal with a one-phase signal or with a read-only signal leads always to commit (though no log-record is written). This collision is not detected by the TPPM but within the CCR-PM and with this the commit decision is propagated.

6.1.9 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 the User data parameter of a Presentation service primitive, reducing the number of Presentation primitives 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 Presentation primitives (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 Presentation primitives causing a state change in the supporting layers is always delivered to the TPPM before any other APDUs in the Presentation primitive (which might not be related to the state change in the supporting layers).

NOTE — An example of this is the C-ROLLBACK-RI CCR APDU. If another APDU was concatenated before this APDU, say, a TP-GRANT-CONTROL-RI APDU, then the following scenario would result. The incoming RS SPUD containing, in the Presentation User data, both APDUs would be processed by Session, resulting in a Session state where an S-RESYNCHRONIZE indication was given and thus a P-RESYNCHRONIZE. The TPPM would, however, process the TP-GRANT-CONTROL-RI APDU first, without seeing the C-ROLLBACK indication. The TPPM could then allow the TPSUI to issue a TP-ROLLBACK request, resulting in an outgoing C-ROLLBACK-RI CCR APDU which is mapped to a P-RESYNCHRONIZE request and thus to an S-RESYNCHRONIZE. This S-RESYNCHRONIZE request is received after the S-RESYNCHRONIZE indication was given previously, resulting in a violation of the Session service-user rules (in some cases). The incoming C-ROLLBACK indication still has not been processed by the TPPM. If nothing could be concatenated before the C-ROLLBACK-RI CCR APDU, then the TPPM

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would have changed its state to reflect the state change in Session (i.e., process the rollback) before it would accept any other input events from the TPSUI.

Separation involves accepting an incoming Presentation primitive and generating a separate event corresponding to each APDU contained in the User data parameter of the Presentation primitive. The entire Presentation primitive is processed before another Presentation primitive is accepted. While concatenation is an optional feature, separation is mandatory; all concatenation sequences that conform to the rules specified in clause 10.7 shall be supported in incoming Presentation primitives.

6.1.10 Embedding

Where semantics of a combination of APDUs require that they be interpreted as a single unit in order to determine the required action, these APDUs are embedded one within the other. This might arise, for example, when an APDU of the TP-ASE defines added value to a CCR APDU.

NOTE — An example of the use of this principle includes the embedding of TP-PREPARE-RI APDU in C-PREPARE request.

The SACF contains a "router" component which handles TP APDUs embedded in indications and confirms. The router causes a CCR or ACSE indication or confirm not carrying a TP APDU to be directly passed to the MACF (through the applicable SACF procedures). If the CCR or ACSE indication or confirm contains an embedded TP APDU, the router will cause the indication or confirm to be passed to the TP-ASE. The TP-ASE then decodes the TP APDU and passes an AF indication or confirm to the MACF (through the applicable SACF procedures) which expresses the combined semantics of the CCR or ACSE service and TP APDU.

6.2 OSI TP Protocol structure

6.2.1 Components of the PM

The protocol specified in this part of ISO/IEC 10026 provides the services defined by the OSI TP Service, ISO/IEC 10026-2.

The protocol specification for TP is presented as a TP Protocol Machine (TPPM), supplemented by a Channel Protocol Machine (CPM). Within an AEI, there is one CPM with which TPPMs of the same AEI interact for the purpose of recovery.

Interactions between a TPPM and the CPM are represented by a service called the Channel Auxiliary Facility (CAF) service. The CAF service, provided by the CPM to TPPMs, models the ability for channels to be dynamically attached to and detached from a particular TPPM.

The TPPM and the CPM comprise a collection of SAOs controlled by a MACF.

The structure of the OSI TP Protocol is shown in figures 1 and 2.

6.2.1.1 The TPPM

The MACF of the TPPM provides both the TP services over multiple associations and the associated temporal ordering rules. The MACF of the TPPM maps TP services onto the functional capabilities of SAOs included in the TPPM, and onto the CAF service, when appropriate.

Each SAO of a TPPM is composed of

a) ACSE, to establish and terminate associations. The ACSE services are not invoked directly from the TP Service, but are invoked by the MACF of the TPPM (see 6.1.1 and 8.2), or, in some cases, by some source other than the TPPM MACF procedures (see 11.3.21 [11.3.22 in the case of a CPM] and 10.5.68);

b) TP-ASE, to provide for TP APDU generation and reception. Interactions between the TP-ASE and the MACF (through the applicable SACF procedures) of the TPPM are represented by a service called the Auxiliary Facility (AF) service.

The AF service, provided by the TP-ASE, models the ability for TP APDUs to be exchanged and mapped onto appropriate underlying services;

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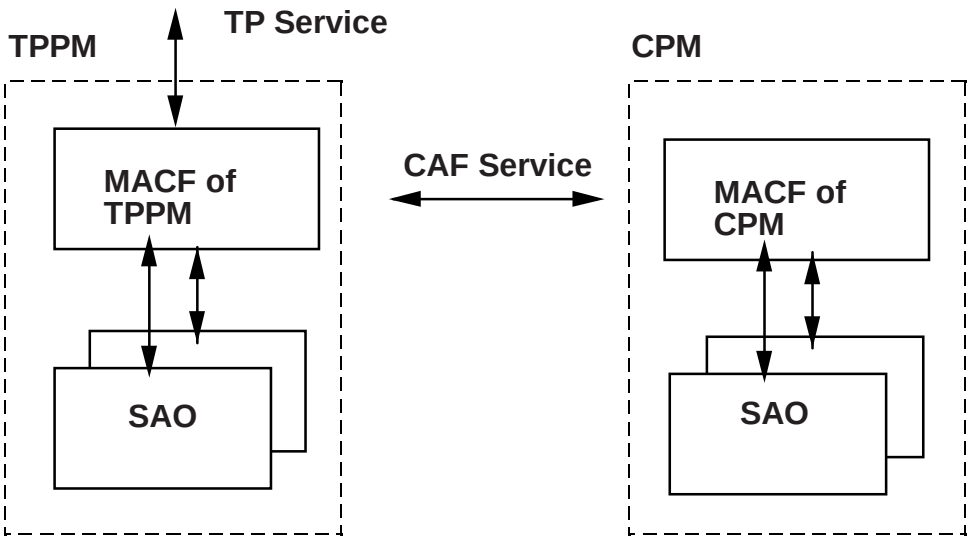
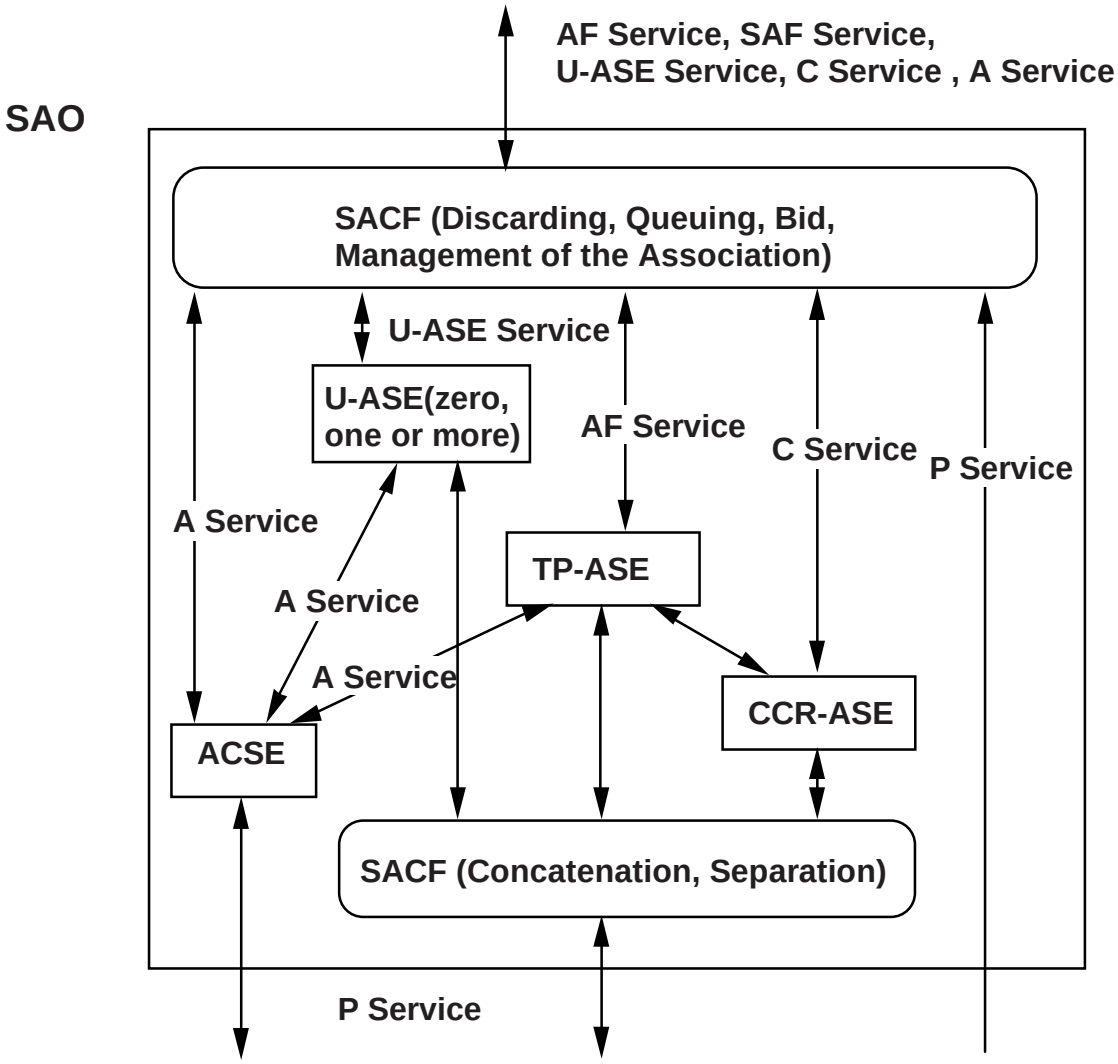


Figure 1 — Relationship between the TPPM and the CPM



NOTE - Only SAOs included in the CPM do not include U-ASE.

Figure 2 — Structure of the SAO

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c) CCR, to provide support for commitment, rollback, and recovery functions, when required. CCR services are used by the MACF of the TPPM either:

1) directly, when no TP APDUs are conveyed by CCR; or,

2) indirectly through the TP-ASE, when TP APDUs are conveyed by CCR (see 8.3);

d) one or more U-ASEs, to provide for application specific protocol. U-ASE services are represented by the TP-DATA service to model TP sequencing constraints on application specific protocols. U-ASE APDUs are mapped onto the Presentation Service, directly or indirectly, as specified by the U-ASE standards;

e) SACF, to coordinate the ASEs in the SAO, in order to maintain a consistent behaviour on the association. The SACF consists of the following components:

1) procedures to examine the services passing between the MACF and SAO and handle actions related to dialogue establishment and managing an association while not in use by a dialogue. These actions can be to allow the service primitive to pass through, discard it, generate additional service primitives, or queue the service primitive. In addition, the procedures provide the SACF Auxiliary Facility (SAF) Service, which represent interactions between the MACF and the SACF;

2) a router which ensures that indications or confirms carrying TP APDUs are directed to the appropriate component. See 6.1.7 on embedding;

3) a concatenator which optionally constructs a single PSDU based on multiple APDUs for outgoing APDUs, and separates each APDU contained in a PSDU for incoming PSDUs.

Both the AF and the SAF services are purely internal to the TPPM: they are not visible outside of the TPPM, and thus are not available for use by anything other than the MACF of the TPPM. The MACF of the TPPM is the only "user" of both the AF and the SAF services. There shall be no conformance requirements to either the AF service or the SAF service.

An application context for an association to be used by TPPM to assign dialogues shall include:

a) ACSE;

b) TP-ASE;

c) CCR, when the Commit functional unit is selected;

d) one or more U-ASEs, specifically identified. When multiple U-ASEs are included, the relationships between them shall be specified as part of their specification, or as part of the application context specification; and,

NOTE — Annex B contains guidelines for writing U-ASEs eligible for inclusion in a TP application context.

e) SACF and MACF procedures.

6.2.1.2 The CPM

The MACF of the CPM includes the necessary provisions to establish and terminate channels, as appropriate. The MACF of the CPM provides the CAF service. The MACF of the TPPM is the only "user" of the CAF services. There shall be no conformance requirements to the CAF service.

SAOs included in the CPM are the same as those of a TPPM except that no U-ASE is required. The AF and SAF services used by the MACF of the CPM are identical in their definitions to those of a TPPM. They are subject to the same restrictions.

An application context for an association to be used by a CPM to assign channels shall include:

a) ACSE;

b) TP-ASE;

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c) CCR; and,

d) SACF and MACF procedures.

7 Execution Rules

7.1 Operation of the PM

This clause describes the interactions between the components of the PM.

7.1.1 Relationship of SAO(s) to MACF(s)

ISO/IEC 9545 defines a one-to-one correspondence between an association and an SAO. While a dialogue or channel is in use on the association, this SAO is associated with a MACF (of a PM). This part of ISO/IEC 10026 provides for the detaching of the SAO from the MACF at the completion of the dialogue or channel such that the association can subsequently be used by a MACF in another PM. In general, when no dialogue or channel exists on an association, the SAO is detached from the MACF. A detached SAO is not considered to be part of any PM. When an incoming request to establish a dialogue or channel is made, the SAO is then attached to a MACF so that the MACF can process the request. When a MACF initiates the establishment of a dialogue or channel, an SAO that is not attached to any other MACF may be attached to the MACF establishing the dialogue or channel. Alternatively, attempts may be made to create a new SAO to attach to the MACF.

All channels that are not in use for recovery are attached to the CPM. When a request is made of the CPM by a TPPM to perform recovery, the CPM satisfies this request by transferring an unused channel (which is associated with the correct AEI) to the TPPM. When an incoming C-RECOVER indication appears on an unused channel, the CPM finds the TPPM corresponding to the transaction being recovered and transfers the channel to that TPPM. As soon as the TPPM completes recovery, the channel is transferred back to the CPM.

7.1.2 Input events to the PM

PM input events occur either as a result of

— request and response primitives issued by the TPSUI or indication primitives issued by the CPM in the case of the TPPM; a request issued by a TPPM in the case of the CPM;

— events triggered by local conditions (internal events); or

— events caused by APDUs and Presentation indications and confirmations output from the concatenator part of the SACF or directly from Presentation if concatenation is not used.

7.1.3 Action sequences

An action sequence is a contiguous sequence of execution of procedures in clause 9, 10, and 11 as a result of a single input event to either the TPPM or the CPM. The CPM and each TPPM have separate action sequences, which proceed independently. An action sequence includes all processing of input events by the PM, except that of the concatenator part of the SACF (see 6.1.9).

An SAO that is not attached to any MACF is not part of any PM action sequences. It may therefore act in parallel with the actions of the PM.

NOTE — This allows association management to be performed independently of normal PM processing.

An action sequence executes completely (i.e., has finished all procedures) before the PM becomes available for handling any subsequent input events.

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An action sequence is a serial and atomic execution of the procedures (except in the event of a node crash), with a single exception where parallelism is allowed: when a request or response is issued to the SAO using the (S)AF, ACSE, CCR, or Presentation services, the SAO may continue this action sequence in parallel with the action sequence of the MACF. The SAO ensures that requests or responses issued by the MACF are processed in the order issued. The SAO completes its part of the action sequence when its procedures are finished.

Within an SAO an A-ABORT request or an A-RELEASE (Result=affirmative) response may be issued. At most one such an event may occur in an action sequence. Such an event is processed by the MACF in order to handle the loss of the association. The event is processed by the MACF in the action sequence in which it was issued once the MACF and all SAOs have completed execution of their procedures (that is, just before the end of the action sequence).

7.1.4 SACF queuing

Certain TP services sometimes cannot be completed in a single action sequence (for example TP-BEGIN-DIALOGUE request). In order to have the TPPM available to accept input events at the TPSUI boundary at all times, it may be necessary to queue requests within the TPPM. Thus, a request that cannot immediately be handled may trigger queuing in the SACF, but is always accepted from the TPSUI. In order to support this, the TPPM describes explicitly queuing operations when they apply.

An example of the need for queuing is that during dialogue establishment for the contention-loser, a bid may be required before the begin dialogue TP APDU is sent. The begin dialogue AF service is therefore queued by the SACF until the bid is complete. While this queuing is taking place, the TPSUI may make further TP service invocations on this dialogue, which will also be queued.

When it becomes necessary to queue, the queuing takes place within the SACF. Certain AF and CCR services are subject to queuing, in that these services may in certain circumstances be queued for a period of time by the SACF before being issued to the TP or CCR ASE. A queue is established for a single dialogue. This queue may subsequently be fully or partially flushed, which causes all or some of the pending service primitives to be processed in a single action sequence, or it may be discarded, which causes the pending service primitives to be discarded. When a queue is fully flushed, any subsequent service primitives are no longer made pending.

7.1.5 Input event blocking at the PSAP

When completing processing for a transaction, APDUs related to a subsequent transaction may be received on an association. The corresponding service primitives cannot be issued to the TPSUI until the transaction is complete.

When service primitives from an association cannot be processed, the TPPM stops accepting service primitives at the PSAP. When processing can resume, the TPPM resumes accepting service primitives at the PSAP including those previously blocked.

NOTE — The concatenator/separator part of the SACF is not prevented from delivering service primitives to the rest of the SAO while service primitives are blocked at the PSAP. These service primitives would be the result of a PSDU already received by the SACF prior to blocking input events at the PSAP. The concatenation rules are such that these incoming events may be processed correctly in that case.

The TPPM stops accepting input events at the PSAP under the following conditions:

a) when a commit confirm has been received from a subordinate and the dialogue has neither been aborted nor had a deferred end dialogue;

b) when a rollback response is issued to or a rollback confirm is received from a subordinate, the Unchained Transactions functional unit is selected, and the dialogue has not been aborted (by the TPSUI);

c) when a C-BEGIN indication is received in the DECIDED (rollback) state and a TP-DONE request is owed;

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d) when a rollback confirm is received from or a rollback response is issued to the superior, the Unchained Transactions functional unit is selected, and a TP-DONE request is owed.

The TPPM resumes accepting input events at the PSAP under the following conditions:

a) when a TP-COMMIT-COMPLETE indication is issued, for each coordinated subordinate dialogue;

b) when a TP-ROLLBACK-COMPLETE indication is issued, for each coordinated subordinate dialogue on which the Unchained Transactions functional unit is selected;

c) when a TP-ROLLBACK-COMPLETE indication is issued, for the superior dialogue;

d) when a TP-U-ABORT request is received on a dialogue on which a rollback response was issued or a rollback confirm was received, and the Unchained Transactions functional unit is selected.

7.1.6 PM error conditions

This part of ISO/IEC 10026 defines three types of error conditions which may occur during the operation of a PM:

a) protocol error - a condition as described in 7.2 e). The association is aborted when a protocol error occurs. When a protocol error occurs, the relevant Protocol Error procedure (10.5.64, 11.3.21, 11.3.22, or 11.3.23) is invoked.

b) internal error - a condition where a local decision is made that the operation of a particular dialogue or channel cannot continue normally. When an internal error on a dialogue is detected, the procedure “Protocol error, internal error, A[-P]-ABORT indication, AF-ABORT (provider, abortRI) indication, A-ABORT request, A-RELEASE (Result=affirmative) response, or A-RELEASE (Result=affirmative) confirm on a dialogue” (11.3.21) is invoked. When an internal error on a channel owned by the TPPM is detected, the procedure “Protocol error, internal error, A[-P]-ABORT indication, AF-ABORT (provider, abortRI) indication, A-ABORT request, A-RELEASE (Result=affirmative) response, or A-RELEASE (Result=affirmative) confirm on a channel” (11.3.22) is invoked. When an internal error on a channel owned by the CPM is detected, the procedure “Protocol error, internal error, A[-P]-ABORT indication, AF-ABORT (provider, abortRI) indication, A-RELEASE (Result=affirmative) response, or A-RELEASE (Result=affirmative) confirm (CPM)” (11.3.23) is invoked.

NOTE 1 Irregularities in the APDU exchanges between U-ASEs are not visible to the TPPM unless they are intentionally signalled to the MACF; in such a case they may be treated as a TP internal error. Although the U-ASE may define such an irregularity as a protocol error, it is not a protocol error in the scope of ISO/IEC 10026.

c) node crash - a condition where the operation of the PM cannot continue as determined by local considerations. Upon restart after a node crash, the internal event “Restart after node crash” (11.4.3) is triggered.

An internal error or node crash may be triggered by an unexpected event which is received from the TPSUI. Note that rule f) in 7.2 specifies that the procedures assume the operation of the TPSUI is correct according to the service rules, but the state tables in annex A check for violations of these rules. Should such a violation occur, either an internal error or node crash may be triggered, depending on the scope of the violation as determined locally.

NOTES

2 An example of a TPSUI triggering a node crash may occur when an error is made in a TP service which affects all dialogues, such as the TP-COMMIT request.

3 A timer expiring is an example of a condition which may trigger an internal error.

7.2 Procedure rules

The following rules govern the execution of the procedures:

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a) Parameter inheritance

The tables of 9.3 use the notation "(=)" to represent matching of parameters/fields values from the values of parameters/fields of the preceding (causal) primitive/APDU. This value matching is assumed implicitly, so that explicit calling out of the setting of these values is not done in the procedures.

b) Procedure atomicity

Each procedure executes atomically, except in the case of a node crash (see 7.1.3).

c) Inspection of transaction-related state

The transaction-related state consists of the transaction state, the node type (that is, root, intermediate, or leaf), and whether the node is a superior, subordinate, or does not exist in the transaction tree. Any inspection of the transaction-related state within the procedures refers to the state at the time of the input event which triggered the current action sequence, with one exception: if the MACF is being re-entered in the same action sequence as a result of an A-ABORT request or an A-RELEASE (Result=affirmative) response, inspection of the transaction-related state refers to its value at the time the MACF is re-entered.

NOTE 1 This handles the situation where the MACF transitioned from the ACTIVE state to the DECIDED (rollback) state, and then the U-ASE issued an A-ABORT request (for example). The state inspection when the MACF is re-entered will not cause a rollback, since the MACF will see the DECIDED (rollback) state and not the ACTIVE state.

d) Procedure sequence

The execution of each action specified in the procedure is assumed to be in the sequence specified in the procedure, unless explicitly stated otherwise.

e) Protocol error detection

A protocol error is declared when one of the following conditions occurs:

1) a procedure, other than an internal event procedure (refer to 10.6 and 11.4) is invoked and

i) no action is taken and no condition is applicable as a result of that procedure invocation; or

NOTE 2 The action "continue" is used in the procedures as a null action, to avoid incurring errors of this type. Other conditions in the same procedure may be applicable, however, resulting in non-null actions being taken.

ii) the procedure precondition is violated. (Preconditions are presented at the beginning of some procedures in the form of declarative sentences.);

2) a TP indication or confirm is issued that violates the constraints specified in ISO/IEC 10026-2;

3) a CCR or ACSE protocol error occurs;

4) a TP APDU is received by the PM which is not encoded as specified in 12.1 "Abstract Syntax of the TP-ASE APDUs", or is not carried on the CCR, ACSE, or Presentation services as specified in 9.5 and 10.7.1;

5) an invalid concatenation sequence is received (see 10.7.2) and is detected as invalid.

NOTE 3 It is not required that invalid concatenation sequences are detected.

When a protocol error is declared,

1) if the protocol error occurs in the TP-ASE or SACF with no attached MACF, procedure "Protocol error" (10.5.64) is executed;

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2) if a TPPM MACF is attached to the association on which the protocol error occurred and a dialogue is active, the procedure "Protocol error or ... on a dialogue" (see 11.3.21) is executed with an indication of a protocol error. As a local decision, this procedure may be invoked on multiple associations, if the protocol error is the result of the attempted issuance of a TP indication or confirm not associated with a particular dialogue;

3) if a TPPM MACF is attached to the association on which the protocol error occurred and a channel is active, the procedure "Protocol error or ... on a channel" (see 11.3.22) is executed with an indication of a protocol error. As a local decision, this procedure may be invoked on multiple associations, if the protocol error is the result of the attempted issuance of a TP indication or confirm not associated with a particular dialogue.

4) if a CPM MACF is attached to the association on which the protocol error occurred, the procedure “Protocol error or ... (CPM)” (see 11.3.23) is executed with an indication of a protocol error.

f) Service rules assumption

Each TP service primitive is assumed to have been received in accordance with the constraints and conditions specified in ISO/IEC 10026-2 and the requirements in annex F.

g) No superior/subordinate assumption

If an action refers to a superior or subordinate, and there is no superior or subordinate (because the node is a root or leaf, respectively), the action is not taken.

h) Bounds of the past

In certain cases, the text refers to a TP or CCR service which has been received. For CCR and TP and related AF services contained in the Commit and Unchained Functional Units, this means that the service primitive was received since the beginning of the current transaction. For all other services, this means that the service primitive was received since the beginning of the current dialogue. In any case, this type of memory of previously received service primitives never survives a node crash.

The terms *ready signal was sent* and *ready signal was received* refer whether the CCR primitive event (issue of C-READY request, receipt of C-READY indication) occurred since the beginning of the current transaction, unless there has been a node crash. Following a node crash, they refer to whether the event was recorded for the current transaction in the log-record.

i) Dialogue assumption

Any dialogue or channel referred to in a procedure is assumed to be the dialogue or channel on which the service primitive was received/issued, unless stated otherwise.

j) Tree topology terminology

Whenever the terms superior, subordinate, root node, intermediate node, or leaf node occur without the qualification “dialogue”, they are understood to refer to the transaction tree.

7.3 Definitions

When the following definitions or their logical negations are used in the text, they will appear in italics. AF services used in these definitions are defined in 9.2.

An AF-TOKEN-PLEASE request is outstanding - When the CPM has issued an AF-TOKEN-PLEASE request, a subsequent C-RECOVER, AF-RECOVER, or AF-TOKEN-GIVE (two-way-recovery) indication has not been received, and the channel still exists.

Attach - The specified SAO and association becomes part of the PM. Any indications or confirms made from that SAO are seen by the PM; the PM may direct requests or responses to the SAO.

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CAF-PLEASE request is outstanding - Once issued a CAF-PLEASE request remains outstanding for a channel until one of the following occurs:

— A CAF-GIVE indication is issued by the CPM for the channel;

— A CAF-FAIL indication is issued by the CPM for the channel;

— A search for the TPPM corresponding to the “Atomic Action Identifier”, ”Branch Identifier”, and “Superior” parameters of the CAF-PLEASE request fails to find the TPPM; or

— A further CAF-PLEASE request is received with the same parameters.

NOTE 1 A further CAF-PLEASE request with the same parameters can be received following a node crash.

Basic functional units - The following functional units are collectively referred to as the *basic functional units*: Dialogue, Shared Control, Polarized Control, Handshake, Commit, Chained Transactions, Unchained Transactions and Recovery. If the Functional-Units-Capability field is not present on the TP-INITIALIZE-RI/-RC exchange, the *basic functional units* are assumed to be available for selection.

NOTE 2 In practice, they may not be, but the first edition of this Protocol Specification did not provide for identification of functional unit capability at association establishment.

Carrying the reporting status - Various auxiliary request and response service primitives are required to be issued *carrying the reporting status.* These primitives always have a Heuristic-Report parameter and, in most cases, Severity, Diagnostic and Completion-data parameters. *Carrying the reporting status* means these parameters shall be set as follows:

a) the Heuristic-Report parameter shall be absent if the Heuristic Containment Required functional unit is selected on the dialogue, or on the dialogue, now detached, that supported the branch; it shall be present otherwise

b) if present, according to a), the Heuristic-Report parameter shall be set to the current value of the log-damage record, if there is a log-damage record or set to "none" if there is no log-damage record;

c) the Severity, Diagnostic and Completion-data parameters shall be absent if the Completion Diagnostics functional unit is not selected on the dialogue, or if the primitive is issued on a channel

d) if the primitive is issued on a dialogue on which the Completion Diagnostics functional unit is selected, and no TP-EARLY-EXIT request was received, the Completion-data parameter on the primitive shall be set to the value of the Completion-data parameter on the most recent TP-DONE request on which the parameter was present (this may be a null value)

e) if the primitive is issued on a dialogue on which the Completion Diagnostics functional unit is selected and the TPPM is in the DECIDED (rollback) state and no TP-EARLY-EXIT request was received, the Severity parameter on the primitive shall be set to the value of the Severity parameter on the most recent TP-DONE request on which the Severity parameter was present

f) if the primitive is issued on a dialogue on which the Completion Diagnostics functional unit is selected and the TPPM is in the DECIDED (rollback) state, and a *rollback indication* was not received on the dialogue, the Diagnostics parameter of the primitive shall set to the first applicable value of the following:

   1) “user-rollback” if a rollback initiating request was received and no TP-ROLLBACK indication was issued;

   2) “user-data-transaction-completion-collision” if a TP-ROLLBACK indication with that value in the Diagnostic parameter was issued

   3) “early-exit-transaction-completion-collision” if a TP-ROLLBACK indication with that value in the Diagnostic parameter was issued

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4) the value from the Diagnostic parameter on any TP-COMPLETION-REPORT indication issued with the Diagnostic parameter; it is a local option which value is used if there is more than one such TP-COMPLETION-REPORT indication;

5) "other-provider-rollback", if none of the previous conditions apply

a) if the primitive is issued on a dialogue on which the Completion Diagnostics functional unit is selected, a TP-EARLY-EXIT request was received and a C-ROLLBACK indication was received, the Completion-data parameter on the primitive shall be set to the value of the Completion-data parameter on the TP-EARLY-EXIT request

b) if the primitive is issued on a dialogue on which the Completion Diagnostics functional unit is selected, a TP-EARLY-EXIT request was received and a C-ROLLBACK indication was received, the Severity parameter on the primitive shall be set to the value of the Severity on the TP-EARLY-EXIT request

If no value is assigned to a parameter by the above conditions, the parameter shall be absent.

NOTE 3 The phrase is used only for primitives issued on the superior dialogue, or in the recovery sequence for a branch on the former superior dialogue.

Close the PSAP - No further PSDUs are accepted at the PSAP unless and until the PSAP is opened (see 7.3, "Open the PSAP").

Commit confirm - One of the following:

— C-COMMIT confirm;

— C-RECOVER(done) confirm;

— AF-REPORT (commitRC) indication;

— AF-REPORT (recoverDoneRC) indication;

— AF-ABORT (user, commitRC) indication; or

— AF-ABORT-AND-REPORT (commitRC) indication.

Commit indication - One of the following:

— C-COMMIT indication;

— C-COMMIT+C-BEGIN indication;

— AF-ABORT (user, commitRI) indication;

— C-RECOVER (commit) indication; or

— AF-RECOVER (commit) indication.

Commit Response - One of the following:

— C-COMMIT response;

— AF-REPORT (commitRC) request;

— AF-ABORT (user, commitRC) request; or

— AF-ABORT-AND-REPORT (commitRC) request.

— C-RECOVER (done) response

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Commit request - One of the following:

— C-COMMIT request;

— C-COMMIT+C-BEGIN request;

— AF-ABORT (user, commitRI) request;

— C-RECOVER(commit) request; or

— AF-RECOVER (commit) request.

DECIDED (commit-one-phase) state - The node is in the DECIDED (commit) state as specified in ISO/IEC 10026-1, but has previously been in the ONE-PHASE state and not in the READY state..

NOTE 4 This Protocol Specification uses the term “TPPM is in the DECIDED (commit) state” only when the TPPM has previously been in the READY state.

Detach - The specified SAO and association ceases being part of the PM. The SAO is no longer able to make indications or confirms to any PM; no PM may direct requests or responses to the SAO.

Dialogue has been detached - One of the following service primitives has been issued/received by the PM for the dialogue:

— SAF-DETACH-ASSOCIATION request;

— SAF-ASSOCIATION-LOST indication;

— A-ABORT request;

— A-[P-]ABORT indication;

— A-RELEASE (Result=affirmative) response or confirm.

Dialogue is chaining transaction branches; chaining dialogue - When all of the following conditions are met:

— the dialogue exists;

— the Chained Transactions functional unit was selected;

— no TP-U-ABORT request was received for the dialogue;

— no AF-ABORT, AF-ABORT-AND-REPORT, or A[-P]-ABORT indication was received for the dialogue; and

— if the outcome of the transaction is either commitment or unknown, no TP-DEFERRED-END-DIALOGUE request and no AF-DEFER (end-dialogue) indication has been received for the dialogue, unless an AF-EARLY-EXIT request has been issued or AF-EARLY-EXIT indication received

Dialogue supports a continuing branch — the dialogue has a coordination level of “commitment” and no C-NOCHANGE indication or AF-NOCHANGE indication or AF-EARLY-EXIT indication has been received

Dialogue will be coordinated - a dialogue established with the following:

— the Chained Transactions functional unit; or

— the begin-transaction parameter is set to "true" on the TP-BEGIN-DIALOGUE request or indication.

NOTE 5 This definition is necessary because the coordination level does not become defined until the TP-BEGIN-DIALOGUE indication is made. This definition is intended only for use during dialogue establishment.

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Discard a queue - The SACF discards all queued service primitives.

NOTE 6 This definition is used only when a dialogue is terminated.

Discard any PDUs in the separator - The SACF discards all queued PDUs in the separator.

Establish a queue - the SACF ensures that the AF, CCR, and Presentation service primitives invoked subsequent to the establishment of the queue, are queued.

Flush a queue - the SAO processes some or all (depending on the context in which the definition is used) of the queued service primitives in the order in which they were queued. If all requests and responses were flushed, the SACF then ensures that any subsequently invoked AF, CCR, ACSE, and Presentation requests and responses are not queued.

NOTE 7 The processing of all requests and responses on the queue is done by the SAO atomically as part of the action sequence in which the queue is flushed.

Forget a transaction - Remove from secure storage the log-ready or log-commit record concerning this transaction, retaining, if any, the log-heuristic and/or the log-damage records.

Heuristic reporting applies on a dialogue / on a branch - for a dialogue, the Heuristic Containment Required functional unit was not selected when the dialogue was established; for a branch, the Heuristic Containment Required functional unit was not selected on the dialogue (possibly now *detached)* that originally supported the branch.

Identifies a branch - A CCR or AF service primitive that includes parameters Atomic Action Identifier and Branch Identifier *idenitifies* the corresponding branch

Intermediate log-record has been rewritten - A *commit indication* was received and a log-commit record is in secure storage (as a result of invoking internal event “Rewriting intermediate record” (see 11.4.9).

Last commit confirm was received - When all of the following conditions are met:

— the TPSUI does not *owe a TP-DONE request*;

— a *commit confirm* has been received from each neighbour to which a *commit request* was issued.

Last partner identifier is valid - The last-partner-identifier parameter of the most recently received AF-BEGIN-DIALOGUE indication or AF-BID indication is either

— absent or may carry any value, if no AF-BEGIN-DIALOGUE request was issued on this association; or

— has a value equal to the Correlator of the most recently issued AF-BEGIN-DIALOGUE request on this association.

Last ready was received - When all of the following conditions are met :

— at least one of the following is true

i) TP-COMMIT req has been received; or

ii) TP-READ-ONLY request or TP-ONE-PHASE request has been received and there is *TPPM bound data*

iii) TP-READ-ONLY request or TP-ONE-PHASE request has been received and more than one C-READY indication has been received.

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and

— if the TPPM previously started to set the *TPPM bound data* into the ready-to-commit state, the *TPPM bound data* are in the ready-to-commit state; and,

NOTE 8 The TPPM may either atomically set the bound data to the ready-to-commit state when writing the log-ready record, or may start to set the bound data to the ready-to-commit state before writing the log-ready record. This condition applies only to the case where the TPPM previously started to set the bound data to the ready-to-commit state.

— a C-READY indication or *ready-substitute indication* has been received on all branches of the transaction

Last ready-substitute has been received - When all of the following conditions are met

— a TP-ONE-PHASE request or TP-READ-ONLY request has been received

— *there is no bound data at the TPPM*

— a *ready-substitute indication* has been received on all branches of the transaction

Last rollback confirm was received - When all of the following conditions are met:

— the TPSUI does not *owe a TP-DONE request*;

— a *rollback indication* or *rollback confirm* has been received from each of the subordinates whose *dialogue has not been detached*.

Lazy-log-forget is applicable - the "lazy log forgets tolerated" functional unit was available on the association that supported the dialogue that supported the branch on which a *commit request* was issued and there is no log-commit record and bound data will not be released in the initial state even if there were a node crash followed by the procedures for restart after node crash

NOTE 9 Performing a lazy log forget implies that the TPPM may, following a node crash, issue a C-RECOVER (Ready) request for a transaction branch after it has issued a *commit-confirm.* In response, the TPPM may receive a C-RECOVER (unknown) confirm or a C-RECOVER (commit) indication, depending on the state of the partner. The C-RECOVER (unknown) confirm implies that the transaction has rolled back. The local decision of performing a lazy log thus requires that the TPPM guarantees that the ACID properties of the transaction will not be violated in this case.

Non-recovery states may be entered - When all of the following conditions are met

— a TP-ONE-PHASE request or TP-READ-ONLY request has been received

— *there is no bound data at the TPPM*

— there is precisely one dialogue of the transaction on which no *ready-substitute indication* has been received and on that dialogue

i) *ready-is-sendable* and

ii) at least one of the following is true:

a) an AF-PREPARE indication has been received; or

b) it is a subordinate dialogue and no AF-PREPARE(data-permitted) request has been sent; or

c) it is a superior dialogue and the Implicit Prepare functional unit is selected and no AF-PREPARE(data-permitted) request has been sent

— no C-READY indication has been received on any other dialogue

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NOTE 10 *Non-recovery states may be entered* is true even if a C-READY indication has been received on the one branch of the transaction on which a *ready-substitute indication* has not been received

One-phase indication - One of the following:

— C-NOCHANGE indication;

— AF-NOCHANGE indication;

Open the PSAP - PSDUs are now accepted at the PSAP.

Ready signal was sent (to a neighbour/on a dialogue) - a log-ready record was written identifying that a C-READY request will be issued (to the neighbour/on the dialogue) and, (in the same action, unless there was a failure) a C-READY request was so issued.

Ready signal was received (from a neighbour/on a dialogue) - a C-READY indication was received (from the neighbour/on the dialogue) since the beginning of the current transaction; or, if there has been a node failure since the beginning of the current transaction, a log-record was written that stated that a C-READY indication was received from the neighbour. The condition remains true till the end of the transaction even if the log-record has since been removed.

Ready-is-receivable (on a dialogue) - The dialogue is included in the current transaction and one of the following sets of conditions is true

i) the dialogue is to a subordinate, the Commit functional unit is selected and the Dynamic Commit functional unit is not selected on the dialogue; or

ii) the dialogue is to a superior and the One-phase commit functional unit is selected and the Commit functional unit is not selected

iii) the dialogue is to a subordinate and the Subordinate-may-send-ready parameter on the TP-BEGIN-DIALOGUE request had the value "true"

iv) the dialogue is to the superior and the Superior-may-send-ready parameter on the AF-BEGIN-DIALOGUE indication had the value "true"

NOTE 11 In case ii), the dialogue is using static one-phase commit and a ready signal will not be received.

Ready-is-sendable (on a dialogue) - The dialogue is included in the current transaction and one of the following sets of conditions is true

i) the dialogue is to the superior, the Commit functional unit is selected and the Dynamic Commit functional unit is not selected on the dialogue; or

ii) the dialogue is to a subordinate and the One-phase commit functional unit is selected and the Commit functional unit is not selected

iii) the dialogue is to the superior and the Subordinate-may-send-ready parameter on the AF-BEGIN-DIALOGUE indication had the value "true"

iv) the dialogue is to a subordinate and the Superior-may-send-ready parameter on the TP-BEGIN-DIALOGUE request had the value "true"

NOTE 12 In case ii), the dialogue is using static one-phase commit and a ready signal will not be sent.

Ready state may be entered - When all of the following conditions are met:

— a local decision determines that (if the other conditions are met), the READY state should be entered if possible; and

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13 It is expected that this decision will usually be to attempt to enter the ready state. The decision not to attempt to enter the READY state is equivalent to the existence of an additional subordinate (or local resource) which is not yet ready.

14 The local decision can be different when “ready state may be entered” is evaluated more than once

— at least one of the following is true

i) TP-COMMIT req has been received; or

ii) TP-READ-ONLY request or TP-ONE-PHASE request has been received and there is *TPPM bound data*

iii) TP-READ-ONLY request or TP-ONE-PHASE request has been received and at least one C-READY indication has been received

and

— if the TPPM previously started to set the *TPPM bound data* into the ready-to-commit state, the *TPPM bound data* are in the ready-to-commit state; and,

NOTE 15 The TPPM may either atomically set the bound data to the ready-to-commit state when writing the log-ready record, or may start to set the bound data to the ready-to-commit state before writing the log-ready record. This condition applies only to the case where the TPPM previously started to set the bound data to the ready-to-commit state.

— there is precisely one dialogue in the transaction on which no C-READY indication or *ready-substitute indication* has been received, and, on that dialogue,

i) none of C-READY request, C-NOCHANGE request and AF-NOCHANGE request have been issued; and

ii) *ready-is-sendable*; and

iii) at least one of the following is true:

a) an AF-PREPARE indication has been received; or

b) it is a subordinate dialogue and no AF-PREPARE(data-permitted) request has been sent; or

c) it is a superior dialogue and the Implicit Prepare functional unit is selected and no AF-PREPARE(data-permitted) request has been sent; and

iii) at least one of the following is true:

d) it is a superior dialogue; or

e) an AF-BEGIN-DIALOGUE confirm has been received; or

f) the RCH-on-dialogue functional unit was not selected on the supporting association; or

g) when the supporting association was established, on whichever of TP-INITIALIZE-RI or TP-INITIALIZE-RC APDU was received, the Senders-RCH-Varies parameter had the value “false”

NOTE 16 The last condition, iv), ensures that a log-ready record is not written if might contain the wrong recovery-context-handle. This will only occur if the superior has begun a dialogue and issued TP-COMMIT request before any reply has been received from a subordinate, and the subordinate’s TPPM is liable to change the recovery-context-handle for each dialogue.

Ready-substitute indication - C-NOCHANGE indication or AF-NOCHANGE indication or AF-EARLY-EXIT indication

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NOTE 17 Although an AF-EARLY-EXIT indication is not equivalent to a 'ready signal without recovery' in the way that C-NOCHANGE and AF-NOCHANGE indication are, it is included in this definition because the effect in the procedures is similar. A dialogue on which AF-EARLY-EXIT indication has been received will only remain in the transaction if the Chained functional unit is selected.

Ready-substitute request - C-NOCHANGE request or AF-NOCHANGE request

Reporting applies on a dialogue/ on a branch - for a dialogue, the Heuristic Containment Required functional unit is not selected or the Completion Reporting functional unit is selected or both; for a branch whose *dialogue has not been detached*, as for that dialogue; for a branch whose *dialogue has been detached*, only that the Heuristic Containment Required functional unit was selected on the dialogue that originally supported the branch.

A *report is to be sent* when at least one of the following is true; *a report is not to be sent* when all are false:

a) the Heuristic Containment Required functional unit is not selected on the superior dialogue and a log-damage record exists;

b) the Completion diagnostics functional unit is selected on the superior dialogue and, on the most recent TP-DONE request on which the Completion-data parameter was present, that parameter had a non-empty value;

c) the Completion diagnostics functional unit is selected on the superior dialogue and a TP-DONE request has been received on which the Severity parameter was present;

d) the Completion diagnostics functional unit is selected on the superior dialogue and a TP-EARLY-EXIT request was received on which the Completion-data parameter had a non-empty value or the Severity parameter was present and C-ROLLBACK indication was received

Reporting status is known to a TPPM when

a) a TP-DONE request is not owed; and

b) for each branch to a subordinate (if there are any) at least one of the following is true

i) the Heuristic Containment Required functional unit was selected on the dialogue (possibly now detached) that supported the branch and either the dialogue is detached or the Completion Reporting functional unit is not selected

ii) a commit-confirm or rollback-confirm or *ready-substitute indication* has been received

iii) an AF-REPORT indication or AF-ABORT-AND-REPORT indication has been received

iv) a CAF-RECOVER indication with the Heuristic Report parameter present has been received

v) any heuristic condition that may yet be reported will be compensated by the TPPM and either the dialogue is detached or the Completion Reporting functional unit is not selected

Rollback confirm - One of the following:

— C-ROLLBACK confirm;

— AF-EARLY-EXIT confirm;

— AF-REPORT (rollbackRC) indication;

— AF-ABORT (user/provider, rollbackRC) indication;

— AF-ABORT-AND-REPORT (rollbackRC) indication; or

— AF-BEGIN-DIALOGUE (accepted/rejected(user), rollbackRC) confirm.

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Rollback indication - One of the following:

— C-ROLLBACK indication;

— AF-EARLY-EXIT indication;

— AF-REPORT (rollbackRI) indication;

— AF-ABORT (user/provider, rollbackRI) indication;

— AF-ABORT-AND-REPORT (rollbackRI) indication; or

— AF-BEGIN-DIALOGUE (rejected(user), rollbackRI) confirm.

Rollback reporting has completed - A *rollback response* was issued to the superior or a *rollback confirm* was received from the superior, or there is no superior dialogue.

Rollback request - One of the following:

— C-ROLLBACK request;

— AF-REPORT (rollbackRI) request;

— AF-ABORT (user/provider, rollbackRI) request; or

— AF-ABORT-AND-REPORT (rollbackRI) request.

Rollback response - One of the following:

— C-ROLLBACK response;

— AF-REPORT (rollbackRC) request;

— AF-ABORT (user/provider, rollbackRC) request; or

— AF-ABORT-AND-REPORT (rollbackRC) request.

Token - The Session Layer synchronize-minor token which is required by CCR.

A TP-DONE request is owed - When either or both of the following cases holds:

a) the TPPM has received or issued one or more of the following service primitives without having received a subsequent TP-DONE request:

— a TP-COMMIT indication;

— a TP-ROLLBACK request/indication;

— a TP-UNKNOWN indicatrion;

— a TP-COMPLETION-REPORT indication;

b) the TPPM is in the DECIDED (commit) or DECIDED (rollback) state and has received or issued one or more of the following service primitives on a dialogue with coordination level of “commitment” without having received a subsequent TP-DONE request:

— a TP-P-ABORT indication;

— a TP-U-ABORT request/indication; or

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— a TP-BEGIN-DIALOGUE (rejected) confirm.

TPPM bound data - The bound data controlled by the TPPM.

Transaction initiation purging period - A state of a TPPM with respect to a given dialogue which is entered upon receipt of a TP-BEGIN-TRANSACTION request if

a) the Shared Control functional unit is selected; and

b) there is a *user error purging period*.

The *transaction initiation purging period* is terminated as soon as

a) the number of AF-U-ERROR confirms, AF-END-DIALOGUE indications with the Confirmation parameter set to “true”, and AF-HANDSHAKE indications received since the reception of the TP-BEGIN-TRANSACTION request equals the number of TP-U-ERROR requests that were outstanding at that time; or

b) a *rollback confirm* is received.

Transfer the channel - The specified SAO is transferred from the PM to another PM. The specified service invocation and any subsequent service invocations made at this SAO are sent/received to/by the PM to which the SAO is transferred.

The two-way-recovery token is expected - When the CPM has received a C-RECOVER or an AF-RECOVER indication, and the subsequent AF-TOKEN-GIVE (two-way-recovery) indication has not been received.

User error purging period - A state of a TPPM with respect to a given dialogue which is entered upon receipt of a TP-U-ERROR request if

a) the Polarized Control functional unit is selected and the TPPM does not have control and there is no handshake or dialogue termination indication outstanding; or

b) the Shared Control functional unit is selected and there is no handshake or dialogue termination indication outstanding.

The *user error purging period* is terminated as soon as

a) if the Polarized Control functional unit is selected and a TP-HANDSHAKE indication, a TP-GRANT-CONTROL indication, a TP-HANDSHAKE-AND-GRANT-CONTROL indication, or a TP-END-DIALOGUE indication is issued; or

b) if the Shared Control functional unit is selected and the number of AF-U-ERROR confirms, AF-END-DIALOGUE indications with the confirmation parameter set to “true”, and AF-HANDSHAKE indications received since the beginning of the *user error purging period* equals the number of TP-U-ERROR requests received during that period; or

c) a *rollback confirm* is received.

Write the log-commit record - The TPPM ensures that the information specified in 7.4.2 will be available even after the occurrence of a node crash. Remove from secure storage the log-ready record concerning this transaction, if one exists.

Write the log-damage record - The TPPM ensures that the information specified in 7.4.4 will be available even after the occurrence of a node crash.

Write the log-heuristic record - The TPPM ensures that the information specified in 7.4.3 will be available even after the occurrence of a node crash.

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Write the log-ready record - The TPPM ensures that the information specified in 7.4.1 will be available even after the occurrence of a node crash.

7.4 Log records used by the PM

The transaction identifier defined in ISO/IEC 10026-1 is the atomic action identifier as defined in ISO/IEC 9804. The transaction branch identifier defined in ISO/IEC 10026-1 is the branch identifier as defined in ISO/IEC 9804.

7.4.1 Log-ready record

The log-ready record contains the following information written in secure storage:

a) to identify the transaction:

— atomic action identifier;

b) to identify the branch to which the *ready signal was sent*:

— branch identifier;

— neighbour's AE Title;

— if provided on the TP-INITIALIZE-RI or -RC APDU, or on the TP-BEGIN-DIALOGUE-RI or -RC APDU, the recovery-context-handle received from the superior;

c) for each neighbour from which a C-READY indication was received, if any, to identify the neighbour:

— branch identifier;

— neighbour’s AE Title;

— if provided on the TP-INITIALIZE-RI or -RC APDU, or on the TP-BEGIN-DIALOGUE-RI or -RC APDU, the recovery-context-handle received from the subordinate.

7.4.2 Log-commit record

The log-commit record contains the following information written in secure storage:

a) to identify the transaction:

— atomic action identifier;

b) for each neighbour from which a C-READY indication was received, to identify the neighbour:

— branch identifier;

— neighbour’s AE Title;

— if provided on the TP-INITIALIZE-RI or -RC APDU, or on the TP-BEGIN-DIALOGUE-RI or -RC APDU the recovery-context-handle received from the subordinate.

7.4.3 Log-heuristic record

The log-heuristic record contains the following information written in secure storage:

a) the atomic action identifier;

b) the state of the bound data;

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c) information necessary to execute compensating actions, if required.

NOTE — The log-heuristic record models the need for an open system to retain, beyond node crashes, information about the heuristic decision.

7.4.4 Log-damage record

The log-damage record contains the following information:

a) the atomic action identifier;

b) the current known state of the bound data in the node's subtree. Its value is either "heuristic-hazard" or "heuristic-mix".

The log-damage record is written in secure storage, except where the node is using one-phase commitment. When using one-phase commitment, the log-damage record is not required to survive node crashes, as there is no recovery.

7.5 Recovery-context-handle

A recovery-context-handle is an identification of a grouping of log records, that will be used for all transactions on a particular association or dialogue. The use of this grouping and associated recovery-context-handle are optional on any particular association or dialogue.

NOTE — A possible use of the recovery-context-handle is to allow the partitioning of the set of log records, each part having a different value for the recovery-context-handle.

When the recovery-context-handle is provided by the partner for a given association or dialogue, its value shall be logged for all transaction branches that are initiated by the partner on this association or dialogue, and, if initiation of recovery is subsequently required for any of these transaction branches, the value of the recovery-context-handle shall be conveyed on the consequent recovery primitives. If values for the recovery-context-handle are passed on both association and dialogue establishment, the value from the dialogue establishment is used for transactions begun on that dialogue. If no value. is passed on the dialogue establishment, the value from the association establishment is used, if there is one.

The recovery-context-handle shall only be passed on dialogue establishment if the RCH-on-dialogue functional unit was selected on the supporting association, and on whichever of TP-INITIALIZE-RI and TP-INITIALIZE-RC APDU was sent by the TPPM, the Senders-RCH-Varies parameter had the value "true".

8 Use of ACSE, CCR and the Presentation Layer

8.1 Introduction

This clause identifies the use and requirements made of ACSE, CCR, and the Presentation Layer, and the rules for establishing, assigning, and terminating associations.

8.2 Use of ACSE Service primitives

The Association Control Service Element (ACSE) is used as described in ISO/IEC 8649 to establish and release associations.

The TPPM uses the following ACSE services:

— A-ASSOCIATE and A-RELEASE to establish and release associations; and

— A-ABORT to abruptly release an association.

The TPPM also must react to the occurrence of the A-P-ABORT indication primitive.

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Table 1 — Use of A-ASSOCIATE parameters

A-ASSOCIATE Parameters	Used by TPPM	
	Application-supported Transactions	Provider-supported Transactions or TP Channel
Mode	Yes	Yes
Application Context Name	Yes	Yes
Calling AP Title	Conditional	Yes
Calling AE Qualifier	Conditional	Yes
Calling AP Invocation Identifier	Conditional	Conditional
Calling AE Invocation Identifier	Conditional	Conditional
Called AP Title	Conditional	Conditional
Called AE Qualifier	Conditional	Conditional
Called AP Invocation Identifier	Conditional	Conditional
Called AE Invocation Identifier	Conditional	Conditional
Responding AP Title	Conditional	Yes
Responding AE Qualifier	Conditional	Yes
Responding AP Invocation-Identifier	Conditional	Conditional
Responding AE Invocation-Identifier	Conditional	Conditional
User Information	Yes	Yes
Result	Yes	Yes
Result Source	Yes	Yes
Diagnostic	Conditional	Conditional
Calling Presentation Address	Yes	Yes
Called Presentation Address	Yes	Yes
Responding Presentation Address	Yes	Yes
Presentation Context Definition List	Yes	Yes
Presentation Context Definition Result List	Yes	Yes
Default Presentation Context Name	No	No
Default Presentation Context Result	No	No
Quality Of Service	Yes	Yes
Presentation Requirements	Conditional	Conditional
Session Requirements	Yes	Yes[1)]
Initial Synchronization Point Serial Number	Conditional	Yes
Initial Assignment of Tokens	Conditional	Yes[2)]
Session-Connection Identifier	No	No

1) See 8.5.2 and 8.5.3 for constraints on this parameter.
2) See 8.5.4 for the assignment of the parameter.

8.2.1 Use of the A-ASSOCIATE parameters

The parameters of the A-ASSOCIATE service are used by the PMs as specified in table 1.

8.2.2 Use of the A-RELEASE parameters

The parameters of the A-RELEASE service are used by the PMs as specified in table 2.

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Table 2 — Use of A-RELEASE parameters

A-RELEASE Parameters	Used by TPPM
Reason	No
User Information	No
Result	Yes

8.2.3 Use of the A-ABORT and A-P-ABORT parameters

The parameters of the A-ABORT and A-P-ABORT services are used by the PMs as specified in tables 3 and 4.

Table 3 — Use of A-ABORT parameters

A-ABORT Parameters	Used by TPPM
Abort Source	No
User Information	Yes

Table 4 — Use of A-P-ABORT parameters

A-P-ABORT Parameters	Used by TPPM
Provider Reason	No

8.3 Use of CCR Service primitives

The Commitment, Concurrency and Recovery Service Element (CCR) is used for provider-supported transactions.

The PMs use the following CCR services:

— C-BEGIN, C-PREPARE, C-READY, C-COMMIT and C-ROLLBACK for TP services supported by commitment-related functional units; and

— C-INITIALIZE to identify the CCR functional units

— C-CANCEL for the TP Cancel functional unit; and

— C-NOCHANGE for the one-phase commitment and read-only functional units; and

— C-RECOVER for transaction recovery.

The PMs use the User Data parameter of some CCR services to convey certain TP APDUs. These CCR services and TP APDUs are specified in table 35.

The parameters of the CCR services are used by the PMs as specified in tables 6 to 12.

Table 5 — Use of C-INITIALIZE parameters

C-INITIALIZE Parameters	Used by TPPM
CCR Requirements	Yes
Version	Yes
Ready-collision-reservation	Yes
User Data	No

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Table 6 — Use of C-BEGIN parameters

C-BEGIN Parameters	Used by TPPM
Atomic Action Identifier - Owner's Name	Yes
Atomic Action Identifier - Suffix	Yes
Branch Identifier - Branch-owner's name	Yes
Branch Identifier - Suffix	Yes
User Data	Conditional

Where the TP procedures refer to the "atomic-action-identifier" parameter of C-BEGIN request and indication, this is the combination of the "Atomic Action Identifier - Owner's Name" and the "Atomic Action Identifier - Suffix". Where the TP procedures refer to the "atomic-action-branch-identifier" parameter of C-BEGIN request and indication, this is the combination of the "Branch Identifier - Branch-owner's Name" and the "Branch Identifier - Suffix".

Table 7 — Use of C-PREPARE parameters

C-PREPARE Parameters	Used by TPPM
User Data	Yes

Table 8 — Use of C-READY parameters

C-READY Parameters	Used by TPPM
User Data	Conditional

Table 9 — Use of C-COMMIT parameters

C-COMMIT Parameters	Used by TPPM
User Data	Conditional

Table 10 — Use of C-ROLLBACK parameters

C-ROLLBACK Parameters	Used by TPPM
User Data	Conditional

Table 11 — Use of C-CANCEL parameters

C-CANCEL Parameters	Used by TPPM
User Data	Conditional

Table 12 — Use of C-RECOVER parameters

C-RECOVER Parameters	Used by (TP)PM
Recovery State	Yes
Atomic Action Identifier	Yes
Branch Identifier	Yes
User Data	Conditional

Table 13 — Use of C-NOCHANGE parameters

C-NOCHANGE Parameters	Used by TPPM
Confirmation	Yes
Outcome	Yes
User Data	Conditional

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8.4 Use of the Presentation Layer

8.4.1 Use of Presentation Service primitives

Implementations shall take care that parallelism between the lower layers and the SAO does not result in a violation of the service user rules of those layers.

NOTE — An example of this problem may occur in the case of a rollback. A C-ROLLBACK indication, which is mapped to a P-RESYNCHRONIZE indication, may be processed by the Session layer and not yet processed by the SAO. Before this indication is processed by the SAO, a C-ROLLBACK request, mapped to a P-RESYNCHRONIZE request may be sent to Session, resulting in a violation of the Session Service user rules.

In addition to Presentation Service primitives used by CCR and ACSE Protocol Machines, the TPPM makes use of:

— P-TOKEN-PLEASE and P-TOKEN-GIVE for token management (to position the tokens correctly for CCR);

— P-DATA for all other services.

The U-ASE may make use of the P-TOKEN-GIVE or P-TOKEN-PLEASE service to manage the Session tokens. In general, the use of these services by the U-ASE is manifested in the TPPM as a TP-DATA request or a U-ASE indication. There are some cases, however, where the P-TOKEN-GIVE indication which refers to the synchronize-minor token may be seen by the PM. In this case, the procedures of the PM will refer to a P-TOKEN-GIVE (sync-minor) request or indication.

The parameters of the Presentation services are used by the TPPMs as specified in tables 14 to 16.

Table 14 — Use of P-TOKEN-PLEASE parameters

P-TOKEN-PLEASE Parameters	Used by TPPM
Tokens (synchronize-minor)	Yes
User data	Yes

Table 15 — Use of P-TOKEN-GIVE (sync-minor) parameters

P-TOKEN-GIVE (sync-minor) Parameters	Used by TPPM
Tokens (synchronize-minor)	Yes
User data	Yes

Table 16 — Use of P-DATA parameters

P-DATA Parameters	Used by TPPM
User data	Yes

8.4.2 Mapping of C-ROLLBACK-RI to Presentation

CCR requires a C-ROLLBACK-RI to be mapped to a P-RESYNCHRONIZE request. When CCR is used with TP, the Tokens parameter of the P-RESYNCHRONIZE request shall be set so that the synchronize-minor token is passed to the superior. TP places no requirements on the setting of the Tokens parameter for the other available tokens.

8.5 Association Management

8.5.1 Introduction

This clause defines the requirements of this part of ISO/IEC 10026 with respect to the management and use of associations.

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8.5.2 Association/dialogue compatibility

An association is said to be compatible with a dialogue if it meets the following conditions:

a) the association shall have been established with an AEI fulfilling the requirements expressed in the Application Context Name, Recipient-AP-Title, and any of the following for which a value was specified: Recipient-API-Identifier, Recipient-AE-Qualifier, and Recipient-AEI-Identifier parameters as specified by the TP-BEGIN-DIALOGUE request;

b) the association shall have selected the kernel and full duplex Session functional units, the kernel Presentation functional unit, and, if the Commit functional unit is selected, the Session functional units as required by CCR;

NOTE — This includes the Session Data Separation functional unit required by CCR version 2.

c) if the Commit functional unit is selected, CCR version 2's abstract syntax name shall be found in the Presentation Context Definition List and the application context;

d) The association shall have been established with a Quality of Service parameter compatible with the Quality-of-Service parameter specified by the TP-BEGIN-DIALOGUE request, if any.

e) The TP functional unit capabilities selected for the association include all of the TP functional units selected for the dialogue

f) The CCR functional units selected for the association shall include all those required to support the TP functional units selected for the dialogue, as listed in table 17.

Table 17 — TP and CCR functional unit compatibility

If this TP functional unit is selected	These CCR functional units are required
Dialogue	
Shared Control	
Polarized Control	
Handshake	
Commit	Static-commitment or Dynamic-commitment
Chained Transactions	
Unchained Transactions	
Dynamic Commit	Dynamic-commit
Unchecked Tree	
Implicit Prepare	
Read-oOnly	No-change completion
Early-exit	
One-phase Commit	No-change completion
Completion Diagnostics	
Heuristic Containment Required	
RCH-on-dialogue	
Cancel	Cancel
Where no CCR functional unit is listed in the right-hand column, selection of the TP functional unit does not directly require particular CCR functional units to be selected. The requirements on which TP functional units can be combined means that there are indirect requirements on CCR functional units.	

8.5.3 Association/channel compatibility

An association is said to be compatible with a channel if it meets the following conditions:

a) the association shall have been established with an AEI identified by the AE-title as specified in the log record(s) for the transaction(s) to be recovered, and with an application context appropriate for recovery;

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b) the association shall have selected the kernel and full duplex Session functional units, the kernel Presentation functional unit, and the Session functional units as required by CCR for recovery;

c) CCR version 2's abstract syntax name shall be found in the Presentation Context Definition List and the application context.

8.5.4 Initiating an association establishment

When establishing an association, a TP-INITIALIZE-RI APDU shall be constructed and issued as User Information of the A-ASSOCIATE request. Table 18 lists the fields of this TP APDU.

Table 18 — TP-INITIALIZE-RI/RC APDUs' fields

TP APDU	TP-INITIALIZE-	
Field	**RI**	**RC**
Protocol-Version	M	M
Contention-Winner-Assignment	M	
Bid-Mandatory	M	
Recovery-Context-Handle	O	O
Diagnostic		O
Functional-Unit-Capabilities	C	C
Senders-RCH-Varies	O	O

The fields of the TP-INITIALIZE-RI APDU are set as follows:

a) the Protocol-Version field indicates the possible versions of the TP Protocol that can be supported. The TPPM may support more than one version of the protocol;

NOTE 1 A TPPM may also propose different subsets of the versions it supports; which versions to propose is a local matter.

b) the Contention-Winner-Assignment field identifies whether or not the initiating TPPM will be considered as the contention-winner of this association. This field takes one of the following values:

"true" (the initiator is the contention-winner);
"false" (the initiator is the contention-loser).

If CCR is included in the application context of the association, then the following applies to the setting of the A-ASSOCIATE request parameter "Initial Assignment of Tokens":

1) if the value of the Contention-Winner-Assignment field is "true", the value of the A-ASSOCIATE request parameter "Initial Assignment of Tokens" (see 8.2.1) is "requestor side";

2) if the value of this field is "false", the value of the A-ASSOCIATE request parameter "Initial Assignment of Tokens" is "acceptor side";

c) the Bid-Mandatory field indicates whether the use of the bid mechanism (by the contention-loser) is mandatory or not. This field takes one of the following values:

"true";
"false";

d) the Recovery-Context-Handle field is optionally used to provide a value that is to be supplied when recovery is requested by the remote TPPM;

e) the Functional-Unit-Capabilities field indicates which TP functional units the AEI supports for selection on this association. This value of this field is a set of values, each identifying one of the TP functional units. The set of functional units identified by the value of this field are not required to be a valid selection of functional units for the TP-BEGIN-DIALOGUE service as specified in ISO/IEC 10026-2. The Functional-Unit-Capabilities field can be absent if the functional units supported include only some or all of the *basic functional units*.

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NOTE 2 An association, once established, may be required to support dialogues with different requirements, and also TP channels. Therefore, the requirements declared when the association is established, must be sufficient for all intended uses of the association. For example, a Recovery-Context-Handle may be specified even though initial use of the association may be for a dialogue without the Commit functional unit or for a TP channel, neither of which have any use for a Recovery-Context-Handle.

f) the Senders-RCH-Varies field indicates whether the Recovery-Context-Handle field will be present in any TP-BEGIN-DIALOGUE-RI and TP-BEGIN-DIALOGUE-RC APDUs issued by the initiating TPPM. It is only present if the RCH-on-dialogue functional unit is selected in the Functional-Unit-Capabilities field. This field takes one of the following values:

"true";
"false";

If the Functional-Unit-Capabilities field of the TP-INITIALIZE-RI APDU indicates TP functional units that require CCR functional units other than static-commitment, a C-INITIALIZE request shall be issued with the following parameter values:

a) the CCR Requirements parameter shall indicate at least the CCR functional units required, according to table 17, by the TP functional units indicated in the Functional-Unit-Capabilities field of the TP-INITIALIZE-RI APDU

b) the Ready-collision-reservation parameter shall have the value “true”

8.5.5 Receiving an association establishment indication

Upon receipt of an A-ASSOCIATE indication, a TP-INITIALIZE-RI APDU shall be received as User Information of the A-ASSOCIATE indication. Table 18 lists the fields of this TP APDU.

A C-INITIALIZE indication may also have been issued by the CCR ASE.

The fields of the TP-INITIALIZE-RI APDU are used as follows:

a) if the Protocol-Version field contains a version that is supported by the TPPM, the association may be accepted. If not, the association shall be rejected. The TPPM ignores any values that indicate a later version of the protocol than it can support;

b) if the value of the Contention-Winner-Assignment field is acceptable to the TPPM, the association may be accepted. Otherwise, the association shall be rejected;

c) if the value of the Bid-Mandatory field is acceptable to the TPPM, the association may be accepted. Otherwise, the association shall be rejected;

d) if the Recovery-Context-Handle field is present, its value shall be stored in the recovery log (the log-ready record or the log-commit record, whichever applies, see 7.5) for all transactions on the association (except transactions on dialogues where a different Recovery-Context-Handle is received at dialogue establishment);

e) if the Functional-Unit-Capabilities field is present, values that indicate functional units that are not supported by the TPPM, including functional units not known to the TPPM, are ignored.

If CCR will be used on the association (for a coordinated dialogue or a channel), and the A-ASSOCIATE indication either

i) does not contain an entry for CCR version 2’s abstract syntax name in the Presentation Context Definition List parameter; or

ii) the Session functional units required by CCR version 2 are not selected in the Session Requirements parameter;

then the association shall be rejected. Otherwise, the association may be accepted.

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If a C-INITIALIZE indication was issued by the CCR ASE, any TP functional units indicated in the Functional-Unit-Capabilities field that require CCR functional units that are not indicated in the CCR Requirements parameter of the C-INITIALIZE indication shall be ignored. If no C-INITIALIZE indication was issued by the CCR ASE, any TP functional units indicated in the Functional-Unit-Capabilities field that require CCR functional units other than static-commitment shall be ignored.

8.5.6 Responding to association establishment

When responding to association establishment, a TP-INITIALIZE-RC APDU shall be constructed and issued as User Information of the A-ASSOCIATE response. Table 18 lists the fields of this TP APDU.

If a C-INITIALIZE indication was issued by the CCR ASE when the A-ASSOCIATE indication was received, and the association is to be accepted, a C-INITIALIZE response shall be issued to the CCR ASE.

The fields of the TP-INITIALIZE-RC APDU (and the Result parameter of the A-ASSOCIATE response and the parameters of the C-INITIALIZE response, if one is issued) are set as follows:

a) if the association is accepted,

1) the Result parameter of the A-ASSOCIATE response shall be set to “accepted”;

2) the Protocol-Version field of the TP-INITIALIZE-RC APDU shall be set to the version of ISO/IEC 10026 to be used for this association. This version shall be one of the protocol versions proposed on the TP-INITIALIZE-RI APDU;

3) the Recovery-Context-Handle field of the TP-INITIALIZE-RC APDU may (optionally) be set to a value that shall be used when recovery is requested by the remote TPPM;

4) the Diagnostic field of the TP-INITIALIZE-RC APDU shall be omitted;

5) the Functional-Unit-Capabilities field of the TP-INITIALIZE-RC APDU shall be omitted if the field was omitted on the TP-INITIALIZE-RI APDU. It shall contain the identifications of all the functional units that were included in the field on the TP-INITIALIZE-RI APDU, were not ignored and are supported by the TPPM for selection on this association

6) if the Functional-Unit-Capabilities field is present in the TP-INITIALIZE-RC APDU, subsequent TP-BEGIN-DIALOGUE-RI APDUs issued on this association shall not select functional units that are not identified in this field

7) if the Functional-Unit-Capabilities field is absent from the TP-INITIALIZE-RC APDU, subsequent TP-BEGIN-DIALOGUE-RI APDUs issued on this association shall not select functional units that are not *basic functional units*

8) the CCR requirements parameter of the C-INITIALIZE response shall indicate those CCR functional units required, as specified in table 17, by the TP functional units identified in the Functional-Unit-Capabilities field of the TP-INITIALIZE-RC APDU; if the Functional-Unit-Capabilities field is absent from the TP-INITIALIZE-RC APDU, and a C-INITIALIZE response is issued to the CCR ASE, it shall identify at least static commitment.

9) the Ready-collision-reservation parameter of the C-INITIALIZE response shall have the value “true”

10) If the RCH-on-dialogue functional unit is selected in the Functional-Unit-Capabilities field, the Senders-RCH-Varies field indicates whether the Recovery-Context-Handle field will be present in any TP-BEGIN-DIALOGUE-RI and TP-BEGIN-DIALOGUE-RC APDUs issued by the responding TPPM. This field takes one of the following values:

"true";
"false";

b) if the association is rejected,

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