INTERNATIONAL TELECOMMUNICATION UNION

CCITT

THE INTERNATIONAL
TELEGRAPH AND TELEPHONE
CONSULTATIVE COMMITTEE

X.861

(09/92)

DATA COMMUNICATION NETWORKS

OPEN SYSTEMS INTERCONNECTION – DISTRIBUTED TRANSACTION PROCESSING: SERVICE DEFINITION

Recommendation X.861

FOREWORD

The CCITT (the International Telegraph and Telephone Consultative Committee) is a permanent organ of the International Telecommunication Union (ITU). CCITT is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The Plenary Assembly of CCITT which meets every four years, establishes the topics for study and approves Recommendations prepared by its Study Groups. The approval of Recommendations by the members of CCITT between Plenary Assemblies is covered by the procedure laid down in CCITT Resolution No. 2 (Melbourne, 1988).

Recommendation X.861 was revised by Study Group VII and was approved under the Resolution No. 2 procedure on the 10th of September 1992.

CCITT NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized private operating agency.

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INTRODUCTION

Recommendation X.861, Distributed Transaction Processing (OSI TP), is one of a set of Recommendations produced to facilitate the interconnection of computer systems. It is related to other Recommendations in the set as defined by Reference Model for Open Systems Interconnection (Recommendation X.217). 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 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.

Recommendation X.861 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 information which can be related as transactions, which may involve two or more open systems.

Recommendation X.861 defines a basic OSI TP Service. It provides sufficient facilities to support transaction processing, and establishes a framework for coordination across multiple TP resources in separate open systems.

Recommendation X.861 does not specify the interface to local resources or access facilities that the provided within the local system. However, future enhancement of this Recommendation may deal with these issues.

Recommendation X.861

OPEN SYSTEMS INTERCONNECTION – DISTRIBUTED TRANSACTION PROCESSING: SERVICE DEFINITION[1)]

(1992)

1 Scope

This Recommendation defines in an abstract way the Distributed Transaction Processing Service within the Application Layer in terms of:

a) the actions and events of the service primitives;

b) the parameter data associated with each service primitive's action and event; and

c) the relationship between, and the valid sequences of these actions and events.

This Reommendation does not specify individual implementation or products, nor does it constrain the implementation of entities or interfaces within a computer system.

2 Normative references

The CCITT Secretariat maintains a list of the currently valid CCITT Recommendations.

Normative references to other CCITT Recommendations or International Standards used in this Recommendation are listed in Recommendation X.860 (OSI TP Model).

3 Definitions

Definitions of terms used in this Recommendation are contained in Recommendation X.860 (OSI TP Model), except for the following:

3.1 dialogue establishment indication outstanding

A dialogue state in which a TP-BEGIN-DIALOGUE indication with the Confirmation parameter set to "always" has been issued but has not yet been responded to by a TP-BEGIN-DIALOGUE response.

3.2 dialogue establishment request outstanding

A dialogue state in which a TP-BEGIN-DIALOGUE request with the Confirmation parameter set to "always" has been issued but has not yet been responded to by a TP-BEGIN-DIALOGUE confirm.

3.3 dialogue termination indication outstanding

A dialogue state in which a TP-END-DIALOGUE indication with the Confirmation parameter set to "true" has been issued while there is no *user error request outstanding*, but has not yet been responded to by a TP-END-DIALOGUE response, or by a TP-U-ERROR request.

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1) Recommendation X.861 and ISO/IEC 10026-2 (Information Technology – Open Systems Interconnection – Distributed Transaction Processing – Part 2: Service Definition) were developed in close collaboration and are technically aligned.

3.4 **dialogue termination request outstanding**

A dialogue state in which a TP-END-DIALOGUE request with the Confirmation parameter set to "true" has been issued, but has not yet been responded to by a TP-END-DIALOGUE confirm, or by a TP-U-ERROR indication.

3.5 **handshake indication outstanding**

A dialogue state in which one of the following service primitives:

– TP-HANDSHAKE indication,

– TP-HANDSHAKE-AND-GRANT-CONTROL indication,

has been issued while there is no *user error request outstanding*, but has not yet been responded to by one of the following service primitives (respectively):

– TP-HANDSHAKE response;

– TP-HANDSHAKE-AND-GRANT-CONTROL response; or

by a TP-U-ERROR request, or, if the coordination level of the dialogue is "commitment", by any *rollback-initiating service primitive*.

3.6 **handshake request outstanding**

A dialogue state in which one of the following service primitives:

– TP-HANDSHAKE request;

– TP-HANDSHAKE-AND-GRANT-CONTROL request,

has been issued, but has not yet been responded to by one of the following service primitives (respectively):

– TP-HANDSHAKE confirmation;

– TP-HANDSHAKE-AND-GRANT-CONTROL confirmation; or

by a TP-U-ERROR indication, or, if the coordination level of the dialogue is "commitment", by any *rollback-initiating service primitive*.

3.7 **rollback-initiating indication**

An indication or confirmation that triggers a rollback; it is one of the following service primitives:

– TP-ROLLBACK indication;

– TP-U-ABORT indication with the Rollback parameter set to "true";

– TP-P-ABORT indication with the Rollback parameter set to "true";

– TP-BEGIN-DIALOGUE confirmation with the Rollback parameter set to "true".

3.8 **rollback-initiating request**

A request that triggers a rollback; it is one of the following service primitives:

– TP-ROLLBACK request;

– TP-U-ABORT request for a dialogue with a coordination level of "commitment" not issued during the *termination phase of a transaction*.

3.9 **rollback-initiating service primitive**

A service primitive that triggers a rollback; it may be either a *rollback-initiating request* or a *rollback-initiating indication*.

3.10 **subordinate dialogue**

A dialogue with a subordinate.

3.11 **subordinate subtree**

A subtree of a subordinate.

3.12 **superior dialogue**

The dialogue with the superior.

3.13 **termination phase of a transaction**

The phase of a transaction between initiation of commitment or rollback and the end of the transaction.

This phase is entered, for a given TPSUI, upon issuance of a TP-COMMIT request or any *rollback-initiating service primitive*.

For a TPSUI which does not have a *dialogue establishment indication outstanding*, this phase is exited upon issuance of a TP-COMMIT-COMPLETE indication or a TP-ROLLBACK-COMPLETE indication.

For a TPSUI which does have a *dialogue establishment indication outstanding* when the termination phase is entered (this can only happen when a TP-ROLLBACK indication is issued), this phase is exited by a TP-BEGIN-DIALOGUE response with the Result parameter set to "rejected(user)" or by a TP-P-ABORT indication for the dialogue; if the dialogue is accepted during the termination phase, the termination phase is exited by the subsequent TP-ROLLBACK-COMPLETE indication.

3.14 **transaction tree constraint**

a constraint that cannot be checked at a single node.

3.15 **user error indication outstanding**

A state of a dialogue with the Polarized Control functional unit selected. In this state, a TP-U-ERROR indication, issued while the recipient had control of the dialogue and has neither a *handshake request outstanding* nor a *dialogue termination request outstanding*, has not yet been responded to by a TP-GRANT-CONTROL request, or, if the coordination level of the dialogue is "commitment", by any *rollback-initiating service primitive*.

3.16 **user error request outstanding**

A state of a dialogue with the Polarized Control functional unit selected. In this state, a TP-U-ERROR request, issued without having control of the dialogue and without having either a *handshake indication outstanding* or a *dialogue termination indication outstanding*, has not yet been responded to by a TP-GRANT-CONTROL indication, a TP-HANDSHAKE indication, a TP-HANDSHAKE-AND-GRANT-CONTROL indication, a TP-END-DIALOGUE indication with the Confirmation parameter set to "true", or, if the coordination level of the dialogue is "commitment", by any *rollback-initiating service primitive.*

4 Abbreviations

Abbreviations used in this document are defined in CCITT Rec. X.860 (OSI TP Model), except for the following which are used in some tables:

cnf Confirmation service primitive;

ind Indication service primitive;

req Request service primitive;

rsp Response service primitive;

5 Conventions

5.1 *Service conventions*

This Recommendation defines services for Distributed Transaction Processing guided by the descriptive conventions defined in Recommendation X.210.

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 may 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 this TPSUI and by 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, the issuance of a TP-COMMIT request will cause a TP-PREPARE indication to be issued).

Note – In this Recommendation, requests and responses are described as being issued by the TPSUI whereas indications and confirmations are described as being issued by the TPSP.

For a given primitive, the presence of each parameter 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; and

C presence is conditional.

In addition the notation (=) indicates that a parameter value is semantically equal to the value of the parameter of the preceding primitive in the table.

5.2 *Usage of the term transaction*

In this Recommendation, the term “transaction” is used to denote a distributed provider-supported transaction.

5.3 *Usage of italics for notations*

In this Recommendation, the following notations, defined in clause 3, appear in italic

– *dialogue establishment indication outstanding;*

– *dialogue establishment request outstanding;*

– *dialogue termination indication outstanding;*

– *dialogue termination request outstanding;*

– *handshake indication outstanding;*

– *handshake request outstanding;*

– *rollback-initiating indication;*

– *rollback-initiating request;*

– *rollback-initiating service primitive;*

– *subordinate dialogue;*

– *subordinate subtree;*

– *superior dialogue;*

– *termination phase of a transaction;*

– *user error indication outstanding;*

– *user error request outstanding.*

6 Overview of the OSI TP Service

The Distributed Transaction Processing Service and its supporting protocol are concerned with creating an environment in which two or more users may interact to:

a) establish dialogues;

b) invoke services of specific user application service elements, subject to the constraints of the TPSP;

c) delimit provider-supported transactions;

d) coordinate work for application-supported transactions or provider-supported transactions;

e) prepare for commitment, and commit or rollback a provider-supported transaction;

f) heuristically place bound data either in the final or initial state;

g) report errors;

h) terminate dialogues allowing all resources allocated to these dialogues to be freed;

i) terminate dialogues abnormally;

j) synchronize processing by handshaking;

k) support chained or unchained sequences of provider-supported transaction branches for a dialogue.

A node crash may result in the TPSP issuing certain TP service primitives more than once (i.e. TP-COMMIT indication, TP-ROLLBACK indication, and TP-HEURISTIC-REPORT indication). The TPSP and the TPSUI are both aware of the node crash through local means.

7 Service facilities

7.1 *Functional unit descriptions*

The following functional units are defined:

a) *Dialogue:* The Dialogue functional unit supports the basic services required to establish a dialogue between two TPSUIs within which U-ASE primitives may be invoked, signal user-initiated errors and terminate the dialogue. The user or the provider may signal abnormal termination.

b) *Shared Control:* The Shared Control functional unit supports both TPSUIs having control of the dialogue at the same time and allows them to issue request primitives subject only to the normal sequencing constraints of the primitives. For example, data may be transferred by both TPSUIs at the same time.

c) *Polarized Control:* The Polarized Control functional unit allows only one TPSUI to have control of the dialogue at any point in time. Many request primitives may be issued only by the TPSUI which has control of the dialogue. This restriction is in addition to the normal sequencing constraints for the primitives. For example, a handshake may only be requested by the TPSUI which has control of the dialogue.

d) *Handshake:* The Handshake functional unit allows the TPSUIs to synchronize their processing with one another.

e) *Commit:* The Commit functional unit allows reliable commitment and rollback of transactions.

f) *Chained Transactions:* The Chained Transactions functional unit supports coordination of both TPSUIs with a chained sequence of transaction branches. The coordination level of the dialogue will always be "commitment". The subordinate TPSUI will always be a participant in the same transaction as the superior TPSUI.

g) *Unchained Transactions:* The Unchained Transactions functional unit supports coordination of both TPSUIs with an unchained sequence of transaction branches. The superior determines when the coordination level of the dialogue is "commitment". At a given point in time, the two TPSUIs may be participants in the same transaction, in different transactions, or one or both TPSUIs may not be involved in a transaction.

The Dialogue functional unit shall always be selected.

For a given dialogue, the Shared Control and Polarized Control functional units are mutually exclusive. One and only one of these two functional units shall be selected.

For a given dialogue, the Chained Transactions and Unchained Transactions functional units are mutually exclusive. If the Commit functional unit is selected, one and only one of them shall be selected. If the Commit functional unit is not selected, neither one shall be selected.

7.2 *Services contained in OSI TP functional units*

Table 1/X.861 lists the functional units and the associated services.

TABLE 1/X.861

Functional units and their services

Functional unit	Services
Dialogue	TP-BEGIN-DIALOGUE TP-END-DIALOGUE[a)] TP-U-ERROR TP-U-ABORT TP-P-ABORT
Shared control	(No-associated services)
Polarized control	TP-GRANT-CONTROL TP-REQUEST-CONTROL
Handshake	TP-HANDSHAKE TP-HANDSHAKE-AND-GRANT-CONTROL[b)]
Commit	TP-DEFERRED-END-DIALOGUE TP-DEFERRED-GRANT-CONTROL[b)] TP-PREPARE TP-READY TP-COMMIT TP-DONE TP-COMMIT-COMPLETE TP-ROLLBACK TP-ROLLBACK-COMPLETE TP-HEURISTIC-REPORT
Chained transactions	(No associated services)
Unchained Transactions	TP-BEGIN-TRANSACTION

a) This service shall not be used if the Chained Transactions functional unit is selected.

b) This service may be used only if the Polarized Control functional unit is also selected.

7.3 *Service for modelling data transfer*

Table 2/X.861 shows the service for modelling data transfer.

TABLE 2/X.861

Service for modelling data transfer

Data transfer	TP-DATA (Note)

Note – TP-DATA is not a service in the normal sense. It represents the capability of a TPSUI to invoke specific U-ASE services on a dialogue, constrained by the TPSP.

7.4 *Structure of services descriptions*

7.4.1 *"Purpose" subclause*

The "Purpose" subclause describes, in a few words, the purpose of the service.

7.4.2 *"Service and parameters" subclause*

The "Service and parameters" subclause describes the service primitives and their parameters.

The constraints or conditions on the presence or values of these parameters are described in this subclause.

7.4.3 *"Sequences of primitives" subclause*

The "Sequence of primitives" subclause is included for certain services; it shows the relationship in time between the service request and the resulting indication, and, if applicable, the subsequent response and the resulting confirmation.

7.4.4 *"TPSUI conditions" subclause*

The "TPSUI conditions" subclause applies to certain requests and responses only; it contains prerequisites for the respective request or response to be issued by the TPSUI. TPSUI conditions cannot be monitored by the TPSP, nevertheless it is vital for orderly cooperation of the TPSUI and for atomicity that they are obeyed.

TPSUI conditions include

– the state of bound data;

– the success of synchronization.

7.4.5 *"TPSP constraints" subclause*

The "TPSP constraints" subclause applies to all service primitives. For request and response service primitives, it specifies prerequisites for issuance by the TPSUI that are enforced by the TPSP. For indication and confirmation service primitives, it specifies constraints on the issuance of the service primitives by the TPSP. Constraints on the values of parameters for service primitives are described separately in the "Service and parameters" subclause for each service.

In general, the constraints are based on information associated with the state of the TPSUI at the time the service primitive is issued. Constraints for service primitives that are associated with a particular dialogue relate only to that dialogue unless the constraints explicitly reference other dialogues or attributes that are not related to a particular dialogue.

Information on which constraints are based include:

– functional units selected for a dialogue;

– superior or subordinate status;

– control of the dialogue;

– coordination level;

– state of bound data;

– transaction state;

– sequence of service primitives and associated parameter values.

7.4.6 *"Effects of a service primitive" subclause*

The "Effects of a service primitive" subclause describes any effects on the characteristics of the dialogue or the transaction resulting from the issuance of a service primitive.

Effects include:

– initiating or terminating the dialogue or the transaction;

– control of the dialogue;

– superior or subordinate status;

– change of the coordination level;

– issuance of resulting service primitives.

Note – Effects of a service primitive on certain lower layers facilities (e.g. Session tokens) are described in Recommendation X.862.

7.4.7 *"Collisions" subclause*

There is a collision of two requests if the requests have been issued:

– on opposite sides of the same dialogue; and

– before the indication resulting from the request issued on the other side is either issued or suppressed.

The "Collisions" subclause describes any effects on a service request or response caused by collision with a service primitive issued by the partner TPSUI.

In general, the effects of a collision involving a particular service are described in the "Collisions" subclause for that service.

These effects include:

– suppression of an indication;

– generation of a different indication.

7.5 *Effects of dialogue termination*

Whenever a dialogue is terminated for a particular TPSUI, no further service primitives are issued to the TPSUI for the dialogue, except TP-HEURISTIC-REPORT indication, which may be issued during the *termination phase of the transaction*.

For a particular TPSUI, a dialogue is terminated by one of the following service primitives:

– TP-END-DIALOGUE request with the Confirmation parameter set to "false";

– TP-END-DIALOGUE indication with the Confirmation parameter set to "false";

– TP-END-DIALOGUE response;

– TP-END-DIALOGUE confirmation;

– TP-BEGIN-DIALOGUE response with the Result parameter set to “rejected(user)”;

– TP-BEGIN-DIALOGUE confirmation with the Result parameter set to “rejected(provider)” or “rejected(user)”;

– TP-U-ABORT request;

– TP-U-ABORT indication;

– TP-P-ABORT indication;

– TP-COMMIT-COMPLETE indication when a TP-DEFERRED-END-DIALOGUE request or indication has been issued.

Suppression of subsequent service primitives is not described in the collisions subclauses.

8 Service primitives and their parameters

The OSI TP Service is invoked using a sequence of OSI TP service primitives.

Table 3/X.861 lists:

a) the service primitives of the OSI TP Service;

b) for each service primitive, whether the service primitive is associated with a particular dialogue or with the TPSUI as a whole;

c) the subclause in which the service primitive is described; and

d) the parameters associated with each service.

Blanks in the parameters column indicates that the service primitive has no parameters.

9 Data transfer

9.1 *Overview of data transfer*

Data transfer is performed within the framework of OSI TP by issuance of the service primitives offered by one or more U-ASEs. To specify the coordination between these service primitives and OSI TP service primitives, these U-ASE service primitives are modelled as TP-DATA.

Note – TP-DATA may not only be used to model data transfer but also to model any other U-ASE services that may be constrained by the TPSP (see Recommendation X.862) for constraints on such services).

9.2 *Data transfer service, TP-DATA*

9.2.1 *Purpose*

This service represents the capability of a TPSUI to transfer data. From the standpoint of the TPSP, it is used to specify the coordination between data transfer and other OSI TP services.

This service is never invoked as such, but is used in the OSI TP Service Definition to represent any U-ASE service primitive within the OSI TP framework.

This service is associated with one particular dialogue.

TABLE 3/X.861

OSI TP service primitives

Services	Primitives	Scope	Subclause	Parameters
TP-BEGIN-DIALOGUE	req/ind/rsp/cnf	Dialogue	10.2	Initiating-AP-Title
				Initiating-API-Identifier
				Initiating-AE-Qualifier
				Initiating-AEI-Identifier
				Initiating-TPSU-Title
				Recipient-AP-Title
				Recipient-API-Identifier
				Recipient-AE-Qualifier
				Recipient-AEI-Identifier
				Recipient-TPSU-Title
				Functional-units
				Quality-of-Service
				Application-Context-Name
				Begin-Transaction
				Confirmation
				Result
				Diagnostic
				Rollback
				User-Data
TP-END-DIALOGUE	req/ind/rsp/cnf	Dialogue	10.3	Confirmation
TP-U-ERROR	req/ind	Dialogue	10.4	

TABLE 3/X.861 (*cont.*)

OSI TP service primitives

TP-U-ABORT	req/ind	Dialogue	10.5	Rollback User-Data
TP-P-ABORT	ind	Dialogue	10.6	Diagnostic Rollback
TP-GRANT-CONTROL	req/ind	Dialogue	12.2	
TP-REQUEST-CONTROL	req/ind	Dialogue	12.3	
TP-HANDSHAKE	req/ind/rsp/cnf	Dialogue	13.2	Confirmation-Urgency
TP-HANDSHAKE-AND-GRANT-CONTROL	req/ind/rsp/cnf	Dialogue	13.3	Confirmation-Urgency
TP-BEGIN-TRANSACTION	req/ind	Dialogue	14.5	
TP-DEFERRED-END-DIALOGUE	req/ind	Dialogue	14.6	
TP-DEFERRED-GRANT-CONTROL	req/ind	Dialogue	14.7	
TP-PREPARE	req	Dialogue	14.8	Data-Permitted
TP-PREPARE	ind	Dialogue	14.9	Data-Permitted
TP-READY	ind	Dialogue	14.10	
TP-COMMIT	req	TPSUI	14.11	
TP-COMMIT	ind	TPSUI	14.12	
TP-DONE	req	TPSUI	14.13	Heuristic-Report
TP-COMMIT-COMPLETE	ind	TPSUI	14.14	
TP-ROLLBACK	req	TPSUI	14.15	
TP-ROLLBACK	ind	TPSUI	14.16	
TP-ROLLBACK-COMPLETE	ind	TPSUI	14.17	
TP-HEURISTIC-REPORT	ind	Dialogue	14.18	Heuristic-Report

Note – The method for identifying the appropriate dialogue for the service primitives which are associated with a particular dialogue is a local matter.

9.2.2 *Primitives and parameters*

Table 4/X.861 lists the TP-DATA primitives.

TABLE 4/X.861

TP-DATA primitives and parameters

TP-DATA		
Parameters defined in the U-ASE	req	ind

Note – TP-DATA is modelled as an unconfirmed service. This is not meant to exclude the possibility of other types of services (e.g. confirmed services).

9.2.3 *TPSP constraints on TP-DATA request*

The requestor shall not have a *dialogue establishment indication outstanding*.

The requestor shall have control of the dialogue or, if the Polarized Control functional unit is selected, the coordination level of the dialogue shall be "commitment" and a TP-PREPARE indication with the Data-Permitted parameter set to "true" shall have been issued during the current transaction.

The requestor shall not have a *handshake request outstanding*.

The requestor shall not have a *user error indication outstanding*.

The requestor shall have neither a *dialogue termination request outstanding* nor a *dialogue termination indication outstanding*.

If the coordination level is "commitment", a TP-PREPARE request shall not have been issued during the current transaction.

If the coordination level is "commitment", the current transaction shall not be in the *termination phase*.

9.2.4 *TPSP constraints on TP-DATA indication*

The recipient shall not have a *dialogue establishment request outstanding*.

If the Polarized Control functional unit is selected:

– the recipient shall not have control of the dialogue; or

– the coordination level of the dialogue shall be "commitment" and a TP-PREPARE request with the Data-Permitted parameter set to "true" shall have been issued during the current transaction.

The recipient shall not have a *handshake indication outstanding*.

The recipient shall not have a *user error request outstanding*.

The recipient shall not have a *dialogue termination indication outstanding*.

If the coordination level is "commitment", neither a TP-PREPARE indication nor a TP-READY indication shall have been issued during the current transaction.

If the coordination level is "commitment", the current transaction shall not be in the *termination phase*.

9.2.5 *Collisions*

A TP-DATA indication is not issued to a TPSUI if there is a collision of the TP-DATA request and a TP-U-ERROR request.

A TP-DATA indication is not issued for a dialogue with a coordination level of "commitment" after a *rollback-initiating service primitive*.

A TP-DATA indication is not issued for a dialogue with a coordination level of "commitment" after a TP-COMMIT request; instead a TP-ROLLBACK indication is issued (unless a *rollback-initiating service primitive* has already been issued for the current transaction).

If the Polarized Control functional unit is selected, a TP-DATA indication is not issued for a dialogue with a coordination level of "commitment" after a TP-PREPARE request with the Data-Permitted parameter set to "false"; instead a TP-ROLLBACK indication is issued (unless a *rollback-initiating service primitive* has already been issued for the current transaction).

10 The dialogue functional unit

10.1 *Overview of the Dialogue functional unit*

The Dialogue functional unit supports the basic services required to establish a dialogue within which U-ASE primitives may be invoked, signal user-initiated errors, and terminate the dialogue. The user or the provider may signal abnormal termination.

The Dialogue functional unit shall always be selected.

10.2 *Dialogue establishment service, TP-BEGIN-DIALOGUE*

10.2.1 *Purpose*

This optionally confirmed service is used to establish a dialogue with a new TPSUI.

This service is associated with one particular dialogue.

10.2.2 *Primitives and parameters*

Table 5/X.861 lists the TP-BEGIN-DIALOGUE primitives and their parameters.

10.2.2.1 **Initiating-AP-Title, Initiating-API-Identifier, Initiating-AE-Qualifier, and Initiating-AEI-Identifier** are parameters optionally provided by the TPSP. They give information about the application-entity-invocation of the TPSUI that has issued the TP-BEGIN-DIALOGUE request.

These parameters are of type AP-Title, API-Identifier, AE-Qualifier, and AEI-Identifier, respectively, as defined in Recommendation X.217.

10.2.2.2 **Initiating-TPSU-Title** is an optional parameter which is provided by the TPSUI. It denotes the TPSU and identifies the type of TPSUI which has issued the TP-BEGIN-DIALOGUE request.

10.2.2.3 **Recipient-AP-Title, Recipient-API-Identifier, Recipient-AE-Qualifier, and Recipient-AEI-Identifier** are parameters which are provided by the initiating TPSUI in order to give information about the recipient application-entity-invocation at which the remote TPSUI will be located.

These parameters are of type AP-Title, API-Identifier, AE-Qualifier, and AEI-Identifier, respectively, as defined in Recommendation X.217.

TABLE 5/X.861

TP-BEGIN-DIALOGUE primitives and their parameters

TP-BEGIN-DIALOGUE				
Parameters	req	ind	rsp	cnf
Initiating-AP-Title		O		
Initiating-API-Identifier		O		
Initiating-AE-Qualifier		O		
Initiating-AEI-Identifier		O		
Initiating-TPSU-Title	U	C(=)		
Recipient-AP-Title	M			
Recipient-API-Identifier	U			
Recipient-AE-Qualifier	U			
Recipient-AEI-Identifier	U			
Recipient-TPSU-Title	U			
Functional-Units	M	M(=)		C
Quality-of-Service	U			
Application-Context-Name	M			
Begin-Transaction	C	C(=)		
Confirmation	M	M(=)		
Result			M	M
Diagnostic				C
Rollback				M
User-Data	U	C(=)	U	C(=)

10.2.2.4 **Recipient-TPSU-Title** is an optional parameter provided by the initiating TPSUI in order to identify the type of TPSUI with which the initiating TPSUI wants to establish a dialogue.

10.2.2.5 **Functional-Units** defines, in the request/indication, the functional units which may be used during the life of the dialogue. The rules according to which functional units may be combined are described in 7.1. In the confirmation, Functional-Units is used, if the Result parameter is set to "rejected(provider)" and the Diagnostic parameter is set to "functional-unit-not-supported", to define the functional units that the recipient application-entity-invocation may support for a dialogue.

10.2.2.6 **Quality-of-Service**: this optional parameter specifies the quality of service required for the dialogue. It is of type Quality of Service as defined in Recommendation X.217.

Note – Quality-of-Service parameters are currently being studied by CCITT.

10.2.2.7 **Application-Context-Name**: this parameter specifies the application context to be used for the dialogue. It is of type Application Context Name as defined in Recommendation X.217.

10.2.2.8 **Begin-Transaction** is mandatory when the Unchained Transactions functional unit is selected and is absent otherwise. This parameter is used to specify whether a transaction branch is initiated on the dialogue. It shall take one of the following values:

a) "false", when the subordinate TPSUI will not initially be a participant in a transaction;

b) "true", when the subordinate TPSUI will initially be a participant in a transaction.

10.2.2.9 **Confirmation** is used to specify whether confirmed dialogue establishment is required. It shall take one of the following values:

a) "always", when confirmed dialogue establishment is required;

b) "negative", when the requestor only requires notification of rejection of the dialogue.

10.2.2.10 **Result** is used to specify the result of the dialogue establishment attempt. It shall take one of the following values:

a) "accepted", when the Confirmation parameter was set to "always" and the recipient has accepted the dialogue.

b) "rejected(provider)", when the TPSP has rejected the dialogue.

The value "rejected(provider)" is only valid on the confirmation service primitive.

c) "rejected(user)", when the recipient has rejected the dialogue.

10.2.2.11 **Diagnostic** is a conditional parameter which is present in the confirmation if the Result parameter is set to "rejected(provider)". It describes the type of error which caused the dialogue to be rejected. It shall take one of the following values:

a) "recipient-unknown" when the parameters identifying the recipient application-entity-invocation do not identify a known application-entity-invocation;

b) "recipient-tpsu-title-unknown" when the TPSP cannot find the requested TPSU-Title at the recipient;

c) "tpsu-not-available(permanent)" when the dialogue request is recognized as being valid, but the addressed TPSU is not available due to a permanent failure. It is not worth trying again until the failure has been repaired;

d) "tpsu-not-available(transient)" when the dialogue request is recognized as being valid, but the addressed TPSU is not available due to a transient condition. It might be worth retrying with a reasonable expectation of success;

e) "recipient-tpsu-title-required" when the recipient application-entity-invocation requires the presence of the Recipient-TPSU-Title and this parameter was not provided in the TP-BEGIN-DIALOGUE request;

f) "functional-unit-not-supported" when one or more of the functional units selected in the TP-BEGIN-DIALOGUE request are not supported by the recipient application-entity-invocation for the dialogue;

g) "functional-unit-combination-not-supported" when the combination of functional units, selected in the TP-BEGIN-DIALOGUE request is not supported by the recipient application-entity-invocation for the dialogue;

h) "no-reason-given".

Note – It is recognized that, with respect to diagnostic values, work is still in progress to provide an integrated treatment across all the layers of the OSI Reference Model.

10.2.2.12 **Rollback** is a parameter of the confirmation primitive. It shall take one of the following values:

a) "true", if the transaction in which the recipient is a participant is being rolled back; this value has the same usage and semantics as the TP-ROLLBACK indication. This value occurs on a TP-BEGIN-DIALOGUE confirm if the dialogue has a coordination level of "commitment", the Result parameter is set to "rejected(provider)" or "rejected(user)", and the TP-BEGIN-DIALOGUE confirmation is issued after a TP-COMMIT request.

b) "false", otherwise.

10.2.2.13 **User-Data** is an optional parameter that may be present in the request/indication and/or in the response/confirmation. This parameter may be present in the response/confirmation only if the Result parameter is set to "accepted" or "rejected(user)".

In the request and indication, this parameter may identify user-specific semantics associated with the dialogue establishment attempt, for example, security-related information for validation, or additional information regarding the particular activity to be commenced.

In the response and confirmation, this parameter may identify user-specific semantics associated with the acceptance or rejection of the dialogue by the recipient TPSUI.

10.2.3 *Sequence of primitives*

The time sequence diagram of Figure 1/X.861 shows the dialogue establishment sequence of primitives when the service is not confirmed.

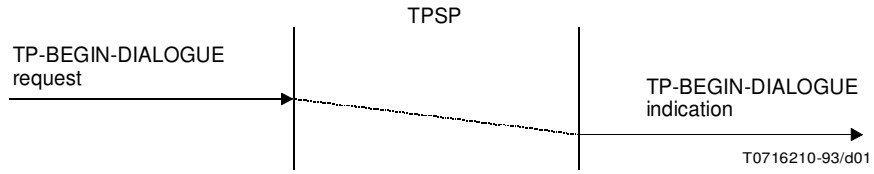

FIGURE 1/X.861

Unconfirmed TP-BEGIN-DIALOGUE sequence of primitives

The time sequence diagram of Figure 2/X.861 shows the dialogue establishment sequence of primitives when the service is confirmed.

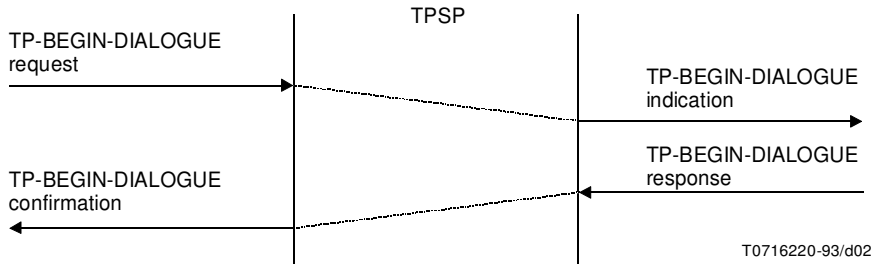

FIGURE 2/X.861

Confirmed TP-BEGIN-DIALOGUE sequence of primitives

10.2.4 *TPSP constraints on TP-BEGIN-DIALOGUE request*

The requestor shall not have a *dialogue establishment indication outstanding* with the superior.

This service primitive shall be issued as the first service primitive for the particular dialogue and shall not be issued more than once for a particular dialogue.

If the TP-BEGIN-DIALOGUE request is used to establish a dialogue with a coordination level of "commitment", the current transaction shall not be in the *termination phase*.

10.2.5 *Effects of a TP-BEGIN-DIALOGUE request*

The requestor is the superior of the recipient.

The requestor has control of the dialogue.

If the Chained Transactions functional unit is selected, or if the Unchained Transactions functional unit is selected and the Begin-Transaction parameter is set to "true", the coordination level of the dialogue is initialized to "commitment"; otherwise the coordination level of the dialogue is initialized to "none".

If the coordination level of the dialogue was initialized to "commitment", the requestor becomes a participant in a new transaction if it is not already a participant in a transaction.

If the TPSP rejects the dialogue, it issues a TP-BEGIN-DIALOGUE confirm with the Result parameter set to "rejected(provider)" to the requestor and does not issue a TP-BEGIN-DIALOGUE indication.

10.2.6 *TPSP constraints on TP-BEGIN-DIALOGUE indication*

The recipient shall not have any other dialogues.

This service primitive shall be issued as the first service primitive for that particular TPSUI and shall not be issued more than once for a particular TPSUI.

10.2.7 *Effects of a TP-BEGIN-DIALOGUE indication*

The recipient is a subordinate of the requestor.

If the Chained Transactions functional unit is selected, or if the Unchained Transactions functional unit is selected and the Begin-Transaction parameter is set to "true", the coordination level of the dialogue is initialized to "commitment"; otherwise the coordination level of the dialogue is initialized to "none".

If the coordination level is "commitment" and the Confirmation parameter is set to "negative", the recipient becomes a participant in the same transaction as the requestor by manipulating bound data, or issuing any service primitives other than a TP-BEGIN-DIALOGUE response with the Result parameter set to "rejected(user)".

If the Polarized Control functional unit is selected, the recipient does not have control of the dialogue.

10.2.8 *TPSUI conditions on TP-BEGIN-DIALOGUE response*

If the coordination level is "commitment", the responder shall not have manipulated bound data.

10.2.9 *TPSP constraints on TP-BEGIN-DIALOGUE response*

A TP-BEGIN-DIALOGUE indication shall have been issued to the responder.

Bound data handled by the TPSP shall not be changed prior to the issuance of a TP-BEGIN-DIALOGUE response.

The TPSUI shall not have issued any requests or responses to any dialogues (including TP-BEGIN-DIALOGUE requests).

If the Confirmation parameter of the TP-BEGIN-DIALOGUE indication is set to "negative", a TP-BEGIN-DIALOGUE response with the Result parameter set to "accepted" shall not be issued.

Note – Indications may be issued for the dialogue before TP-BEGIN-DIALOGUE response (for example a TP-ROLLBACK indication).

10.2.10 *Effects of a TP-BEGIN-DIALOGUE response*

If the Result parameter is set to "accepted", the dialogue is established.

If the Result parameter is set to "rejected(user)", the dialogue is terminated.

If the coordination level of the dialogue is "commitment" and the Result parameter is set to "accepted", the recipient is a participant in the same transaction as the requestor.

Note – If a TP-ROLLBACK indication has been issued before a TP-BEGIN-DIALOGUE response with the Result parameter set to "rejected(user)", no TP-DONE request is owed and TP-ROLLBACK-COMPLETE indication is not issued.

10.2.11 *TPSP constraints on TP-BEGIN-DIALOGUE confirmation*

No indications or confirmations shall have been issued for the dialogue.

10.2.12 *Effects of a TP-BEGIN-DIALOGUE confirmation*

If the Result parameter is set to "accepted", the dialogue is established.

If the Result parameter is set to "rejected(provider)" or "rejected(user)", the dialogue is terminated:

a) if the value of the Rollback parameter is "true", then the transaction is being rolled back. This value has the same usage and semantics as a TP-ROLLBACK indication.

b) if the TP-BEGIN-DIALOGUE confirm is issued with the Rollback parameter is set to "false", for the only dialogue with a coordination level of "commitment", before the transaction is in the termination phase, there is no longer a distributed provider-supported transaction; in such a situation, the TPSUI shall either continue with the current transaction by initiating new transaction branches, or terminate the transaction through the use of TP-COMMIT request or TP-ROLLBACK request.

10.3 *Dialogue Termination service, TP-END-DIALOGUE*

10.3.1 *Purpose*

This optionally confirmed service is used to terminate a dialogue.

This service is associated with one particular dialogue.

10.3.2 *Primitives and parameters*

Table 6/X.861 lists the TP-END-DIALOGUE primitives and their parameter.

TABLE 6/X.861

TP-END-DIALOGUE primitives and their parameters

TP-END-DIALOGUE				
Parameters	req	ind	rsp	cnf
Confirmation	M	M(=)		

10.3.2.1 **Confirmation** is a parameter that indicates whether the TP-END-DIALOGUE request will be confirmed. It shall take one of the following values:

a) "true", when confirmation is required and dialogue termination is conditional (confirmed dialogue termination service);

b) "false", when dialogue termination is unconditional (unconfirmed dialogue termination service).

10.3.3 *Sequence of primitives*

The time sequence diagram of Figure 3/X.861 shows the dialogue termination sequence of primitives when the service is not confirmed.

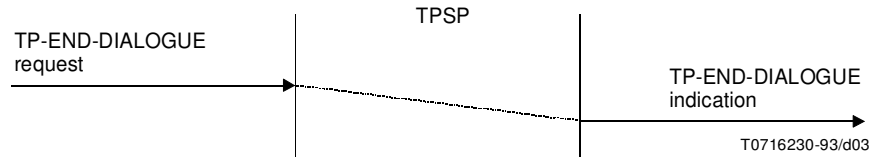

FIGURE 3/X.861

Unconfirmed TP-END-DIALOGUE sequence of primitives

The time sequence diagram of Figure 4/X.861 shows the dialogue termination sequence of primitives when the service is confirmed.

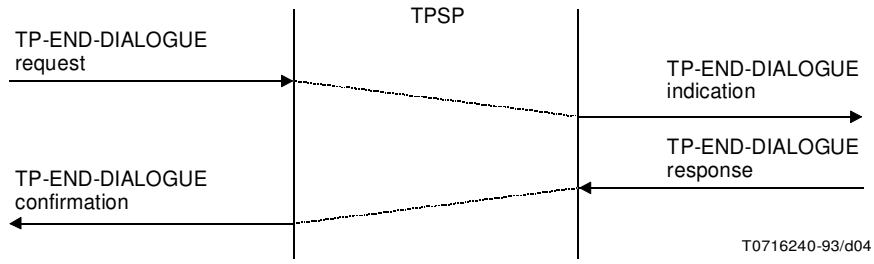

FIGURE 4/X.861

Confirmed TP-END-DIALOGUE sequence of primitives

In Figure 4/X.861, TP-END-DIALOGUE response and TP-END-DIALOGUE confirmation may be replaced by TP-U-ERROR request and TP-U-ERROR indication, respectively, if the dialogue termination is rejected.

10.3.4 *TPSP constraints on TP-END-DIALOGUE request*

The requestor shall have neither a *dialogue establishment request outstanding* nor a *dialogue establishment indication outstanding*.

The requestor shall have control of the dialogue and shall not have a *user error indication outstanding*.

The requestor shall have neither a *handshake request outstanding* nor a *handshake indication outstanding*.

The coordination level of the dialogue shall be "none".

The requestor shall have neither a *dialogue termination request outstanding* nor a *dialogue termination indication outstanding*.

10.3.5 *Effects of a TP-END-DIALOGUE request*

If the Confirmation parameter is set to "false", the dialogue is terminated.

10.3.6 *TPSP constraints on TP-END-DIALOGUE indication*

The recipient shall have neither a *dialogue establishment request outstanding nor a dialogue establishment indication outstanding*.

If the Polarized Control functional unit is selected, the recipient shall not have control of the dialogue.

The recipient shall have neither a *handshake indication outstanding* nor a *dialogue termination indication outstanding*.

The coordination level of the dialogue shall be "none".

10.3.7 *Effects of a TP-END-DIALOGUE indication*

If the Confirmation parameter is set to "false", the dialogue is terminated.

If the Confirmation parameter is set to "true" and the recipient had a *user error request outstanding*, the recipient has control of the dialogue.

10.3.8 *TPSP constraints on TP-END-DIALOGUE response*

A TP-END-DIALOGUE response shall not be issued if a *handshake request is outstanding*.

The requestor shall have a *dialogue termination indication outstanding*.

10.3.9 *Effects of a TP-END-DIALOGUE response*

The dialogue is terminated.

10.3.10 *TPSP constraints on TP-END-DIALOGUE confirmation*

The recipient shall not have a *handshake indication outstanding*.

The recipient shall have a *dialogue termination request outstanding*.

10.3.11 *Effects of a TP-END-DIALOGUE confirmation*

The dialogue is terminated.

10.3.12 *Collisions*

If the Shared Control functional unit is selected, a TP-END-DIALOGUE indication with the Confirmation parameter set to "true" is not issued to a TPSUI if there is a collision of the TP-END-DIALOGUE request and a TP-U-ERROR request.

A TP-END-DIALOGUE indication is not issued to a TPSUI which has issued a TP-BEGIN-TRANSACTION request; instead, a TP-P-ABORT indication with the Diagnostic parameter set to "begin-transaction-end-dialogue-collision" is issued.

A TP-END-DIALOGUE indication with the Confirmation parameter set to "true" is not issued to a TPSUI which has issued a TP-END-DIALOGUE request with the Confirmation parameter set to "true"; instead, a TP-P-ABORT indication with the Diagnostic parameter set to "end-dialogue-collision" is issued.

10.4 *User Error Reporting service, TP-U-ERROR*

10.4.1 *Purpose*

This service is used to notify a partner TPSUI of a processing error occurrence; it also serves as a negative response to the handshake service, to the handshake with grant-control service, and to the confirmed dialogue termination service.

The description of the error may be communicated by the TPSUI, using TP-DATA.

This service is associated with one particular dialogue.

10.4.2 *Primitives and parameters*

Table 7/X.861 lists the TP-U-ERROR primitives.

TABLE 7/X.861

TP-U-ERROR primitives

TP-U-ERROR		
No parameters	req	ind

10.4.3 *Sequence of primitives*

The time sequence diagram of Figure 5/X.861 shows the TP-U-ERROR sequence of primitives.

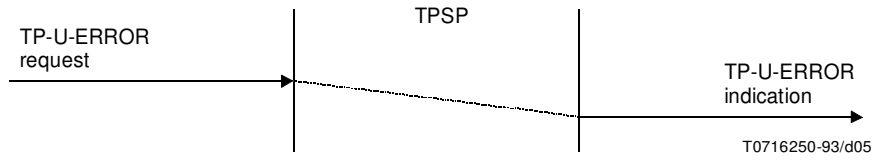

FIGURE 5/X.861

TP-U-ERROR sequence of primitives

The time sequence diagram of Figure 6/X.861 shows a TP-U-ERROR request issued as a negative confirmation of a handshake service.

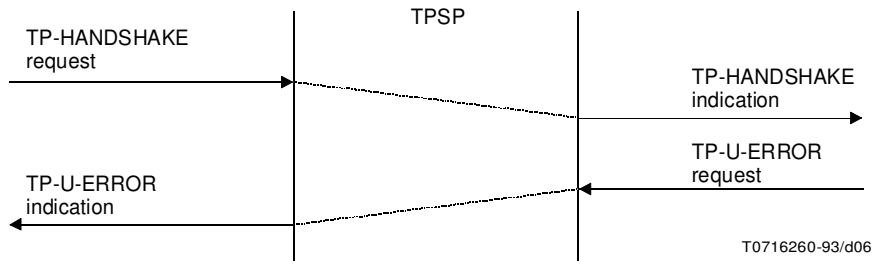

FIGURE 6/X.861

TP-U-ERROR as the negative confirmation to a handshake service

In Figure 6/X.861, the TP-HANDSHAKE may be replaced by a TP-END-DIALOGUE with Confirmation set to "true" or, if the Polarized Control functional unit has been selected, a TP-HANDSHAKE-AND-GRANT-CONTROL.

10.4.4 *TPSUI conditions on TP-U-ERROR request*

If the requestor has a *handshake indication outstanding*, synchronization was not successful.

10.4.5 *TPSP constraints on TP-U-ERROR request*

The requestor shall not have a *dialogue establishment indication outstanding*.

If the Polarized Control functional unit is selected, the requestor shall not have a *handshake request outstanding*.

The requestor shall not have a *dialogue termination request outstanding* unless the Shared Control functional unit is selected and the requestor has a *handshake indication outstanding*.

The requestor shall have neither a *user error request outstanding* nor a *user error indication outstanding*.

If the coordination level of the dialogue is "commitment", a TP-PREPARE indication or a TP-PREPARE request shall not have been issued during the current transaction.

If the coordination level of the dialogue is "commitment", the current transaction shall not be in the *termination phase*.

10.4.6 *Effects of a TP-U-ERROR request*

If the Polarized Control functional unit is selected, and there was a *handshake indication outstanding* or a *dialogue termination indication outstanding*, the requestor has control of the dialogue.

10.4.7 *TPSP constraints on TP-U-ERROR indication*

The recipient shall not have a *dialogue establishment request outstanding*.

If the Polarized Control functional unit is selected, the recipient shall have neither a *handshake indication outstanding* nor a *dialogue termination indication outstanding*.

The recipient shall have neither a *user error request outstanding* nor a *user error indication outstanding*.

If the coordination level of the dialogue is "commitment", a TP-PREPARE indication or a TP-PREPARE request shall not have been issued during the current transaction.

If the coordination level of the dialogue is "commitment", the current transaction shall not be in the termination phase.

10.4.8 *Effects of a TP-U-ERROR indication*

If the Polarized Control functional unit is selected and the recipient has control of the dialogue, then the recipient shall surrender control by issuing a TP-GRANT-CONTROL request.

If the Polarized Control functional unit is selected, and a *handshake request is outstanding* or a *dialogue termination request is outstanding*, the recipient does not have control of the dialogue.

10.4.9 *Collisions*

A TP-U-ERROR indication is not issued if one of the following service primitives has been issued:

– TP-U-ERROR request while not having control of the dialogue;

– any *rollback-initiating service primitives* for the current transaction if the coordination level of the dialogue is "commitment".

A TP-U-ERROR indication is not issued to a TPSUI which has issued TP-COMMIT request or a TP-PREPARE request, insteas a TP-ROLLBACK indication is issued (unless a *rollback-initiating service primitive* has already been issued for the current transaction).

10.5 *User Abort service, TP-U-ABORT*

10.5.1 Purpose

This service is used to abort a dialogue. Use of this service may cause loss of indications and/or confirmations to both TPSUIs.

This service is associated with one particular dialogue.

10.5.2 *Primitives and parameters*

Table 8/X.861 lists the TP-U-ABORT primitives and their parameters.

TABLE 8/X.861

TP-U-ABORT primitives and their parameters

TP-U-ABORT		
Parameters	req	ind
Rollback		M
User-Data	U	C(=)

10.5.2.1 **Rollback** is a parameter of the indication primitive. It shall take one of the following values:

a) "true", if the transaction in which the recipient is a participant is being rolled back; this value has the same usage and semantics as the TP-ROLLBACK indication.

This value shall occur if all the following conditions are satisfied:

– the dialogue has a coordination level of "commitment";

– there is no *dialogue establishment indication outstanding*;

– a TP-COMMIT request or a *rollback-initiating service primitive* has not been issued for the current transaction;

– a TP-BEGIN-TRANSACTION request has not been disrupted by the TP-U-ABORT.

This value may also occur whenever the TPSP is in a state that requires the current transaction to be rolled back.

b) "false", if no rollback of a transaction occurs or if a rollback is already in progress.

This value shall occur if any of the following conditions are satisfied:

– the dialogue has a coordination level of "none";

– the dialogue has a coordination level of "commitment", but the recipient has a *dialogue establishment indication outstanding*;

– the dialogue has a coordination level of "commitment", but a TP-COMMIT indication or a *rollback initiating service primitive* has been issued for the current transaction;

This value may also whenever the TPSP is in a state such that the rollback of the current transaction is not required.

Note – The TPSP is in such a state when a TP-U-ABORT request disrupts a TP-BEGIN-TRANSACTION request or when a TP-U-ABORT request is issued by a subordinate during a rollback procedure and received by the superior after TP-ROLLBACK-COMPLETE indication (see Recommendation X.862 for more information).

10.5.2.2 **User-Data** is an optional parameter which may be used to convey user-specific semantics associated with the abort of the dialogue.

10.5.3 *Sequence of primitives*

The time sequence diagram of Figure 7/X.861 shows the TP-U-ABORT sequence of primitives.

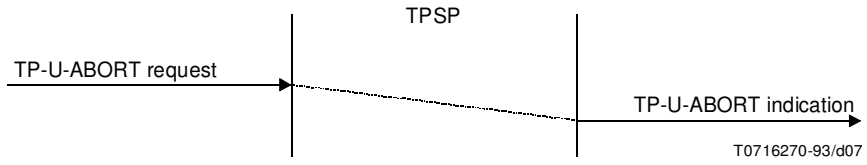

FIGURE 7/X.861

TP-U-ABORT sequence of primitives

10.5.4 *TPSP constraints on TP-U-ABORT request*

The requestor shall not have a *dialogue establishment indication outstanding*.

For a dialogue which has a coordination level of "commitment", TP-U-ABORT request shall only be issued either:

a) before the current transaction is in the *termination phase*; or

b) during the termination of the current transaction, after the issuance of any of the following service primitives:

   – TP-ROLLBACK request;

   – TP-ROLLBACK indication;

   – TP-U-ABORT indication issued for a dialogue which has a coordination level of "commitment";

   – TP-P-ABORT indication issued for a dialogue which has a coordination level of "commitment";

   – TP-BEGIN-DIALOGUE confirmation with the Result parameter set to "rejected(provider)" or "rejected(user)" for another dialogue which has a coordination level of "commitment";

and prior to the issuance of the subsequent TP-DONE request.

10.5.5 *Effects of a TP-U-ABORT request*

The dialogue is terminated. However, if a TP-U-ABORT request is issued for a dialogue with a subordinate during the *termination phase of a transaction*, a TP-HEURISTIC-REPORT indication may still be issued for the dialogue.

A TP-U-ABORT request, if used for a dialogue with a coordination level of "commitment", causes a rollback of the current transaction unless the TP-U-ABORT request is issued during the *termination phase of the current transaction*.

10.5.6 *TPSP constraints on TP-U-ABORT indication*

The recipient shall not have a *dialogue establishment request outstanding*.

If a TP-ROLLBACK indication has been issued, the recipient shall not have a *dialogue establishment indication outstanding*.

10.5.7 *Effects of a TP-U-ABORT indication*

The dialogue is terminated. However, if a TP-U-ABORT indication is issued for a dialogue with a subordinate during the *termination phase of a transaction*, a TP-HEURISTIC-REPORT indication may still be issued for the dialogue.

A TP-U-ABORT indication with the Rollback parameter set to "true" causes a rollback of the current transaction.

If a TP-U-ABORT indication is issued with the Rollback parameter set to "false", for the only dialogue with a coordination level of "commitment", before the transaction is in the termination phase, there is no longer a distributed provider-supported transaction. In such a situation, the TPSUI shall either continue with the current transaction by initiating new transaction branches, or terminate the transaction through the use of TP-COMMIT request or TP-ROLLBACK request.

10.6 *Provider Abort service, TP-P-ABORT*

10.6.1 *Purpose*

This service is used by the TPSP to notify the TPSUIs of the occurrence of a failure which caused the dialogue between them to be terminated. This service may cause loss of indications and/or confirmations to both TPSUIs.

This service is associated with one particular dialogue.

10.6.2 *Primitives and parameters*

Table 9/X.861 lists the TP-P-ABORT primitive and its parameters.

TABLE 9/X.861

TP-P-ABORT indication and its parameters

TP-P-ABORT	
Parameters	ind
Diagnostic	M
Rollback	M

10.6.2.1 **Diagnostic** is a parameter which describes the type of error which has occurred. It shall take one of the following values:

a) "permanent-failure" when a permanent error condition has been encountered. It is not worth trying again until the failure has been repaired;

b) "transient-failure" when a transient condition has been encountered, for example, congestion. It might be worth retrying with a reasonable expectation of success;

c) "protocol-error" when a protocol error has been encountered;

d) "begin-transaction-reject" when the TP-BEGIN-TRANSACTION indication is not issued because the recipient is already involved in a transaction or because of a local condition;

e) "end-dialogue-collision" when two TP-END-DIALOGUE requests with the Confirmation parameter set to "true" have collided;

f) "begin-transaction-end-dialogue-collision" when a TP-BEGIN-TRANSACTION request and a TP-END-DIALOGUE request have collided.

Note – It is recognized that, with respect to diagnostic values, work is still in progress to provide an integrated treatment across all the layers of the OSI Reference Model.

10.6.2.2 **Rollback** is a parameter of the indication primitive. It shall take one of the following values:

a) "true", if the transaction in which the recipient is a participant is being rolled back; this value has the same usage and semantics as the TP-ROLLBACK indication.

This value shall occur if all the following conditions are satisfied:

– the dialogue has a coordination level of "commitment";

– a *dialogue establishment indication is not outstanding*;

– a TP-COMMIT indication or a *rollback-initiating service primitive* has not been issued for the current transaction;

– a TP-BEGIN-TRANSACTION request has not been disrupted by the TP-P-ABORT.

This value may also occur whenever the TPSP is in a state that requires the current transaction to be rolled back.

b) "false", if no rollback of a transaction occurs or if a rollback is already in progress. This value shall occur if any of the following conditions are satisfied:

– the dialogue has a coordination level of "none";

– the dialogue has a coordination level of "commitment", but the recipient has a *dialogue establishment indication outstanding*;

– the dialogue has a coordination level of "commitment", but a TP-COMMIT indication or a *rollback initiating service primitive* has been issued for the current transaction;

This value may also occur whenever the TPSP is in a state such that the rollback of the current transaction is not required.

Note – The TPSP is in such a state when a TP-P-ABORT indication disrupts a TP-BEGIN-TRANSACTION (see Recommendation X.862 for more information).

10.6.3 *Sequence of primitives*

The time sequence diagram of Figure 8/X.861 shows the TP-P-ABORT sequence of primitives.

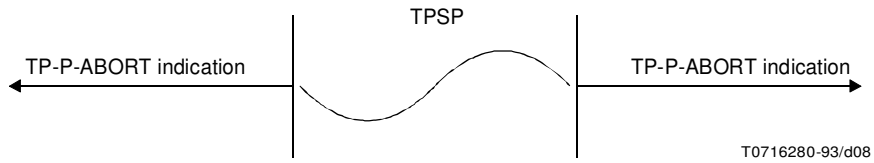

FIGURE 8/X.861

TP-P-ABORT sequence of primitives

10.6.4 *Effects of a TP-P-ABORT indication*

The dialogue is terminated. However, if a TP-P-ABORT indication is issued for a dialogue with a subordinate during the *termination phase of a transaction*, a TP-HEURISTIC-REPORT indication may still be issued for the dialogue.

A TP-P-ABORT indication with the Rollback parameter set to "true" causes a rollback of the current transaction.

If a TP-P-ABORT indication is issued for a dialogue with the Chained Transactions functional unit selected, between a TP-COMMIT indication and the corresponding TP-COMMIT-COMPLETE indication, the TPSP will trigger a rollback of the next transaction unless the deferred end dialogue service has been issued.

If a TP-P-ABORT indication is issued with the Rollback parameter is set to "false", for the only dialogue with a coordination level of "commitment", before the transaction is in the termination phase, there is no longer a distributed provider-supported transaction; in such a situation, the TPSUI shall either continue with the current transaction by initiating new transaction branches, or terminate the transaction through the use of TP-COMMIT request or TP-ROLLBACK request.

11 The Shared Control functional unit

11.1 *Overview of the Shared Control functional unit*

In the Shared Control functional unit both TPSUIs have control of the dialogue and so may issue request primitives subject only to the normal sequencing constraints of the primitives. For example, data may be transferred by both TPSUIs at the same time.

The Shared Control and Polarized Control functional units are mutually exclusive for a given dialogue.

There are no service primitives associated with the Shared Control functional unit.

12 The Polarized Control functional unit

12.1 *Overview of the Polarized Control functional unit*

In the Polarized Control functional unit only one TPSUI has control of the dialogue at any point in time.

When a dialogue is established, control rests with the dialogue initiator. Subsequently, control may be passed by use of a TP-GRANT-CONTROL request or a TP-DEFERRED-GRANT-CONTROL request, and may be requested by a TP-REQUEST-CONTROL request. In addition, when a TP-U-ERROR request is issued in response to a TP-HANDSHAKE indication, or a TP-END-DIALOGUE indication with the Confirmation parameter set to "true", or a TP-HANDSHAKE-AND-GRANT-CONTROL indication, control is passed automatically to the issuer of the TP-U-ERROR request. In the case of rollback, at completion of the transaction, control is with the TPSUI which had it at the beginning of the transaction.

Many request primitives may be issued only by the TPSUI which has control of the dialogue. This restriction is in addition to the normal sequencing constraints for the primitives. For example, data may only be transferred by the TPSUI that has control of the dialogue or by a TPSUI that has been issued a TP-PREPARE indication with the Data-Permitted parameter set to "true".

The Shared Control and Polarized Control functional units are mutually exclusive, for a given dialogue.

12.2 *Grant Control service, TP-GRANT-CONTROL*

12.2.1 *Purpose*

This service is used by a TPSUI to grant control of the dialogue to the partner TPSUI.

This service is associated with one particular dialogue.

12.2.2 *Primitives and parameters*

Table 10/X.861 lists the TP-GRANT-CONTROL primitives.

TABLE 10/X.861

TP-GRANT-CONTROL primitives

TP-GRANT-CONTROL		
No parameters	req	ind

12.2.3 *Sequence of primitives*

The time sequence diagram of Figure 9/X.861 shows the TP-GRANT-CONTROL sequence of primitives.

12.2.4 *TPSP constraints on TP-GRANT-CONTROL request*

The Polarized Control functional unit shall be selected for the dialogue.

The requestor shall not have a *dialogue establishment indication outstanding*.

The requestor shall have control of the dialogue.

The requestor shall not have a *handshake request outstanding*.

If the coordination level of the dialogue is “commitment”, a TP-PREPARE request shall not have been issued during the current transaction.

If the coordination level of the dialogue is “commitment”, the current transaction shall not be in the *termination phase*.

The requestor shall not have a *dialogue termination request outstanding*.

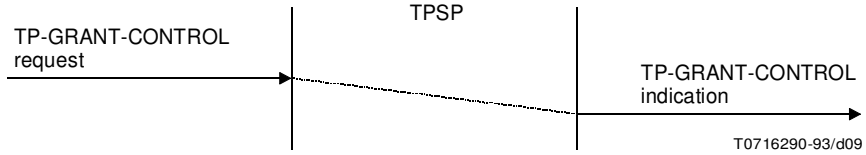

FIGURE 9/X.861

TP-GRANT-CONTROL sequence of primitives

12.2.5 *Effects of a TP-GRANT-CONTROL request*

The requestor no longer has control of the dialogue.

12.2.6 *TPSP constraints on TP-GRANT-CONTROL indication*

The Polarized Control functional unit shall be selected for the dialogue.

The recipient shall not have a *dialogue establishment request outstanding*.

The recipient shall not have control of the dialogue.

If the coordination level of the dialogue is “commitment”, a TP-PREPARE indication shall not have been issued for the current transaction.

If the coordination level of the dialogue is “commitment”, the current transaction shall not be in the termination phase.

The recipient shall not have a *dialogue termination indication outstanding*.

12.2.7 *Effects of a TP-GRANT-CONTROL indication*

The recipient has control of the dialogue.

12.2.8 *Collisions*

A TP-GRANT-CONTROL indication is not issued for a dialogue having a coordination level of “commitment” if any *rollback-initiating service primitive* has been issued during the current transaction.

12.3 *Request Control service, TP-REQUEST-CONTROL*

12.3.1 *Purpose*

This service is used by a TPSUI to request control of the dialogue. However, control is not actually transferred by this service and the TPSUI to which the indication is issued is not obliged to relinquish control.

This service is associated with one particular dialogue.

12.3.2 *Primitives and parameters*

Table 11/X..861 lists the TP-REQUEST-CONTROL primitives.

TABLE 11/X.861

TP-REQUEST-CONTROL primitives

TP-REQUEST-CONTROL		
No parameters	req	ind

12.3.3 *Sequence of primitives*

The time sequence diagram of Figure 10/X.861 shows the TP-REQUEST-CONTROL sequence of primitives.

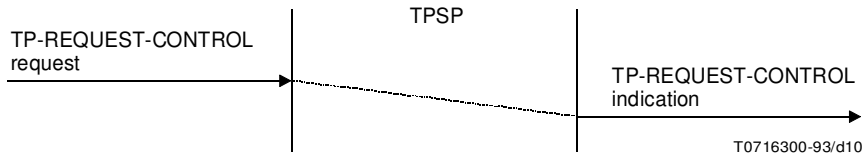

FIGURE 10/X.861

TP-REQUEST-CONTROL sequence of primitives

12.3.4 *TPSP constraints on TP-REQUEST-CONTROL request*

The Polarized Control functional unit shall be selected for the dialogue.

The requestor shall not have a *dialogue establishment indication outstanding*.

The requestor shall not have control of the dialogue.

The requestor shall not have a TP-HANDSHAKE-AND-GRANT-CONTROL indication outstanding.

The requestor shall not have a *user error request outstanding*.

If the coordination level of the dialogue is "commitment", a TP-PREPARE indication shall not have been issued during the current transaction.

If the coordination level of the dialogue is "commitment", the current transaction shall not be in the *termination phase*.

The requestor shall not have a *dialogue termination indication outstanding*.

12.3.5 *TPSP constraints on TP-REQUEST-CONTROL indication*

The Polarized Control functional unit shall be selected for the dialogue.

The recipient shall not have a *dialogue establishment request outstanding*.

The recipient shall have control of the dialogue.

The recipient shall not have a *user error indication outstanding*.

If the coordination level of the dialogue is "commitment", a TP-PREPARE request shall not have been issued during the current transaction.

If the coordination level of the dialogue is "commitment", the current transaction shall not be in the *termination phase*.

The recipient shall not have a *dialogue termination request outstanding*.

12.3.6 *Collisions*

A TP-REQUEST-CONTROL indication is not issued if one of the following service primitives has been issued:

– TP-GRANT-CONTROL request;

– TP-HANDSHAKE-AND-GRANT-CONTROL request;

– any *rollback-initiating service primitives*;

– TP-END-DIALOGUE request with the Confirmation parameter set to "true";

– TP-PREPARE request;

– TP-COMMIT request.

13 Handshake functional unit

13.1 *Overview of the Handshake functional unit*

The Handshake functional unit allows partner TPSUIs to synchronize their processing with one another, and possibly transfer control.

13.2 *Handshake service, TP-HANDSHAKE*

13.2.1 Purpose

This service is used by partner TPSUIs to synchronize their processing with one another.

This service is associated with one particular dialogue.

13.2.2 *Primitives and parameters*

Table 12/X.861 lists the TP-HANDSHAKE primitives and their parameter.

TABLE 12/X.861

TP-HANDSHAKE primitives and their parameters

TP-HANDSHAKE				
Parameter	req	ind	rsp	cnf
Confirmation-Urgency	C			

13.2.2.1 **Confirmation-Urgency** applies only if the Shared Control functional unit has been selected. It is provided by the requestor to specify the urgency with which the response is required. This parameter shall take one of the following values:

a) "urgent" when the TPSUI requests minimal delay in receiving the confirmation primitive;

b) "normal" when the TPSUI has no particular delay requirement in receiving the confirmation primitive. In this case, the communication flow may be optimized by the TPSP.

13.2.3 *Sequence of primitives*

The time sequence diagram of Figure 11/X.861 shows the TP-HANDSHAKE sequence of primitives.

In Figure 11/X.861 the TP-HANDSHAKE response and the TP-HANDSHAKE confirmation may be replaced by a TP-U-ERROR request and a TP-U-ERROR indication, respectively, if synchronization is unsuccessful.

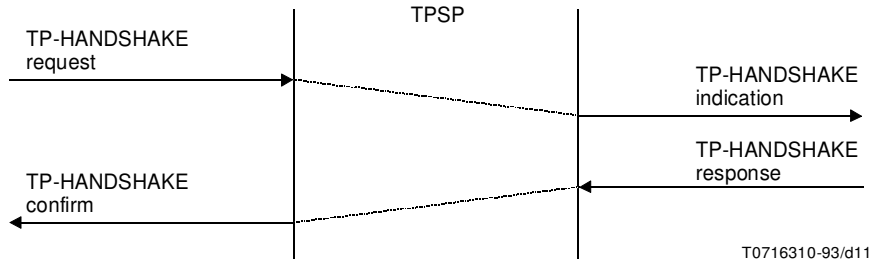

FIGURE 11/X.861

TP-HANDSHAKE sequence of primitives

13.2.4 *TPSP constraints on TP-HANDSHAKE request*

The Handshake functional unit shall be selected for the dialogue.

The requestor shall not have a *dialogue establishment indication outstanding*.

The requestor shall have control of the dialogue.

The requestor shall not have a *handshake request outstanding*.

The requestor shall not have a *user error indication outstanding*.

If the coordination level of the dialogue is "commitment", a TP-PREPARE indication or a TP-PREPARE request shall not have been issued during the current transaction.

If the coordination level of the dialogue is "commitment", the current transaction shall not be in the *termination phase*.

The requestor shall have neither a *dialogue termination request outstanding* nor a *dialogue termination indication outstanding*.

13.2.5 *TPSP constraints on TP-HANDSHAKE indication*

The Handshake functional unit shall be selected for the dialogue.

The recipient shall not have a *dialogue establishment request outstanding*.

If the Polarized Control functional unit is selected, the recipient shall not have control of the dialogue.

The recipient shall not have a *handshake indication outstanding*.

If the Shared Control functional unit is selected and the coordination level of the dialogue is "commitment", a TP-PREPARE request shall not have been issued during the current transaction.

If the coordination level of the dialogue is "commitment", the current transaction shall not be in the *termination phase*.

The recipient shall not have a *dialogue termination indication outstanding*.

13.2.6 *Effects of a TP-HANDSHAKE indication*

If a *user error request was outstanding*, the recipient has control of the dialogue. In this case, no response is required and the synchronization is considered unsuccessful.

13.2.7 *TPSUI conditions on TP-HANDSHAKE response*

Synchronization is successful.

13.2.8 *TPSP constraints on TP-HANDSHAKE response*

The responder shall not have a *dialogue establishment indication outstanding*.

A TP-HANDSHAKE indication shall be outstanding.

13.2.9 *TPSP constraints on TP-HANDSHAKE confirmation*

A TP-HANDSHAKE request shall be outstanding.

The recipient shall not have a *dialogue establishment request outstanding*.

13.2.10 *Collisions*

If the Shared Control functional unit is selected, a TP-HANDSHAKE indication is not issued to a TPSUI if there is a collision of the TP-HANDSHAKE request and a TP-U-ERROR request.

If the Shared Control functional unit is selected, a TP-HANDSHAKE indication is not issued for a dialogue with a coordination level of "commitment" after a TP-COMMIT request or a TP-PREPARE request. Instead a TP-ROLLBACK indication is issued (unless a *rollback-initiating service primitive* has already been issued for the current transaction).

A TP-HANDSHAKE indication or confirmation is not issued for a dialogue having a coordination level of "commitment" if any *rollback-initiating service primitive* has been issued during the current transaction.

Note – If the Shared Control functional unit is selected, then a TP-HANDSHAKE request colliding with TP-HANDSHAKE indication from a remote partner is not regarded as a collision, but as two separate uses of the service. Either may be successful or fail independently of the other.

13.3 *Handshake and Grant Control service, TP-HANDSHAKE-AND-GRANT-CONTROL*

13.3.1 *Purpose*

This service is used by partner TPSUIs to synchronize their processing with one another and to transfer control.

This service is associated with one particular dialogue.

13.3.2 *Primitives and parameters*

Table 13/X.861 lists the TP-HANDSHAKE-AND-GRANT-CONTROL primitives and their parameter.

TABLE 13/X.861

TP-HANDSHAKE-AND-GRANT-CONTROL primitives and their parameters

TP-HANDSHAKE-AND-GRANT-CONTROL				
Parameter	req	ind	rsp	cnf
Confirmation-Urgency	M			

13.3.2.1 **Confirmation-Urgency** is a parameter which is provided by the requestor to specify the urgency with which the response is required. This parameter shall take one of the following values:

a) "urgent" when the TPSUI requests minimal delay in receiving the confirmation primitive;

b) "normal" when the TPSUI has no particular delay requirement in receiving the confirmation primitive. In this case, the communication flow may be optimized by the TPSP.

13.3.3 *Sequence of primitives*

The time sequence diagram of Figure 12/X.861 shows the TP-HANDSHAKE-AND-GRANT-CONTROL sequence of primitives.

In Figure 12/X.861, the TP-HANDSHAKE-AND-GRANT-CONTROL response and the TP-HANDSHAKE-AND-GRANT-CONTROL confirm may be replaced by a TP-U-ERROR request and a TP-U-ERROR indication, respectively, if synchronization is unsuccessful.

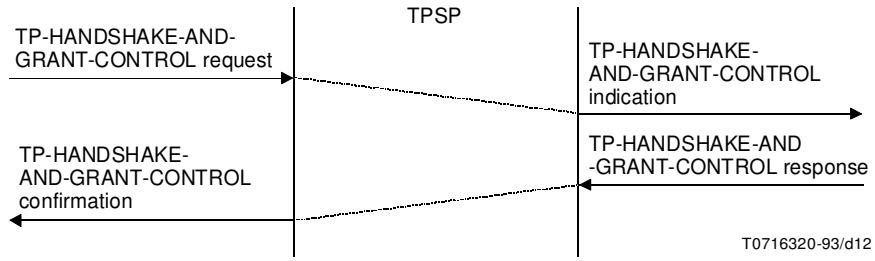

FIGURE 12/X.861

TP-HANDSHAKE-AND-GRANT-CONTROL sequence of primitives

13.3.4 *TPSP constraints on TP-HANDSHAKE-AND-GRANT-CONTROL request*

The Handshake and Polarized Control functional units shall both be selected for the dialogue.

The requestor shall not have a *dialogue establishment indication outstanding*.

The requestor shall have control of the dialogue.

The requestor shall not have a *handshake request outstanding*.

The requestor shall not have a *user error indication outstanding*.

If the coordination level of the dialogue is "commitment", a TP-PREPARE request shall not have been issued during the current transaction.

If the coordination level of the dialogue is "commitment", the current transaction shall not be in the *termination phase*.

The requestor shall not have a *dialogue termination request outstanding*.

13.3.5 *Effects of a TP-HANDSHAKE-AND-GRANT-CONTROL request*

The requestor no longer has control of the dialogue.

13.3.6 *TPSP constraints on TP-HANDSHAKE-AND-GRANT-CONTROL indication*

The Handshake and Polarized Control functional units shall both be selected for the dialogue.

The recipient shall not have a *dialogue establishment request outstanding*.

The recipient shall not have control of the dialogue.

The recipient shall not have a *handshake indication outstanding*.

If the coordination level of the dialogue is "commitment", a TP-PREPARE indication shall not have been issued during the current transaction.

If the coordination level of the dialogue is "commitment", the current transaction shall not be in the *termination phase*.

The recipient shall not have a *dialogue termination indication outstanding*.

13.3.7 *Effects of a TP-HANDSHAKE-AND-GRANT-CONTROL indication*

The recipient has control of the dialogue.

13.3.8 *TPSUI conditions on TP-HANDSHAKE-AND-GRANT-CONTROL response*

Synchronization is successful.

13.3.9 *TPSP constraints on TP-HANDSHAKE-AND-GRANT-CONTROL response*

The responder shall not have a *dialogue establishment indication outstanding*.

A TP-HANDSHAKE-AND-GRANT-CONTROL indication shall be outstanding.

13.3.10 *TPSP constraints on TP-HANDSHAKE-AND-GRANT-CONTROL confirmation*

A TP-HANDSHAKE-AND-GRANT-CONTROL request shall be outstanding.

There shall be no *dialogue establishment request outstanding*.

13.3.11 *Collisions*

A TP-HANDSHAKE-AND-GRANT-CONTROL indication or a TP-HANDSHAKE-AND-GRANT-CONTROL confirm is not issued for a dialogue with a coordination level of "commitment" if any *rollback-initiating service primitive* has been issued during the current transaction.

14 The commitment-related functional units

14.1 *Introduction*

The commitment-related functional units are:

– the Commit functional unit;

– the Chained Transactions functional unit; and

– the Unchained Transactions functional unit.

The Commit functional unit shall be selected on a dialogue if the TPSUI wants transaction branches to be supported on the dialogue.

The Chained Transactions functional unit and the Unchained Transactions functional unit are mutually exclusive; one and only one shall be selected if the Commit functional unit is selected.

If the Chained Transactions functional unit is selected, the dialogue will always support transaction branches, thus its coordination level is always "commitment". During the lifetime of the dialogue, the superior and the subordinate TPSUIs will be in the same transaction tree.

If the Unchained Transactions functional unit is selected, the dialogue may support transaction branches. The superior determines when the coordination level of the dialogue is "commitment". At a given point in time, the two TPSUIs may be participants in the same transaction, in different transactions, or one or both TPSUIs may not be involved in a transaction.

14.2 *Overview of the Commit functional unit*

14.2.1 *Introduction*

The Commit functional unit shall be selected if the TPSUI wants the TPSP to coordinate the maintenance of the ACID properties.

The commitment procedures are based on two-phase commitment. In the first phase, all TPSUIs in the transaction tree are brought to a state called READY, in which all processing and data transfer for the current transaction are complete, and all bound data for the transaction are in a state called ready-to-commit from where they may be placed in either the initial or the final state. In the second phase, the transaction is either committed or rolled back.

Any *rollback-initiating service primitive* may be used to trigger a rollback of the entire transaction tree before completion of the first phase.

A heuristic decision may be taken for any bound data that are in the ready-to-commit state.

The TPSP and/or the TPSUI may handle bound data; the Commit functional unit enables the TPSP and/or the TPSUI to manage the effects of commitment or rollback on their bound data.

14.2.2 *Phase 1 of Commitment*

Phase 1 of Commitment uses the following service primitives:

– TP-PREPARE request which allows a superior TPSUI to request a subordinate transaction subtree to enter the READY state. When the *subordinate subtree* is ready-to-commit, it is indicated to the superior TPSUI by a TP-READY indication (unless the superior TPSUI has issued a TP-COMMIT request). The use of this service is optional.

– TP-PREPARE indication is used to indicate that the superior is requesting its subordinate transaction subtree to complete processing for the current transaction and place its bound data in the ready-to-commit state. This indication is issued when either a TP-PREPARE request or a TP-COMMIT request has been issued by the superior.

– TP-COMMIT request is used to indicate willingness to end the transaction, to indicate that the bound data handled by the TPSUI are in the ready-to-commit state, and to request all the subordinate nodes to enter the READY state. After this point, the TPSUI is no longer allowed to initiate rollback for this transaction and shall wait for a TP-COMMIT indication or a *rollback-initiating indication*.

TP-PREPARE request and TP-COMMIT request support two approaches to initiating commitment:

– If the TPSUI issues TP-COMMIT request, then it can no longer participate in the organization of the two-phase commit procedure.

– By issuing the optional TP-PREPARE request to a subordinate, the TPSUI may achieve the following:

  1) the *subordinate subtree* is requested to proceed with the first phase of the two-phase commit procedure while the TPSUI is still in the active phase of the transaction;

  2) by waiting for the corresponding TP-READY indication from the particular subordinate, the TPSUI may determine that the subordinate is ready-to-commit before it proceeds with the remainder of the commitment process;

  3) a subordinate is notified that no more messages will be sent to it, while the subordinate may still be allowed to send messages to its superior before it enters the commitment procedure.

14.2.3 *Phase 2 of Commitment*

Phase 2 of Commitment uses the following service primitives:

– TP-COMMIT indication is issued to inform a TPSUI that the transaction is in the process of being committed and to request the TPSUI to release its bound data in the final state;

– TP-DONE request is issued when the TPSUI has released its bound data in the final state;

– TP-COMMIT-COMPLETE indication is issued to a TPSUI to indicate that the prior transaction has been committed. If any dialogue exists with the Chained Transactions functional unit selected, the indication also indicates that the TPSUI is involved in the subsequent transaction.

14.2.4 *Rollback*

Rollback uses the following service primitives:

– A *rollback-initiating* request is issued by a TPSUI to request that the transaction be rolled back. More than one TPSUI in the tree may issue a *rollback-initiating request* for a given transaction;

– A rollback may also be initiated by the TPSP when it detects a condition which prevents the transaction from committing;

– A *rollback-initiating indication* is issued to inform a TPSUI that the transaction is in the process of being rolled back and to request the TPSUI to release its bound data in the initial state;

– TP-DONE request is issued when the TPSUI has released its bound data in the initial state;

– TP-ROLLBACK-COMPLETE indication is issued to a TPSUI to indicate that the prior transaction has been rolled back. If any dialogue exists with the Chained Transactions functional unit selected, the indication also indicates that the TPSUI is involved in the subsequent transaction.

14.2.5 *Heuristic decision reporting*

Heuristic decision reporting uses the following service primitives:

– TP-DONE request, with a Heuristic-Report parameter, is issued when the TPSUI has released its bound data in a state inconsistent with the final outcome of the transaction, or when a failure may prevent reporting of bound data inconsistency;

– TP-HEURISTIC-REPORT indication is issued to indicate to a TPSUI that a subordinate subtree has either released its bound data in an inconsistent state, or that a failure may prevent reporting of bound data inconsistency.

14.3 *Overview of the Chained Transactions functional unit*

The Chained Transactions functional unit shall only be selected when the Commit functional unit is selected.

The Chained Transactions functional unit and the Unchained Transactions functional unit are mutually exclusive for a dialogue.

When this functional unit is selected, the coordination level of the dialogue is always “commitment”. There are no service primitives associated with this functional unit.

14.4 *Overview of the Unchained Transactions functional unit*

The Unchained Transactions functional unit shall only be selected when the Commit functional unit is selected.

The Chained Transactions functional unit and the Unchained Transactions functional unit are mutually exclusive for a dialogue.

The superior determines when the coordination level of the dialogue is “commitment”; if the coordination level is “commitment” at the completion of a transaction, it changes to “none”. At a given point in time, the two TPSUIs may be participants in the same transaction, in different transactions, or one or both TPSUIs may not be involved in a transaction.

A TPSUI may involve a subordinate in a transaction by means of the only service primitive in the Unchained Transactions functional unit: TP-BEGIN-TRANSACTION.

A TPSUI may also involve a subordinate in a transaction by means of the Begin-Transaction parameter of the TP-BEGIN-DIALOGUE service.

14.5 *Begin Transaction service, TP-BEGIN-TRANSACTION*

14.5.1 *Purpose*

This service is used by a TPSUI to include a subordinate TPSUI as a participant in the requestor’s current transaction. If the requestor is not already a participant in a transaction, then a new transaction is initiated.

This service is associated with one particular dialogue.

14.5.2 *Primitives and parameters*

Table 14/X.861 lists the TP-BEGIN-TRANSACTION primitives.

TABLE 14/X.861

TP-BEGIN-TRANSACTION primitives

TP-BEGIN-TRANSACTION		
No parameters	req	ind

14.5.3 *Sequence of primitives*

The time sequence diagram of Figure 13/X.861 shows the TP-BEGIN-TRANSACTION sequence of primitives.

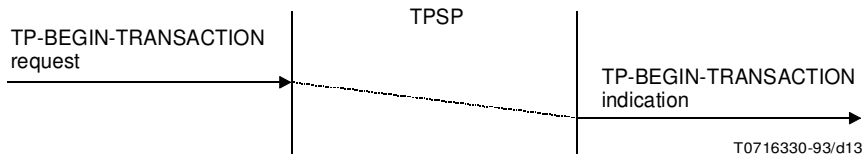

FIGURE 13/X.861

TP-BEGIN-TRANSACTION sequence of primitives

14.5.4 *TPSP constraints on TP-BEGIN-TRANSACTION request*

The Unchained Transactions functional unit shall be selected for the dialogue.

The requestor shall be the superior.

The requestor shall have control of the dialogue.

The requestor shall have neither a *handshake request outstanding* nor a *handshake indication outstanding*.

The requestor shall not have a *user error indication outstanding*.

The coordination level of the dialogue shall be "none".

If there is a current transaction, it shall not be in the *termination phase*.

The requestor shall neither have a *dialogue termination request outstanding* nor a *dialogue termination indication outstanding*.

14.5.5 *Effects of a TP-BEGIN-TRANSACTION request*

The coordination level of the dialogue is changed to "commitment".

The requestor becomes a participant in a new transaction if it is not already a participant in a transaction.

Note – If the subordinate is already involved in a transaction, the TP-BEGIN-TRANSACTION request may be rejected by a TP-P-ABORT indication with the Diagnostic parameter set to "begin-transaction-reject" or may be held until the subordinate is no longer involved in a transaction.

14.5.6 *TPSP constraints on TP-BEGIN-TRANSACTION indication*

The Unchained Transactions functional unit shall be selected.

The recipient shall be the subordinate.

If the Polarized Control functional unit is selected, the recipient shall not have control of the dialogue.

The recipient shall have neither a *handshake indication outstanding* nor a *dialogue termination indication outstanding*.

The coordination level of the dialogue shall be "none".

The recipient shall not be involved in a transaction.

14.5.7 *Effects of a TP-BEGIN-TRANSACTION indication*

The coordination level of the dialogue is changed to "commitment".

The recipient becomes a participant in the same transaction as the requestor by manipulating bound data, receiving a *rollback-initiating indication*, or issuing any service primitives other than a TP-BEGIN-DIALOGUE response with the Result parameter set to "rejected(user)".

14.5.8 *Collisions*

A TP-BEGIN-TRANSACTION indication is not issued to a TPSUI which has issued TP-END-DIALOGUE request with the Confirmation set "true"; instead a TP-P-ABORT indication with Diagnostic parameter set to "begin-transaction-end-dialogue-collision" is issued.

14.6 *Deferred End Dialogue service, TP-DEFERRED-END-DIALOGUE*

14.6.1 *Purpose*

This service is used by a TPSUI to end a dialogue with a subordinate TPSUI if the current transaction is committed, i.e. the termination of the specified dialogue takes place with the completion of commitment of the current transaction.

This service is associated with one particular dialogue.

14.6.2 *Primitives and parameters*

Table 15/X.861 lists the TP-DEFERRED-END-DIALOGUE primitives.

TABLE 15/X.861

TP-DEFERRED-END-DIALOGUE primitives

TP-DEFERRED-END-DIALOGUE		
No parameters	req	ind

14.6.3 *Sequence of primitives*

The time sequence diagram of Figure 14/X.861 shows the TP-DEFERRED-END-DIALOGUE sequence of primitives.

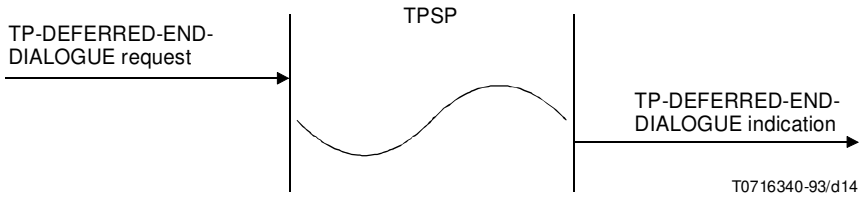

FIGURE 14/X.861

TP-DEFERRED-END-DIALOGUE sequence of primitives

The corresponding TP-DEFERRED-END-DIALOGUE indication may be delayed and issued to the specified subordinate after indications or confirmations resulting from subsequent requests or responses. However, the TP-DEFERRED-END-DIALOGUE indication shall be issued before any TP-PREPARE indication.

14.6.4 *TPSP constraints on TP-DEFERRED-END-DIALOGUE request*

The requestor shall be the superior.

The requestor shall have control of the dialogue.

The requestor shall neither have a *handshake request outstanding* nor a *handshake indication outstanding*.

The requestor shall not have a *user error indication outstanding*.

The coordination level of the dialogue shall be “commitment”.

A TP-DEFERRED-END-DIALOGUE request shall not have been issued during the current transaction.

A TP-PREPARE request shall not have been issued during the current transaction.

The current transaction shall not be in the *termination phase*.

14.6.5 *Effects of a TP-DEFERRED-END-DIALOGUE request*

If the current transaction is committed, the dialogue terminates when the TP-COMMIT-COMPLETE indication is issued.

14.6.6 *TPSP constraints on TP-DEFERRED-END-DIALOGUE indication*

The recipient shall be the subordinate.

If the Polarized Control functional unit is selected, the recipient shall not have control of the dialogue.

The recipient shall not have a *handshake indication outstanding*.

The coordination level of the dialogue shall be “commitment”.

A TP-DEFERRED-END-DIALOGUE indication shall not have been issued during the current transaction.

A TP-PREPARE indication shall not have been issued during the current transaction.

The current transaction shall not be in the *termination phase*.

14.6.7 *Effects of a TP-DEFERRED-END-DIALOGUE indication*

If the current transaction is committed, the dialogue terminates when the TP-COMMIT-COMPLETE indication is issued.

14.6.8 *Collisions*

A TP-DEFERRED-END-DIALOGUE indication is not issued to a TPSUI which has issued any *rollback-initiating service primitives*.

14.7 *Deferred Grant Control service, TP-DEFERRED-GRANT-CONTROL*

14.7.1 *Purpose*

This service is used by a TPSUI to grant control of the dialogue to the specified subordinate if the current transaction is committed.

This service is associated with one particular dialogue.

14.7.2 *Primitives and parameters*

Table 16/X.861 lists the TP-DEFERRED-GRANT-CONTROL primitives.

TABLE 16/X.861

TP-DEFERRED-GRANT-CONTROL primitives

TP-DEFERRED-GRANT-CONTROL		
No parameters	req	ind

14.7.3 *Sequence of primitives*

The time sequence diagram of Figure 15/X.861 shows the TP-DEFERRED-GRANT-CONTROL sequence of primitives.

The corresponding TP-DEFERRED-GRANT-CONTROL indication may be delayed and issued to the specified subordinate after indications or confirmations resulting from subsequent requests or responses. However, the TP-DEFERRED-GRAND-CONTROL indication shall be issued before any TP-PREPARE indication.

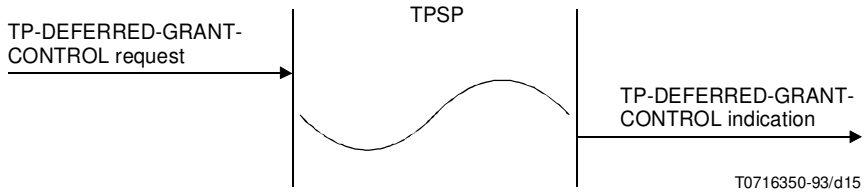

FIGURE 15/X.861

TP-DEFERRED-GRANT-CONTROL sequence of primitives

14.7.4 *TPSP constraints on TP-DEFERRED-GRANT-CONTROL request*

The requestor shall be the superior.

The Polarized Control functional unit shall be selected.

The requestor shall have control of the dialogue.

The requestor shall not have a *handshake request outstanding*.

The requestor shall not have a *user error indication outstanding*.

The coordination level of the dialogue shall be “commitment”.

A TP-DEFERRED-GRANT-CONTROL request shall not have been issued during the current transaction.

A TP-DEFERRED-END-DIALOGUE request shall not have been issued during the current transaction.

A TP-PREPARE request shall not have been issued during the current transaction.

The current transaction shall not be in the *termination phase*.

14.7.5 *Effects of a TP-DEFERRED-GRANT-CONTROL request*

If the current transaction is committed, the requestor will not have control of the specified dialogue when the TP-COMMIT-COMPLETE indication is issued.

14.7.6 *TPSP constraints on TP-DEFERRED-GRANT-CONTROL indication*

The recipient shall be the subordinate.

The Polarized Control functional unit shall be selected.

The recipient shall not have control of the dialogue.

The recipient shall not have a *handshake indication outstanding*.

The coordination level of the dialogue shall be “commitment”.

A TP-DEFERRED-END-DIALOGUE indication shall not have been issued during the current transaction.

A TP-DEFERRED-GRANT-CONTROL indication shall not have been issued during the current transaction.

A TP-PREPARE indication shall not have been issued during the current transaction.

The current transaction shall not be in the *termination phase*.

14.7.7 *Effects of a TP-DEFERRED-GRANT-CONTROL indication*

If the current transaction is committed, the recipient will have control of the dialogue when the TP-COMMIT-COMPLETE indication is issued.

14.7.8 *Collisions*

A TP-DEFERRED-GRANT-CONTROL indication is not issued to a TPSUI which has issued any *rollback-initiating service primitive*.

14.8 *TP-PREPARE request*

14.8.1 *Purpose*

This service primitive is issued by a superior TPSUI involved in a transaction to request a *subordinate subtree* to complete processing for the current transaction and place its bound data in the ready to commit state. In addition, the superior TPSUI issues this service to indicate that no more messages will be sent to the subordinate.

This service primitive is associated with one particular dialogue.

14.8.2 *Primitives and parameters*

Table 17/X.861 lists the TP-PREPARE request primitive and its parameter.

TABLE 17/X.861

TP-PREPARE request and its parameter

TP-PREPARE	
Parameter	req
Data-Permitted	C

14.8.2.1 **Data-Permitted** is a parameter that is present when the Polarized Control functional unit is selected. It shall take one of the following values:

a) "true" when the recipient is still allowed to issue TP-DATA requests to the requestor within the current transaction;

b) "false" if no further TP-DATA requests are allowed to be issued towards the requestor.

14.8.3 *TPSP constraints on TP-PREPARE request*

The requestor shall be the superior.

The requestor shall have control of the dialogue.

The requestor shall have neither a *handshake request outstanding* nor a *handshake indication outstanding*.

The requestor shall not have a *user error indication outstanding*.

The coordination level of the dialogue shall be "commitment".

A TP-PREPARE indication shall have been issued if the requestor is the subordinate for a dialogue with a coordination level of "commitment".

A TP-PREPARE request shall not have been issued.

The current transaction shall not be in the *termination phase*.

14.8.4 *Effects of issuing a TP-PREPARE request*

A TP-PREPARE indication is issued to the specified subordinate.

14.8.5 *Collisions*

A TP-PREPARE indication is not issued to a TPSUI if there is a collision of the TP-PREPARE request and a TP-U-ERROR request, instead a TP-ROLLBACK indication is issued.

14.9 *TP-PREPARE indication*

14.9.1 *Purpose*

This service primitive is issued to intermediate or leaf TPSUIs in a transaction tree to indicate that:

– all messages from the superior for the current transaction have been received;

– completion of the processing for the current transaction is requested;

– placement of the bound data handled by the TPSUI in the ready-to-commit state is requested.

This service is associated with one particular dialogue.

14.9.2 *Primitives and parameters*

Table 18/X.861 lists the TP-PREPARE indication primitive and its parameter.

TABLE 18/X.861

TP-PREPARE indication and its parameter

TP-PREPARE	
Parameter	ind
Data-Permitted	C

14.9.2.1 **Data-Permitted** is a parameter that is present when the Polarized Control functional unit is selected. It shall take one of the following values:

a) "true" when the recipient is allowed to issue TP-DATA requests for its *superior dialogue* within the current transaction;

b) "false" if no further TP-DATA requests are allowed to be issued towards the superior.

This parameter is set to "true" only when the superior has issued a TP-PREPARE request with the Data-Permitted parameter set to "true".

14.9.3 *TPSP constraints on TP-PREPARE indication*

The recipient shall be the subordinate.

If the Polarized Control functional unit is selected, the recipient shall not have control of the dialogue.

The recipient shall have neither a *handshake request outstanding* nor a *handshake indication outstanding*.

The recipient shall not have a *user error request outstanding*.

The coordination level of the dialogue shall be "commitment".

A TP-PREPARE indication shall not have been issued during the current transaction.

The current transaction shall not be in the *termination phase*.

14.9.4 *Collisions*

A TP-PREPARE indication is not issued to a TPSUI if any *rollback-initiating service primitives* has been issued.

If the Shared Control functional unit is selected, a TP-PREPARE indication is not issued to a TPSUI if there is a collision between the TP-COMMIT request or the TP-PREPARE request and a TP-HANDSHAKE request or a TP-U-ERROR request, instead a TP-ROLLBACK indication is issued (unless a *rollback-initiating service primitive* has already been issued for the current transaction).

14.10 *TP-READY indication*

14.10.1 *Purpose*

This service primitive is issued to indicate that the *subordinate subtree* is in the READY state.

This service primitive is associated with one particular dialogue.

14.10.2 *Primitives and parameters*

Table 19/X.861 shows the TP-READY indication primitive.

TABLE 19/X.861

TP-READY indication

TP-READY	
No parameters	ind

14.10.3 *TPSP constraints on TP-READY indication*

The recipient TPSUI shall not have a *dialogue establishment request outstanding*.

The recipient shall be the superior.

The coordination level of the dialogue shall be "commitment".

A TP-PREPARE request shall have been issued during the current transaction.

The current transaction shall not be in the *termination phase*.

All TPSUIs in the subordinate transaction subtree shall have issued a TP-COMMIT request. This is a transaction tree constraint.

14.10.4 *Collisions*

A TP-READY indication is not issued to a TPSUI if a TP-COMMIT request or any *rollback-initiating service primitive* has been issued for the current transaction.

14.11 *TP-COMMIT request*

14.11.1 *Purpose*

This service primitive is issued by a TPSUI to indicate that it has completed all processing for the current transaction and to request that the transaction be committed. When the TPSUI is the root of the transaction tree, this service initiates termination of the transaction. When the TPSUI is an intermediate or leaf, it propagates termination of the transaction.

14.11.2 *Primitives and parameters*

Table 20/X.861 shows the TP-COMMIT request primitive.

TABLE 20/X.861

TP-COMMIT request

TP-COMMIT	
No parameters	req

14.11.3 *TPSUI conditions on a TP-COMMIT request*

All bound data handled by the TPSUI shall have been placed in the ready-to-commit state.

All processing for the transaction by the TPSUI shall have been completed.

The release of the bound data handled by the TPSUI in the final state as part of the commitment processing shall preserve the ACID properties.

14.11.4 *TPSP constraints on TP-COMMIT request*

The requestor shall not have a *dialogue establishment indication outstanding*.

The requestor shall not have any *dialogue establishment requests outstanding* on any dialogues with a coordination level of "commitment".

The requestor shall have control of all dialogues with subordinates for which the coordination level is "commitment".

The requestor shall neither have any *handshake requests outstanding* nor *handshake indications outstanding* for any dialogue with a coordination level of "commitment".

The requestor shall not have any *user error indication outstanding* on any dialogues with a coordination level of "commitment".

One of the following conditions shall be true:

a) at least one dialogue shall have a coordination level of "commitment"; or

b) a TP-BEGIN-DIALOGUE confirmation, a TP-U-ABORT indication, or a TP-P-ABORT indication with the Rollback parameter set to "false" has been issued for at least one dialogue having a coordination level of "commitment" during the current transaction.

A TP-PREPARE indication shall have been issued if the TPSUI is the subordinate for a dialogue with a coordination level of "commitment".

The current transaction shall not be in the *termination phase*.

14.11.5 *Effects of a TP-COMMIT request*

A TP-PREPARE indication is issued to all direct subordinate TPSUIs in the transaction tree to which a TP-PREPARE indication has not already been issued as the result of a TP-PREPARE request.

14.11.6 *Collisions*

A TP-PREPARE indication is not issued to a TPSUI if there is a collision of the TP-COMMIT request and a TP-U-ERROR request, instead a TP-ROLLBACK indication is issued (unless a *rollback-initiating service primitive* has already been issued for the current transaction).

After a TP-COMMIT request, none of the following service primitives will be issued for dialogues with a coordination level of "commitment":

– TP-REQUEST-CONTROL indication;

– TP-READY indication.

14.12 *TP-COMMIT indication*

14.12.1 *Purpose*

This service primitive is issued to indicate that the outcome of the transaction is commitment and to order the TPSUI to release its bound data in the final state.

14.12.2 *Primitives and parameters*

Table 21/X.861 shows the TP-COMMIT indication primitive.

TABLE 21/X.861

TP-COMMIT indication

TP-COMMIT	
No parameters	ind

14.12.3 *TPSP constraints on TP-COMMIT indication*

At least one dialogue shall have a coordination level of "commitment".

All bound data handled by the TPSP for the current transaction shall have been placed in the ready-to-commit state.

All TPSUIs participating in the current transaction shall have issued a TP-COMMIT request. This is a transaction tree constraint.

No *rollback-initiating indication* shall have been issued or will be issued for TPSUIs participating in the current transaction. This is a transaction tree constraint.

14.12.4 *Effects of a TP-COMMIT indication*

The recipient is allowed to release its bound data in the final state.

In the case of a node crash, the TPSP may issue another TP-COMMIT indication on recovery.

14.13 *TP-DONE request*

14.13.1 *Purpose*

This service primitive is issued to indicate that the bound data handled by the TPSUI have been released and that any restructuring of the dialogue tree has been completed in reaction to abnormal dialogue termination.

14.13.2 *Primitives and parameters*

Table 22/X.861 lists the TP-DONE request primitive and its parameter.

TABLE 22/X.861

TP-DONE request and its parameters

TP-DONE	
Parameter	req
Heuristic-Report	U

14.13.2.1 **Heuristic-Report** is an optional parameter which may be used to report any conditions related to heuristic decisions which may have been taken by the TPSUI. It shall take one of the following values:

a) "heuristic-mix": the bound data handled by the TPSUI are in a state which is inconsistent with the outcome of the transaction and the inconsistency cannot be corrected;

b) "heuristic-hazard": a failure occurred within the TPSUI which may prevent reporting of data inconsistency, and the TPSUI may not handle this situation.

14.13.3 *TPSUI conditions on TP-DONE request*

Before issuing the first TP-DONE request following a TP-COMMIT indication, all bound data handled by the requestor shall have been released in the final state, unless the Heuristic-Report parameter is used.

Before issuing the first TP-DONE request following a *rollback-initiating service primitive*, all bound data handled by the requestor shall have been released in the initial state, unless the Heuristic-Report parameter is used.

14.13.4 *TPSP constraints on TP-DONE request*

The requestor shall not have a *dialogue establishment indication outstanding*.

A TP-COMMIT indication or *rollback-initiating service primitive* shall have been issued since the last TP-COMMIT indication or *rollback-initiating service primitive*.

At least one of the following conditions shall also be satisfied:

– the requestor is in the *termination phase of a transaction* and a TP-DONE request has not been issued for the current transaction;

– a TP-P-ABORT indication, a TP-U-ABORT indication, or a TP-BEGIN-DIALOGUE confirmation with the Result parameter set to "rejected(provider)" or "rejected(user)" has been issued for a dialogue with a coordination level of "commitment" and a TP-DONE request has not been issued since the indication or the confirmation.

If the Heuristic-Report parameter is used and the TPSUI is a subordinate for a dialogue with a coordination level of "commitment", a TP-PREPARE indication shall have been issued.

If the Heuristic-Report parameter is used, the request shall the first TP-DONE request following a TP-COMMIT indication or a *rollback-initiating service primitive*.

14.13.5 *Effects of a TP-DONE request*

A TP-COMMIT-COMPLETE indication is issued to the requestor after all TPSUIs in the transaction subtree have issued a TP-DONE request, if the transaction was committed.

A TP-ROLLBACK-COMPLETE indication is issued to the requestor if the transaction has been rolled back and all TPSUIs in the transaction subtree have issued TP-DONE requests except any that are contained in a subtree of the transaction subtree whose root node has a *superior dialogue* that has been aborted.

14.14 *TP-COMMIT-COMPLETE indication*

14.14.1 *Purpose*

This primitive is issued by the TPSP to all TPSUIs which are engaged in a transaction to indicate that commitment is complete.

14.14.2 *Primitives and parameters*

Table 23/X.861 shows the TP-COMMIT-COMPLETE indication primitive.

TABLE 23/X.861

TP-COMMIT-COMPLETE indication

TP-COMMIT-COMPLETE	
No parameters	ind

14.14.3 *TPSP constraints on TP-COMMIT-COMPLETE indication*

The current transaction shall be in the *termination phase*.

All bound data of the node shall have been placed in the final state unless there is a local heuristic mix condition.

All bound data handled by subordinate transaction subtrees shall have been placed in the final state, with the possible exception of subordinates from which a TP-HEURISTIC-REPORT indication has been issued. This is a transaction tree constraint.

A TP-COMMIT indication shall have been issued for the current transaction.

A TP-DONE request shall have been issued for the current transaction.

A TP-DONE request shall have been issued since the last TP-P-ABORT indication or TP-U-ABORT indication issued for a dialogue with a coordination level of "commitment".

14.14.4 *Effects of a TP-COMMIT-COMPLETE indication*

All dialogues for which a TP-DEFERRED-END-DIALOGUE request or a TP-DEFERRED-END-DIALOGUE indication was issued during the committed transaction are terminated.

The recipient no longer has control of any dialogues for which it has issued a TP-DEFERRED-GRANT-CONTROL request during the committed transaction.

The recipient has control of the *superior dialogue* if a TP-DEFERRED-GRANT-CONTROL indication has been issued during the committed transaction.

The coordination level of all dialogues on which the Unchained Transactions functional unit is selected is "none".

If the recipient has at least one dialogue with a coordination level of "commitment", then the recipient is involved in a new transaction.

14.15 *TP-ROLLBACK request*

14.15.1 *Purpose*

This service primitive is issued by a TPSUI to terminate the transaction and release the bound data in the initial state.

14.15.2 *Primitives and parameters*

Table 24/X.861 shows the TP-ROLLBACK request primitive.

TABLE 24/X.861

TP-ROLLBACK request

TP-ROLLBACK	
No parameters	req

14.15.3 *TPSP constraints on TP-ROLLBACK request*

The requestor shall not have a *dialogue establishment indication outstanding*.

One of the following conditions shall be true:

a) at least one dialogue shall have a coordination level of "commitment"; or

b) a TP-BEGIN-DIALOGUE confirmation, a TP-U-ABORT indication, or a TP-P-ABORT indication with the Rollback paramater set to "false" has been issued for at least one dialogue having a coordination level of "commitment" during the current transaction.

The current transaction shall not be in the *termination phase*.

14.15.4 *Effects of a TP-ROLLBACK request*

A TP-ROLLBACK indication is issued to all TPSUIs involved in the current transaction, except to those which have issued any *rollback-initiating requests* or to which any *rollback-initiating indications* have been issued.

14.15.5 *Collisions*

A TP-ROLLBACK indication is not issued if any *rollback-initiating service primitive* has been issued during the current transaction.

14.16 *TP-ROLLBACK indication*

14.16.1 *Purpose*

This service primitive is issued to indicate that the current transaction is being rolled back and to order release of bound data in the initial state.

14.16.2 *Primitives and parameters*

Table 25/X.861 shows the TP-ROLLBACK indication primitive.

TABLE 25/X.861

TP-ROLLBACK indication

TP-ROLLBACK	
No parameters	ind

14.16.3 *TPSP constraints on TP-ROLLBACK indication*

At least one of the following conditions shall be true:

– at least one dialogue shall have a coordination level of “commitment”; or

– a TP-P-ABORT indication has been issued for a dialogue with the Chained Transactions functional unit selected, between a TP-COMMIT indication and the corresponding TP-COMMIT-COMPLETE indication and the deferred-end-dialogue service was not issued.

No *rollback-initiating service primitive* shall have been issued for the current transaction.

A TP-COMMIT indication shall not have been issued during the current transaction.

14.16.4 *Effects of a TP-ROLLBACK indication*

The recipient is allowed to release its bound data in the initial state.

In the case of a node crash, the TPSP may issue another TP-ROLLBACK indication on recovery.

14.17 *TP-ROLLBACK-COMPLETE indication*

14.17.1 *Purpose*

This service primitive is issued to all TPSUIs involved in the transaction to indicate that rollback is complete.

14.17.2 *Primitives and parameters*

Table 26/X.861 shows the TP-ROLLBACK-COMPLETE indication primitive.

TABLE 26/X.861

TP-ROLLBACK-COMPLETE indication

TP-ROLLBACK-COMPLETE	
No parameters	ind

14.17.3 *TPSP constraints on TP-ROLLBACK-COMPLETE indication*

The recipient shall not have any *dialogue establishment request outstanding* for any dialogues with a coordination level of “commitment”.

The current transaction shall be in the *termination phase*.

A *rollback-initiating service primitive* shall have been issued for the current transaction.

All bound data of the node shall have been released in the initial state with the possible exception of a local heuristic mix condition.

All bound data handled by subordinate transaction subtrees shall have been placed in the initial state except for subordinates from which a TP-HEURISTIC-REPORT indication has been issued. This is a transaction tree constraint.

A TP-DONE request shall have been issued for the current transaction.

A TP-DONE request shall have been issued since the last TP-P-ABORT indication, TP-U-ABORT indication, or TP-BEGIN-DIALOGUE confirmation with the Result parameter set to “rejected(provider)” or “rejected(user)” issued for a dialogue with a coordination level of “commitment”.

14.17.4 *Effects of a TP-ROLLBACK-COMPLETE indication*

If the Polarized Control functional unit is selected for a dialogue with a coordination level of "commitment", control of the dialogue is given to the TPSUI that had control at the beginning of the rolled back transaction.

Note – If the Unchained Transactions functional unit is selected for a dialogue, the superior has control.

The coordination level of any dialogue on which the Unchained Transactions functional unit is selected is "none".

If the recipient has at least one dialogue with a coordination level of "commitment", then the recipient is involved in a new transaction.

14.18 *Heuristic Reporting service, TP-HEURISTIC-REPORT indication*

14.18.1 *Purpose*

This service indicates an actual or possible occurrence of a heuristic inconsistency within the *subordinate subtree*.

This service is associated with one particular dialogue which may have been previously terminated.

14.18.2 *Primitives and parameters*

Table 27/X.861 lists the TP-HEURISTIC-REPORT indication primitive and its parameter.

TABLE 27/X.861

TP-HEURISTIC-REPORT indication and its parameter

TP-HEURISTIC-REPORT	
Parameter	ind
Heuristic-Report	M

14.18.2.1 **Heuristic-Report** indicates the heuristic condition. It shall take one of the following values:

a) "heuristic-mix": the bound data of the *subordinate subtree* is in a state which is inconsistent with the outcome of the transaction and the inconsistency cannot be corrected.

b) "heuristic-hazard": a failure occurred which may prevent reporting of data inconsistency in the *subordinate subtree*.

14.18.3 *TPSP constraints on a TP-HEURISTIC-REPORT indication*

The recipient shall not have a *dialogue establishment request outstanding*.

The recipient shall be the superior.

The coordination level of the dialogue shall be "commitment".

A TP-PREPARE request for the dialogue or a TP-COMMIT request shall have been issued for the current transaction.

A TP-COMMIT indication or a *rollback-initiating service primitive* shall have been issued for the current transaction.

A TP-HEURISTIC-REPORT indication shall not have been issued since the last TP-COMMIT indication or *rollback-initiating service primitive*.

The current transaction shall be in the *termination phase*.

Note 1 – The indication is not given if the TPSP is able to correct the effects of heuristic decisions by compensating actions.

Note 2 – A TP-HEURISTIC-REPORT indication may have the value "heuristic-hazard" during commitment, but never solely as a result of a dialogue abort.

14.18.4 *Effets of a TP-HEURISTIC-REPORT indication*

In the case of a node crash, the TPSP may issue another TP-HEURISTIC-REPORT indication on recovery.

ANNEX A

(to Recommendation X.861)

Service state table

(This annex forms an integral part of this Recommendation)

A.1 *Overview*

The service state table describes the allowed sequence of service events for a given TP service boundary (at a given node, between a TPSUI and the TPSP).

A separate state is maintained for each dialogue of the node. Service primitives which relate to a single dialogue affect only the state for that particular dialogue. Some service primitives affect all the dialogues which have a coordination level of "commitment". The issuance of such service primitives are valid only if they are valid for all the dialogues they affect.

The state table specifies predicates which must be satisfied in order for individual service primitives to be valid in a given state. These predicates are based on the values of variables.

The state table also specifies actions to be performed. These actions involve setting variables to specified values. The referenced variables are of two types. One type is private to a particular dialogue and the other type is global among all dialogues of a TPSUI.

The overall state of the service boundary (for a given node) consists of the state of each dialogue of the TPSUI, together with the associated values of the private and global variables.

When a new dialogue is created, a new dialogue context is also created, with its state set to the Idle state and all variables private to the dialogue are initialized to "false". If this newly created dialogue is the first one for that TPSUI, then all the global variables are initialized to "false" as well.

When a dialogue is terminated, the dialogue context ceases to exist.

A.2 *Dialogue States*

1) Idle state.
2) The TPSUI has control of the dialogue.
3) The TPSUI does not have control of the dialogue.

   This state is used only if the Polarized Control functional unit is selected.
4) The TPSUI which does not have control of the dialogue has issued a TP-U-ERROR request.

   This state is used only if the Polarized Control functional unit is selected.
5) The TPSUI which has control of the dialogue has received a TP-U-ERROR indication.

   This state is used only if the Polarized Control functional unit is selected.
6) The TPSUI has issued a TP-HANDSHAKE request.

   This state is used only if the Handshake functional unit is selected.

7) The TPSUI has received a TP-HANDSHAKE indication.

This state is used only if the Handshake functional unit is selected.

8) The TPSUI has received a TP-HANDSHAKE indication and a TP-HANDSHAKE request is outstanding.

This state is used only if both the Handshake and Shared Control functional units are selected.

9) The TPSUI has received a TP-END-DIALOGUE (Confirmation = "true") indication while a TP-HANDSHAKE request is outstanding.

This state is used only if both Handshake and Shared Control functional units are selected and if the dialogue has a coordination level of "none".

10) The TPSUI has received a TP-HANDSHAKE indication and a TP-END-DIALOGUE (Confirmation = "true") request is outstanding.

This state is used only for a dialogue with a coordination level of "none" and both the Shared Control and the Handshake functional units are selected.

11) The TPSUI has issued a TP-END-DIALOGUE (Confirmation = "true") request.

This state is used only for a dialogue with a coordination level of "none".

12) The TPSUI has received a TP-END-DIALOGUE (Confirmation = "true") indication.

This state is used only for a dialogue with a coordination level of "none".

13) The TPSUI has issued a TP-HANDSHAKE-AND-GRANT-CONTROL request.

This state is used only if the Handshake and Polarized Control functional units are selected.

14) The TPSUI has received a TP-HANDSHAKE-AND-GRANT-CONTROL indication.

This state is used only if the Handshake and Polarized Control functional units are selected.

15) The TPSUI has issued a TP-PREPARE (Data-Permitted = "false") request.

This state is used only for a *subordinate dialogue* with a coordination level of "commitment" and the Polarized Control functional unit is selected.

16) The TPSUI has issued a TP-PREPARE request, with either the Data-Permitted parameter set to "true" or the Shared Control functional unit is selected on this dialogue.

This state is used only for a *subordinate dialogue* with a coordination level of "commitment".

17) The TPSUI has received a TP-READY indication.

This state is used only for a *subordinate dialogue* with a coordination level of "commitment".

18) The TPSUI has received a TP-PREPARE (Data-Permitted = "false") indication.

This state is used only for a *superior dialogue* with a coordination level of "commitment" and the Polarized Control functional unit is selected.

19) The TPSUI has received a TP-PREPARE indication, with either the Data-Permitted parameter set to "true" or the Shared Control functional unit is selected on this dialogue.

This state is used only for a *superior dialogue* with a coordination level of "commitment".

20) The TPSUI has issued a TP-COMMIT request.

This state is used only for a dialogue with a coordination level of "commitment".

21) The TPSUI has received a TP-COMMIT indication and is placing its bound data in the final state.

This state is only used for a dialogue with a coordination level of "commitment".

22) The TPSUI has released its bound data in the final state and has issued TP-DONE request.

This state is used only for a dialogue with a coordination level of "commitment".

23) A *rollback-initiating service primitive* has been issued or the TPSUI has one or more of the following indications or confirmations after having issued TP-DONE request: TP-P-ABORT indication, TP-U-ABORT indication, or TP-BEGIN-DIALOGUE [Result = "rejected(provider)" or "rejected(user)"] confirmation.

This state is used only for a dialogue with a coordination level of "commitment".

24) The TPSUI has issued a TP-DONE request in the Decided (Rollback) transaction state.

This state is used only for a dialogue with a coordination level of "commitment".

25) The TPSUI has been issued one of the following service primitive with Rollback = "false" for a dialogue with a coordination level of "commitment" before the termination phase of the transaction:

– TP-BEGIN-DIALOGUE (rejected(provider) or rejected(user)) confirmation;

– TP-P-ABORT indication; or

– TP-U-ABORT indication.

This state is used only for a terminated dialogue with a coordination level of "commitment" when the context of this "zombie" dialogue will be involved in the termination of a transaction.

A.3 *Variables*

The variables are Boolean. When a new dialogue context is created, all the variables private to this dialogue are initialized to "false" and the dialogue is in the Idle State, then the transition corresponding to the initiating service primitive (TP-BEGIN-DIALOGUE request or TP-BEGIN-DIALOGUE indication) is fired.

A.3.1 *Dialogue-related variables*

The name of the variables related to a single dialogue starts with a "D"; they are the following:

– **Da** (**A**ccepted by TPSUI): This variable, when set to "true", indicates that the TPSUI has already received an indication from its partner TPSUI and the TP-BEGIN-DIALOGUE confirm shall no longer occur. This variable is meaningful only for a dialogue with a subordinate.

– **Dar** (**A**fter **R**ollback): This variable, when set to "true", indicates that a TP-ROLLBACK-COMPLETE indication has been issued and no indication or confirmation have been received from a subordinate.

This variable is used to detect if a TP-U-ABORT indication with Rollback = "false" is valid after a TP-ROLLBACK-COMPLETE indication for a subordinate dialogue for which the Chained Transactions functional unit is selected.

– **Db** (a**B**orted): This variable, when set to "true", indicates that the dialogue is being aborted.

– **Dc** (**C**ontrol): This variable, when set to "true", indicates that the TPSUI had control of the dialogue at the beginning of a transaction.

This variable is used to determine which TPSUI acquires control of the dialogue if rollback has occurred.

– **Dcr** (TP-BEGIN-DIALOGUE **C**onfirmation **R**equired): This variable, when set to "true", indicates that a TP-BEGIN-DIALOGUE (Confirmation = "always") request or indication has been issued.

– **De** (deferred **E**nd dialogue): This variable, when set to "true", indicates that the TPSUI has issued TP-DEFERRED-END-DIALOGUE request or received TP-DEFERRED-END-DIALOGUE indication, i.e. the dialogue will be terminated if the provider supported transaction commits.

– **Dg** (deferred **G**rant control): This variable, when set to "true", indicates whether the TPSUI has issued TP-DEFERRED-GRANT-CONTROL request or received TP-DEFERRED-GRANT-CONTROL indication, i.e control of the dialogue will be transferred if the provider supported transaction commits.

– **Dh** (**H**andshake): This variable, when set to "true", indicates that the Handshake functional unit is selected.

– **Dhr** (**H**euristic **R**eport): This variable, when set to "true", indicates that a TP-HEURISTIC-REPORT indication may be received.

  This variable is used to detect if a TP-HEURISTIC-REPORT indication is valid for a given dialogue.

– **Dl** (coordination **L**evel): This variable reflects the value of the coordination level.

  This value, when set to "true", indicates that the coordination level is set to "commitment" this value, when set to "false", indicates that the coordination level is set to "none".

– **Do** (c**O**mmit): This variable, when set to "true", indicates that the Commit functional unit is selected.

– **Dsh** (**Sh**ared Control): This variable, when set to "true" indicates that the Shared Control functional unit is selected.

– **Dsup** (**Sup**erior dialogue): This variable, when set to "true", indicates that the dialogue has been established by a TP-BEGIN-DIALOGUE indication.

– **Dtrb** (**t**o be **r**olled **b**ack): This variable, when set to "true", indicates that a TP-P-ABORT indication has been issued after a TP-COMMIT indication and before a TP-COMMIT-COMPLETE indication, for a dialogue which has the Chained Transactions functional unit selected, and for which no TP-DEFERRED-END-DIALOGUE service has been issued.

– **Du** (**U**nchained): This variable, when set to "true", indicates that the Unchained Transactions functional unit is selected. This variable, when set to "false", indicates that the Chained Transactions functional unit is selected.

  The variable is only relevant when the Commit functional unit is selected (i.e. Do is "true").

– **Dx** (e**X**tension of transaction tree): This variable, when set to "true", indicates that a TP-BEGIN-TRANSACTION request has been issued, and that if either a TP-U-ABORT request is issued by the TPSUI or a TP-P-ABORT indication is triggered by the TPSP, before the TP-BEGIN-TRANSACTION indication is issued, the TP-U/P-ABORT indication shall be received with the Rollback parameter set to "false".

  This variable is set to "true" when a TP-BEGIN-TRANSACTION request is issued. It is set to "false" on a TP-ROLLBACK-COMPLETE indication, a TP-READY indication, a TP-COMMIT indication, a TP-HANDSHAKE confirmation, and a TP-HANDSHAKE-AND-GRANT-CONTROL confirmation.

A.3.2 *Node-related variables*

The name of the variables related to all dialogues of a TPSUI starts with an "N" (standing for "Node"); they are the following:

– **Ndial** (**Dial**ogue established): This variable, when set to "true", indicates that a TP-BEGIN-DIALOGUE indication has been issued, i.e. the node is an intermediate or leaf.

– **Nsupest** (**Sup**erior dialogue **est**ablished): This variable, when set to "true", indicates that a TP-BEGIN-DIALOGUE (Confirmation = "negative") indication has been received, or a TP-BEGIN-DIALOGUE (Result = "accepted") response has been issued.

– **Nfa** (**F**ailure action **A**llowed): This variable, when set to "true", indicates that the TPSUI is allowed to issue a TP-U-ABORT request on a dialogue having a coordination level of "commitment" during the *termination phase of a transaction*. This variable is set to "true" when a TP-P-ABORT indication, TP-U-ABORT indication, or TP-BEGIN-DIALOGUE (rejected(provider)) or rejected(user) confirmation has been received on a dialogue whose coordination level is "commitment" and set to "false" upon issuance of TP-DONE request.

– **Npa** (**P**repare **a**llowed): This variable, when set to "true", indicates that the TPSUI may issue TP-PREPARE request or TP-COMMIT request and, also, that a TP-DONE request may be issued with the Heuristic-Report parameter.

  When the TPSUI is the root of a transaction tree, Npa is set to "true" at the beginning of a transaction, otherwise Npa is set to "true" on receipt of a TP-PREPARE indication.

– **Nr** (**R**oot of transaction tree): This variable, when set to "true", indicates that the node is the root of a transaction tree.

– **Nrn** (TP-BEGIN-DIALOGUE **R**eject **N**o longer allowed): This variable, when set to "true", indicates that the TPSUI has issued a request or response on any dialogue, and the *superior dialogue* can no longer be rejected.

  A TPSUI can no longer issue TP-BEGIN-DIALOGUE response when this variable is set to "true".

– **Nt** (**T**ermination): This variable, when set to "true", indicates that the provider-supported transaction is being terminated.

A.4 *Actions*

[a] Action related to unconditional termination of a dialogue.

The dialogue context ceases to exist. Service primitives can no longer be issued on this dialogue:

Since the status of the node may have changed (from root node of a transaction tree to node not belonging to any transaction tree):

– if Dl is "true" and there are no other dialogues with Dl set to "true", set Nr to "false" and Npa to "false".

[b] Action related to any request or response which may be the first one issued on a dialogue:

– if Dsup is "true", set Nrn to "true".

[c] Action related to TP-BEGIN-DIALOGUE response and confirmation:

– set Dcr to "false";

– if Dsup is "true", set Nrn to "true" and Nsupest to "true", otherwise, set Da to "true".

[d] Action related to TP-DONE request:

– set Nfa to "false";

– set Npa to "false".

[e] Action related to a TP-P-ABORT indication issued after a TP-COMMIT indication for a dialogue which has the Chained Transactions functional unit selected and for which no TP-DEFERRED-END-DIALOGUE has been issued:

– set Dtrb to "true".

[f] Action related to a *rollback-initiating service primitive*:

– set Nt to "true";

– set Nfa to "true".

[g] Action related to TP-DEFERRED-END-DIALOGUE request and indication:

– set De to "true".

[h] Action related to TP-DEFERRED-GRANT-CONTROL request and indication:

- set Dg to “true”.

[k] Action related to TP-ROLLBACK-COMPLETE indication:

- set Da to “true”;
- set Dg to “false”;
- set De to “false”;
- set Dhr to “false”;
- set Dx to “false”;
- if Du is “true” then set Dl to “false”;
- if Du is “false” and Dsup is “false” then set Dar to “true”.

[l] Action related to the reception of TP-U-ABORT indication, TP-P-ABORT indication, TP-BEGIN-DIALOGUE confirmation [Result = “rejected(provider)” or “rejected(user)”] and (Rollback = “false”):

- if Dl is set to “true”, set Nfa to “true”.

[m] Action related to a superior issuing a TP-COMMIT request or a TP-PREPARE request:

- set Dhr to “true”.

[n] Action related to TP-COMMIT-COMPLETE indication, TP-ROLLBACK-COMPLETE indication or dialogue termination without rollback after a TP-PREPARE request has been issued:

- set Dhr to “false”.

[o] Action related to a superior receiving an indication or confirmation.

The subordinate TPSUI has issued some service request or response. The dialogue can no longer be rejected:

- set Da to “true”;
- set Dar to “false”.

[p] Action related to termination of a dialogue.

The dialogue has been terminated. Service requests, invoked by the partner TPSUI, for which an indication has not been delivered yet, are suppressed:

- set Db to “true”;
- set Dx to “false”.

[q] Action related to TP-BEGIN-TRANSACTION request:

- set Dc to “true”;
- set Dl to “true”;
- if the TPSUI has no superior or has a coordination level of “none” on the *superior dialogue*, then set Nr to “true” and set Npa to “true”;
- set Dx to “true”.

[r] Action related to TP-HEURISTIC-REPORT indication:

- set Dhr to “true”.

[s] Action related to TP-COMMIT-COMPLETE indication when the TPSUI has control of the dialogue or the Shared Control functional unit is selected:

- if the Polarized Control functional unit is selected, and Dsup = Dg, then set Dc to “true”, otherwise set Dc to “false”;
- if Nr is “true” then set Npa to “true”;
- set Dg to “false”;
- set De to “false”;

– set Dhr to “false”;

– if Du is set to “true” then set Dl to “false”.

Since the status of the node may have changed (from node root of a transaction tree to node not belonging to any transaction tree):

– if no dialogue with Dl set to “true” exists, set Nr to “false” and Npa to “false”.

[t] Action related to issuance of TP-READY indication, TP-COMMIT indication, TP-HANDSHAKE confirmation, and TP-HANDSHAKE-AND-GRANT-CONTROL confirmation.

The dialogue can no longer be rejected, and an indication or a confirmation has been issued since a TP-ROLLBACK-COMPLETE indication:

– set Da to “true”;

– set Dar to “false”;

– set Dx to “false”.

[u] Action related to TP-BEGIN-TRANSACTION indication:

– set Dc to “false”;

– set Dl to “true”.

[v] Action related to TP-BEGIN-DIALOGUE request:

– set Dc to “true”;

– if Ndial is “true”, set Nrn to “true”;

– set Dsh to “true” if the Shared Control functional unit is selected;

– set Dh to “true” if the Handshake functional unit is selected;

– set Do to “true” if the Commit functional unit is selected;

– set Du to “true” if the Unchained Transactions functional unit is selected;

– set Dl to “true” if the Commit functional unit is selected and if the Chained Transactions functional unit is also selected;

– set Dl to “true” if the Commit functional unit is selected and if the Unchained Transactions functional unit is also selected, Begin-Transaction = “true”;

– if Dl is set to “true” and no other dialogues with Dl set to “true” exist, set Nr to “true” and set Npa to “true”;

– if Confirmation = “always”, then set Dcr to “true”.

[w] Action related to TP-BEGIN-DIALOGUE indication:

– set Dsup to “true”;

– set Ndial to “true”;

– set Dsh to “true” if the Shared Control functional unit is selected;

– set Dh to “true” if the Handshake functional unit is selected;

– set Do to “true” if the Commit functional unit is selected;

– set Du to “true” if the Unchained Transactions functional unit is selected;

– set Dl to “true” if the Commit functional unit is selected and if the Chained Transactions functional unit is also selected;

– set Dl to “true” if the Commit functional unit is selected and if the Unchained Transactions functional unit is also selected, Begin-Transaction = “true”;

– if Confirmation = “always”, then set Dcr to “true”, otherwise set Nsupest to “true”.

[x] Action related to TP-PREPARE indication:

– set Npa to “true”.

[y] Action related to TP-COMMIT request:

– set Nt to “true”.

[z] Action related to TP-COMMIT-COMPLETE indication or TP-ROLLBACK-COMPLETE indication.

If this is the last dialogue to be processed for the indication, then:

– set Nt to “false”;

– if there exists at least one dialogue with Dl set to “true” and, on the dialogue where Dsup is “true”, Dl is “false”, then set Nr to “true” and set Npa to “true”.

A.5 *Node Crash*

The TPSUI and the TPSP are both aware of a node crash through local means. If the node is in the active state, the state tables will not be reinstantiated and the bound data under the control of the TPSUI will be placed into the initial state through local means. If the node is in the ready or decided (commit) state, the state tables will be reinstantiated in state 20 for all dialogues having a coordination level of commitment, with the following predicates set to true: Db, Dhr, Dl, Dsup (for the superior dialogue; false for all other dialogues), Npa, Nt.

A.6 *Keys*

In the state table:

– each column (except the left one) represents a state;

– each row represents a service primitive (optionally with attributes).

Below the number of each state, the predicates that are always true in this state are listed. The predicates do not have to be tested within the state table. This information is given to help the reader.

The intersection of a row and a column represents all transitions that may be fired in the given state for the given service primitives. This intersection contains zero, one or more subcells that represent each a transition.

Example 1

	2
TP-DEFERRED-END-DIALOGUE req	^Dsup ^Dl ^De 2 [g]

The left column lists service primitives which are the input events. When the service primitive is followed by an “*” the event shall be applied to all dialogues having a coordination level of “commitment”.

In the upper part of the subcell, some variables may be listed. The transition is fired only if all the variables listed in the cell have the required value; in the example above, Dl shall be “true” and both Dsup and De shall be “false” (^Dsup means NOT Dsup) in order for the transition to fire.

In the middle of the subcell a number indicates the resulting state; in the example, the resulting state is 2.

If the resulting state is followed by an "*", then this is the resulting state of all the dialogues having a coordination level of "commitment"; in this case the actions are performed only once.

At the lower part of the cell, the action(s) to be performed are listed in square brackets. Zero, one, or more actions may be performed when a transition is fired. These actions shall be performed left to right.

Example 2

	11 ^Dl
TP-HANDSHAKE ind	Dsup Dh Dsh 10
	^Dsup Dsh 10 [o] [p]

For a given state and a given service primitive, if more than one subcell appears, the upper one shall be considered first. At most one transition shall be fired for each intersection. If no transition fires, it is treated as a blank intersection. In the example above, if Dsup is "false" and Dsh is "true", the transition in the bottom subcell fires, the actions [o] and [p] are executed and the resulting state is 10.

A.7 *Blank intersections*

For a given state and a given service primitive, if no transition applies, i.e. the relevant intersection is blank, then the issuance of the service primitive is illegal. If the service primitive is a request or a response, then any effect is a local matter (typically, a local warning will be issued).

Note – See Recommendation X.862 for information on why blank intersections involving indications and confirmations shall not occur.

A.8 *Service State Table*

Table A-1/X.861 contains the OSI TP Service State Table.

TABLE A-1/X.861 (sheet 1 of 12)

OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-DATA req		Dsup ^Dcr 2 [b]					Dsup ^Dcr Dsh 7 [b]												^Dcr 19						
		^Dsup 2					^Dsup Dsh 7																		
TP-DATA ind		Dsup Dsh 2	Dsup 3			Dsup Dsh 6					Dsup Dsh 11					^Dcr 16									
		^Dsup ^Dcr Dsh 2 [o]	^Dsup ^Dcr 3 [o]			^Dsup ^Dcr Dsh 6 [o]					^Dsup Dsh 11 [o]														
TP-BEGIN-DIALOGUE req [(Commit FU not selected) or (Unchained Transactions and Begin-Transaction = "false")]	^Ndial 2 [v]																								
	Nsupest 2 [v]																								
TP-BEGIN-DIALOGUE req [(Chained Transactions) or (Unchained Transactions and Beg in-Transaction = "true")]	^Ndial ^Nt 2 [v]																								
	Nsupest ^Nt 2 [v]																								
TP-BEGIN-DIALOGUE ind (Polarized Control selected)	^Ndial 3 (w)																								
TP-BEGIN-DIALOGUE ind (Shared Control selected)	^Ndial 2 (w)																								

TABLE A-1/X.861 (sheet 2 of 12)

OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-BEGIN-DIALOGUE rsp (Result = "accepted")		Dsup Dcr 2 [c]	Dsup Dcr 3 [c]		Dsup Dcr 5 [c]		Dsup Dcr 7 [c]							Dsup Dcr 14 [c]				Dcr 18 [c]	Dcr 19 [c]				Dsup Dcr ^Db 23 [c]		
TP-BEGIN-DIALOGUE rsp (Result = "rejected")		^Nrn Dsup 1 [a]	^Nrn Dsup 1 [a]		^Nrn Dsup 1 [a]		^Nrn Dsup 1 [a]					^Nrn Dsup 1 [a]		^Nrn Dsup 1 [a]				^Nrn 1 [a]	^Nrn [a]				^Nrn Dsup ^Db 1 [a]		
TP-BEGIN-DIALOGUE cnf (Result = "accepted")		^Dsup ^Dcr 2 [c]	^Dsup ^Dcr 3 [c]	^Dsup Dcr 4 [c]		^Dsup Dcr 6 [c]							^Dsup Dcr 13 [c]		Dcr 15 [c]	Dcr 16 [c]							^Dsup Dcr ^Db 23 [c]	^Dsup Dcr ^Db 24 [c]	
TP-BEGIN-DIALOGUE cnf (Result = " rejected" and Rollback = "false")		^Dsup ^Dl ^Da 1 [a]	^Dsup ^Dl ^Da 1 [a]	^Dsup ^Dl ^Da 1 [a]		^Dsup ^Dl ^Da 1 [a]					^Dsup ^Da 1 [a]		^Dsup ^Dl ^Da 1 [a]		^Dsup ^Da 25 [p][n]	^Dsup ^Da 25 [p][n]							^Dsup ^Db ^Da 23 [p][l]	^Dsup ^Db ^Da 23* [p][l]	
		^Dsup DL ^Da 25 [p]	^Dsup DL ^Da 25 [p]	^Dsup DL ^Da 25 [p]		^Dsup DL ^Da 25 [p]							^Dsup Dl ^Da 25 [p]												
TP-BEGIN-DIALOGUE cnf (Result = "rejected" and Rollback = "true")																				^Dsup ^Da ^Db 23* [p][f]					
TP-END-DIALOGUE req (Confirmation = "true")		^Dl ^Dcr 11 [b]																							
TP-END-DIALOGUE req (Confirmation = "false")		^Dl ^Dcr 1 [a]																							

TABLE A-1/X.861 (sheet 3 of 12)

OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-END-DIALOGUE ind (Confirmation = "true")		^Dl ^Dcr Dsh 12 [o]	^Dl ^Dcr 12 [o]	^Dl ^Dcr 2 [o]		^Dl ^Dcr Dsh 9 [o]																			
TP-END-DIALOGUE ind (Confirmation = "false")		^Dl ^Dcr Dsh 1 [a]	^Dl ^Dcr 1 [a]	^Dl ^Dcr 1 [a]		^Dl ^Dcr Dsh 1 [a]					Dsh 1 [a]														
TP-END-DIALOGUE rsp												1 [a]													
TP-END-DIALOGUE cnf											1 [a]														
TP-U-ERROR req		Dsup ^Dcr 2 [b]	Dsup ^Dcr 4 [b]			Dsh 6	Dsup ^Dcr 2 [b]	6	6	11		Dsup 2 [b]		Dsup ^Dcr 2 [b]											
		^Dsup 2	^Dsup 4				^Dsup 2					^Dsup 2		^Dsup 2											
TP-U-ERROR ind		Dsup ^Dsh 5	Dsup 3			Dsup ^Dsh 3					Dsup ^Dsh 3		Dsup 3												
		Dsup Dsh 2				Dsup Dsh 2					Dsup Dsh 2														
		^Dsup ^Dcr ^Dsh 5 [o]	^Dsup ^Dcr 3 [o]			^Dsup ^Dcr ^Dsh 3 [o]					^Dsup ^Dsh 3 [o]		^Dsup ^Dcr 3 [o]												
		^Dsup ^Dcr Dsh 2 [o]				^Dsup ^Dcr Dsh 2 [o]	7	7	12	7	^Dsup Dsh 2 [o]														

TABLE A-1/X.861 (sheet 4 of 12)

OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-U-ABORT req		Dsup ^Dcr ^Dl 1 [a]	Dsup ^Dcr ^Dl 1 [a]	^Dl 1 [a]	Dsup ^Dcr ^Dl 1 [a]	^Dl 1 [a]	Dsup ^Dcr ^Dl 1 [a]	^Dl 1 [a]	^Dl 1 [a]	1 [a]	1 [a]	1 [a]	^Dl 1 [a]	Dsup ^Dcr ^Dl 1 [a]											
		Dsup ^Dcr Dl 23 * [p][f]	Dsup ^Dcr Dl 23 * [p][f]	Dl 23 * [p][f]	Dsup ^Dcr 23 * [p][f]	Dl 23 * [p][f]	Dsup ^Der 23 * [p][f]	Dl 23 * [p][f]	Dl 23 * [p][f]				Dl 23 * [p][f]	Dsup ^Dcr Dl 23 * [p][f]	23 * [p][f]	23 * [p][f]	23 * [p][f]	^Dcr 23 * [p][f]	^Dcr 23 * [p][f]	Nfa ^Db 20 [p]	Nfa ^Db 21 [p]	Nfa ^Db 22 [p]	^Db 23 [p]		
		^Dsup ^Dl 1 [a]	^Dsup ^Dl 1 [a]		^Dsup ^Dl 1 [a]		^Dsup ^Dl 1 [a]							^Dsup ^Dl 1 [a]											
		^Dsup Dl 23 * [p][f]	^Dsup Dl 23 * [p][f]		^Dsup Dl 23 * [p][f]		^Dsup Dl 23 * [p][f]							^Dsup Dl 23 * [p][f]											
TP-U-ABORT ind (Rollback = “false”)		Dsup ^Dl 1 [a]	Dsup ^Dl 1 [a]	Dsup ^Dl 1 [a]		Dsup ^Dl 1 [a]							Dsup ^Dl 1 [a]											Dsup ^Db 23 * [p][l]	
		^Dsup ^Dcr ^Dl 1 [a]	^Dsup ^Dcr ^Dl 1 [a]	^Dsup ^Dcr ^Dl 1 [a]	^Dl 1 [a]	^Dsup ^Dcr ^Dl 1 [a]	^Dl 1 [a]	^Dl 1 [a]	^Dl 1 [a]	1 [a]	1 [a]	1 [a]	^Dsup ^Dcr ^Dl 1 [a]	^Dl 1 [a]										^Dsup ^Dcr ^Db 23 * [p][l]	
		Dx ^Dcr 25 [p]	Dx ^Dcr 25 [p]	Dx ^Dcr 25 [p]	Dx 25 [p]	Dx ^Dcr 25 [p]	Dx 25 [p]	Dx 25 [p]	Dx 25 [p]				Dx ^Dcr 25 [p]	Dx 25 [p]	Dx ^Dcr 25 [p][n]	Dx ^Dcr 25 [p][n]					^Db 21 [p][l]	^Db 22 [p][l]	^Db 23 [p]		
		Dar ^Dcr 25 [p]	Dar ^Dcr 25 [p]	Dar ^Dcr 25 [p]		Dar ^Dcr 25 [p]							Dar ^Dcr 25 [p]												

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OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-U-ABORT ind (Rollback = "true")		Dsup Dl 23 * [p][f]	Dsup Dl 23 * [p][f]	Dsup Dl 23 * [p][f]	Dl 23 [p][f]	Dsup Dl 23 * [p][f]	Dl 23 [p][f]	Dl 23 [p][f]	Dl 23 [p][f]				Dsup Dl 23 * [p][f]	^Dcr 23 * [p][f]	^Dcr Dl 23 * [p][f]	^Dcr Dl 23 * [p][f]	23 * [p][f]	23 * [p][f]	23 * [p][f]	^Db 23 * [p][f]					
		^Dsup ^Dcr Dl 23 * [p][f]	^Dsup ^Dcr Dl 23 * [p][f]	^Dsup ^Dcr Dl 23 * [p][f]		^Dsup ^Dcr Dl 23 * [p][f]							^Dsup ^Dcr Dl 23 * [p][f]											
TP-P-ABORT ind (Rollback = "false")		^Dl 1 [a]	^Dl 1 [a]	^Dl 1 [a]	^Dl 1 [a]	^Dl 1 [a]	^Dl 1 [a]	^Dl 1 [a]	^Dl 1 [a]	1 [a]	1 [a]	1 [a]	^Dl 1 [a]	^Dl 1 [a]							^Db ^Du ^De		^Db Dcr 1		
		Dsup Dcr Dl 1 [a]	Dsup Dcr Dl 1 [a]		Dsup Dcr Dl 1 [a]		Dsup Dcr Dl 1 [a]							Dsup Dcr Dl 1 [a]							21 [p][l][c] ^DB Du 21 [p][l]		[a]		
		Dx 25 [p]	Dx 25 [p]	Dx 25 [p]	Dx 25 [p]	Dx 25 [p]	Dx 25 [p]	Dx 25 [p]	Dx 25 [p]				Dx 25 [p]	Dx 25 [p]	Dx 25 [p][n]	Dx 25 [p][n]				^Db 20 [p][l]	^Db De 21 [p][l]	^Db 22 [p][l]	^Db ^Dcr 23 [p]	^Db 23 * [p][l]	
TP-P-ABORT ind (Rollback = "true" Diagnostic ^= "begin-tr.-reject")		Dsup ^Dcr Dl 23 * [p][f]	Dsup ^Dcr Dl 23 * [p][f]	Dl 23 * [p][f]	Dsup ^Dcr Dl 23 * [p][f]	Dl 23 * [p][f]	Dsup ^Dcr Dl 23 * [p][f]	Dl 23 * [p][f]	Dl 23 * [p][f]				Dl 23 * [p][f]	Dsup ^Dcr Dl 23 * [p][f]	23 * [p][f]	23 * [p][f]	23 * [p][f]	23 * [p][f]	23 * [p][f]	^Db 23 * [p][f]					
		^Dsup Dl 23 * [p][f]	^Dsup Dl 23 * [p][f]		^Dsup Dl 23 * [p][f]		^Dsup Dl 23 * [p][f]							^Dsup Dl 23 * [p][f]											
TP-P-ABORT ind (Rollback = "true" Diagnostic = "begin-tr.-reject")																				^Db Dx 23 * [p][f]					
TP-GRANT-CONTROL req		Dsup ^Dcr ^Dsh 3 [b]			Dsup ^Dcr 3 [b]																				

^Dsup
^Dsh
3
^Dsup
3

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OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-GRANT-CONTROL ind			Dsup 2	Dsup 2																					
			^Dsup ^Dcr 2 [o]	^Dsup ^Dcr 2 [o]																					
TP-REQUEST-CONTROL req			Dsup ^Dcr 3 [b]				Dsup ^Dcr ^Dsh 7 [b]																		
			^Dsup 3				^Dsup ^dsh 7																		
TP-REQUEST-CONTROL ind		Dsup ^Dsh 2				Dsup ^Dsh 6																			
		^Dsup ^Dcr ^Dsh 2 [o]				^Dsup ^Dcr ^Dsh 6 [o]																			
TP-HANDSHAKE req		Dsup ^Dcr Dh 6 [b]					Dsup ^Dcr Dsh 8 [b]																		
		^Dsup Dh 6					^Dsup Dsh 8																		
TP-HANDSHAKE ind		Dsup Dh Dsh 7	Dsup Dh 7	Dsup Dh 2		Dsup Dsh 8					Dsup Dh Dsh 10														
		^Dsup ^Dcr Dh Dsh 7 [o]	^Dsup ^Dcr Dh 7 [o]	^Dsup ^Dcr Dh 2 [o]		^Dsup ^Dcr Dsh 8 [o]					^Dsup ^Dcr Dh Dsh 10 [o]														

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OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-HANDSHAKE rsp							Dsup ^Dcr ^Dsh 3 [b]	6		11															
							Dsup ^Dcr Dsh 2 [b]																		
							^Dsup ^Dsh 3																		
							^Dsup Dsh 2																		
TP-HANDSHAKE cnf						Dsup 2		7	12																
						^Dsup ^Dcr 2 [t]																				
TP-HDSKE&GRANT-CTL req		Dsup ^Dcr Dh ^Dsh 13 [b]																							
		^Dsup Dh ^Dsh 13																							
TP-HDSKE&GRANT-CTL ind			Dsup Dh 14	Dsup Dh 2																					
			^Dsup ^Dcr Dh 14 [o]	^Dsup ^Dcr Dh 2 [o]																					

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OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-HDSKE&GRANT-CTL rsp														Dsup ^Dcr 2 [b] ^Dsup 2											
TP-HDSKE&GRANT-CTL cnf													Dsup 3 ^Dsup ^Dcr 3 [t]												
TP-BEGIN-TRANSACTION req		^Nt ^Dsup Du ^Dl 2 [q]																							
TP-BEGIN-TRANSACTION ind		^Nr Dsup Du ^Dl Dsh 2 [u]	^Nr Dsup Du ^Dl 3 [u]	^Nr Dsup Du ^Dl 4 [u]		^Nr Dsup Du ^Dl Dsh 6 [u]																			
TP-DEFERRED-END-DIALOGUE req		^Dsup Dl ^De 2 [g]																							
TP-DEFERRED-END-DIALOGUE ind		Dsup Dl ^De Dsh 2 [g]	Dsup Dl ^De 3 [g]	Dsup Dl ^De 4 [g]		Dsup Dl ^De Dsh 6 [g]																			

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OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-DEFERRED-GRANT-CONTROL req		^Dsup Dl ^Dsh ^De ^Dg 2 [h]																							
TP-DEFERRED-GRANT-CONTROL ind			Dsup Dl ^De ^Dg 3 [h]	Dsup Dl ^De ^Dg 4 [h]																					
TP-PREPARE req (Data-Permitted = "false")		Npa ^Dsup Dl ^Dsh 15 [m]																							
		Npa ^Dsup Dl Dsh 16 [m]																							
TP-PREPARE req (Data-Permitted = "true")		Npa ^Dsup Dl ^Dsh 16 [m]																							
TP-PREPARE ind (Data-Permitted = "false")		Dsup Dl Dsh 19 [x]	Dsup Dl 18 [x]																						
TP-PREPARE ind (Data-Permitted = "true")			Dsup Dl 19 [x]																						

TP-READY ind															^Dcr 17 [t]	^Dcr 17 [t]									

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OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-COMMIT req *		Nr Dl ^Dcr 20 [y]													^Dcr 20 [y]	^Dcr 20 [y]	20 [y]	^Dcr 20 [y]	^Dcr 20 [y]						^Dtrb 20 [y][n]
		Npa Dsup Dl ^Dcr 20 [y]																							
		^Nr Npa ^Dsup Dl ^Dcr 20 [y]																							
TP-COMMIT ind *																				21 [t]					
TP-DONE req * (without Heuristic-Report)																					22 [d]	Nfa 22 [d]	Nfa Dsup ^Dcr 24 [b][d]		
																							Nfa ^Dsup 24 [d]		
TP-DONE req* (with Heuristic-Report)																					Npa 22 [d]		Nfa Npa Dsup ^Dcr 24 [b][d]		
																							Nfa Npa ^Dsup 24 [d]		

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OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-COMMIT-COMPLETE ind *																						^Nfa De 1 [a][z]			
																						^Nfa Dtrb 25 [z]			
																						^Nfa Db 1 [a][z]			
																						^Nfa Dsh 2 [s][z]			
																						^Nfa Dsup ^Dsh ^Dg 3 [s][z]			
																						^Nfa Dsup ^Dsh Dg 2 [s][z]			
																						^Nfa ^Dsup ^Dsh ^Dg 2 [s][z]			
																						^Nfa ^Dsup ^Dsh Dg 3 [s][z]			

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OSI TP Service State Table

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
			^Dsh	^Dsh	^Dsh	Dh	Dh	Dsh Dh	Dsh Dh ^Dl	Dsh Dh ^Dl	^Dl	^Dl	^Dsh Dh	^Dsh Dh	^Dsh Dl ^Dsup	Dl ^Dsup	Dl ^Dsup	^Dsh Dl Dsup	Dl Dsup	Dl	Dl	Dl	Dl	Dl	Dl
TP-ROLLBACK req *		Dsup ^Dcr Dl 23 [f]	Dsup ^Dcr Dl 23 [f]	Dl 23 [f]	Dsup ^Dcr Dl 23 [f]	Dl 23 [f]	Dsup ^Dcr Dl 23 [f]	Dl 23 [f]	Dl 23 [f]				Dl 23 [f]	Dsup ^Dcr Dl 23 [f]	23 [f]	23 [f]	23 [f]	^Dcr 23 [f]	^Dcr 23 [f]						^Dtrb 23 [f]
		^Dsup Dl 23 [f]	^Dsup Dl 23 [f]		^Dsup Dl 23 [f]		^Dsup Dl 23 [f]							^Dsup Dl 23 [f]											
TP-ROLLBACK ind *		Dl 23 [f]	Dl 23 [f]	Dl 23 [f]	Dl 23 [f]	Dl 23 [f]	Dl 23 [f]	Dl 23 [f]	Dl 23 [f]				Dl 23 [f]	Dl 23 [f]	23 [f]	23 [f]	23 [f]	23 [f]	23 [f]	23 [f]					Dtb 23 [f]
TP-ROLLBACK-COMPLETE *																								^Nfa Db 1 [a][z]	
																								^Nfa Dsh 2 [k][z]	
																								^Nfa ^Dsh Dc 2 [k][2]	
																								^Nfa ^Dsh ^Dc 3 [k][z]	
TP-HEURISTIC-REPORT ind																					Dhr 21 [r]	Dhr 22 [r]	Dhr 23 [o][r]	^Dcr Dhr 24 [o][r]	