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Information technology — Open Systems Interconnection — Connection-oriented Session protocol: Protocol specification

*Technologies de l'information — Interconnexion de systèmes ouverts
(OSI) — Protocole de session en mode orienté connexion: Spécification du
protocole*



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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 8327-1 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 21, *Open Systems Interconnection, data management and open distributed processing*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.225.

This second edition cancels and replaces the first edition (ISO 8327:1987), which has been technically revised. It also incorporates Amendment 3:1992.

ISO/IEC 8327 consists of the following parts, under the general title *Information technology — Open Systems Interconnection — Connection-oriented Session protocol*:

- *Part 1: Protocol specification*
- *Part 2: Protocol Implementation Conformance Statement (PICS) proforma*

Annexes A to C form an integral part of this part of ISO/IEC 8327. Annex D is for information only.

Introduction

This Recommendation | International Standard is one of a set of Recommendations | International Standards produced to facilitate the interconnection of computer systems. The set of Recommendations | International Standards covers the services and protocols required to achieve such interconnection.

This Recommendation | International Standard is positioned with respect to other related Recommendations | International Standards by the layers defined in the Reference Model for Open Systems Interconnection (see ITU-T Rec. X.200 | ISO/IEC 7498-1). It is most closely related to and lies within the field of application of the Session Service Definition (see ITU-T Rec. X.215 | ISO/IEC 8326). It also uses and references the Transport Service Definition (see ITU-T Rec. X.214 | ISO/IEC 8072), whose provisions it assumes in order to accomplish the aims of the session protocol. The interrelationship of these Recommendations | International Standards is depicted in Figure Intro. 1.

This Recommendation | International Standard specifies a single protocol with a common encoding.

It is intended that the session protocol should be general enough to cater for the total range of session service users without restricting future extensions.

The protocol is structured so that subsets of protocol can be defined.

The primary aim of this Recommendations | International Standards is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer session entities at the time of communication. These rules for communication are intended to provide a sound basis for development in order to serve a variety of purposes:

a)

as a guide for implementors and designers;

b)

for use in the testing and procurement of equipment;

c)

as a part of an agreement for the admittance of systems into the open systems environment;

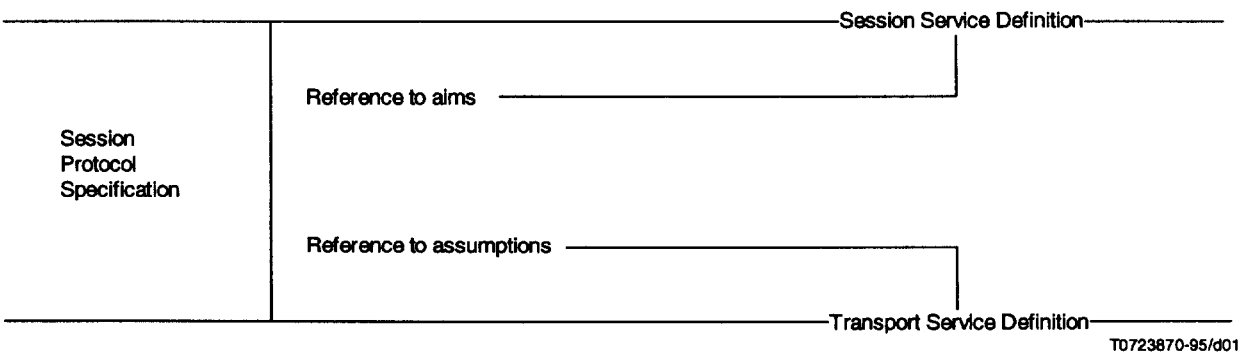
d)

as a refinement to the understanding of OSI.

It is expected that the initial users of this Recommendation | International Standard will be designers and implementors of equipment and the Recommendation | International Standard contains, in Notes or in annexes, guidance on the implementation of the procedures defined in this Recommendation | International Standard.

It should be noted that, as the number of valid protocol sequences is very large, it is not possible with current technology to verify that an implementation will operate the protocol defined in this Recommendation | International Standard correctly under all circumstances. It is possible by means of testing to establish confidence that an implementation correctly operates the protocol in a representative sample of circumstances. It is, however, intended that this Recommendation | International Standard can be used in circumstances where two implementations fail to communicate in order to determine whether one or both have failed to operate the protocol correctly.

The variations and options available within this Recommendation | International Standard are essential as they enable a session service to be provided for a wide variety of applications. Thus, a minimally conforming implementation will not be suitable for use in all possible circumstances. It is important, therefore, to qualify all references to this Recommendation | International Standard with statements of the options provided or required or with statements of the intended purpose of provision or use.



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Figure Intro. 1 – Relationship between the connectionless session protocol and adjacent services

INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – OPEN SYSTEMS INTERCONNECTION – CONNECTION-ORIENTED SESSION PROTOCOL: PROTOCOL SPECIFICATION

SECTION 1 – GENERAL

1 Scope

This Recommendation | International Standard specifies:

- a) procedures for a single protocol for the transfer of data and control information from one session entity to a peer session entity;
- b) the means of selecting the functional units to be used by the session entities;
- c) the structure and encoding of the session protocol data units used for the transfer of data and control information;

The procedures are defined in terms of:

- a) the interactions between peer session entities through the exchange of session protocol data units;
- b) the interactions between a session entity and the session service user in the same system through the exchange of session service primitives;
- c) the interactions between a session entity and the transport service provider through the exchange of transport service primitives.

These procedures are applicable to instances of communication between systems which support the session layer of the OSI Reference Model and which wish to interconnect in an open systems environment.

This Recommendation | International Standard also specifies conformance requirements for systems implementing these procedures. It does not contain tests which can be used to demonstrate this conformance.

The text pertaining to the symmetric synchronization functional unit is not applicable to the support of ITU-T applications.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and International Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and International Standards listed below. Members of ISO and IEC maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*.
- ITU-T Recommendation X.214 (1993) | ISO/IEC 8072:1994, *Information technology – Open Systems Interconnection – Transport service definition*.

- ITU-T Recommendation X.215 (1995) | ISO/IEC 8326:1996, *Information technology – Open Systems Interconnection – Session service definition*.
- ITU-T Recommendation X.245 (1995) | ISO/IEC 8327-2:¹⁾, *Information technology – Open Systems Interconnection – Connection-oriented Session protocol: Protocol Implementation Conformance Statement (PICS) proforma*.

2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.290 (1992), *OSI conformance testing methodology and framework for protocol Recommendations for CCITT applications – General concepts*.
ISO/IEC 9646-1:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 1: General concepts*.
- CCITT Recommendation X.291 (1992), *OSI conformance testing methodology and framework for protocol Recommendations for CCITT applications – Abstract test suite specification*.
ISO/IEC 9646-2:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 2: Abstract Test Suite specification*.

2.3 Additional References

- ITU-T Recommendation T.62 (1993), *Control procedures for teletex and Group 4 facsimile services*.
NOTE – ITU-T Recommendation T.62 is not essential for the application of this Recommendation | International Standard, but is included in the list of references as it has been referred to, for information, in relation to interworking with the ITU-T Telematic services (see Annexes B and C).

3 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

NOTE – The definitions contained in this clause make use of abbreviations defined in clause 4.

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

- a) expedited session service data unit;
- b) session connection;
- c) Session Layer;
- d) session protocol data unit;
- e) session service;
- f) session service access point;
- g) session service data unit;
- h) Transport Layer;
- i) transport connection;
- j) transport service;
- k) transport service access point;
- l) concatenation;
- m) segmenting.

3.2 This Recommendation | International Standard is also based on concepts developed in ITU-T Rec. X.215 | ISO/IEC 8326 and makes use of the following terms defined in it:

- a) token;
- b) calling SS-user;
- c) called SS-user;
- d) sending SS-user;

¹⁾ To be published.

- e) receiving SS-user;
- f) requesting SS-user;
- g) accepting SS-user;
- h) requestor;
- i) acceptor.

NOTE – The following terms used in this Recommendation | International Standard are used in relation to tokens and are explained in ITU-T Rec. X.215 | ISO/IEC 8326:

- a) assigned;
- b) not assigned;
- c) available;
- d) not available.

3.3 This Recommendation | International Standard also uses concepts developed in CCITT Rec. X.290 | ISO/IEC 9646-1 and makes use of the following terms defined in it:

- a) Protocol Implementation Conformance Statement (PICS);
- b) PICS proforma.

3.4 Session protocol definitions

3.4.1 Session Protocol Machine (SPM): An abstract machine that carries out the procedures specified in this protocol.

NOTE – A session entity is comprised of one or more SPMs.

3.4.2 session service user (SS-user): An abstract representation of the totality of those entities within a single system that make use of the Session Service.

3.4.3 transport service provider (TS-provider): An abstract machine which models the totality of the entities providing the transport service, as viewed by a session entity.

3.4.4 local matter: A decision made by a system concerning its behaviour in the Session Layer that is not subject to the requirements of this protocol.

3.4.5 initiator: An SPM that initiates a CONNECT SPDU.

3.4.6 responder: An SPM with whom an initiator wishes to establish a session connection.

NOTE – Initiator and responder are defined with respect to a single session connection.

3.4.7 sending SPM: An SPM that sends a given SPDU.

3.4.8 receiving SPM: An SPM that receives a given SPDU.

3.4.9 owner (of a token): The SPM to whom a token is assigned.

3.4.10 proposed parameter: The value for a parameter proposed by an SPM in a CONNECT SPDU or an ACCEPT SPDU that it wishes to use on the session connection.

3.4.11 negotiation: The process by which two SPMs agree on a common set of functional units and protocol values and on the initial setting of available tokens.

3.4.12 selected parameter: The value for a parameter that has been chosen for use on the session connection.

3.4.13 valid SPDU: An SPDU which complies with the requirements of ITU-T Rec. X.225 | ISO/IEC 8327-1 with respect to structure and encoding.

3.4.14 invalid SPDU: An SPDU which does not comply with the requirements of ITU-T Rec. X.225 | ISO/IEC 8327-1 with respect to structure and encoding.

- 3.4.15 protocol error:** Use of an SPDU that does not comply with the procedures agreed for the session connection.
- 3.4.16 transparent (data):** SS-user data which is transferred intact between SPMs and which is unavailable for use by the SPMs.
- 3.4.17 SPDU identifier (SI):** Heading information that identifies the SPDU concerned.
- 3.4.18 length indicator (LI):** An indicator that represents the length of an associated parameter field.
- 3.4.19 parameter field:** A group of one or more octets used to represent a particular set of information.
- 3.4.20 parameter identifier (PI):** An identifier, defined in ITU-T Rec. X.225 | ISO/IEC 8327-1, that indicates the type of information contained in its associated parameter field.
- 3.4.21 PI unit:** An element of an SPDU that contains a PI field together with its associated LI field and parameter field.
- 3.4.22 parameter group identifier (PGI):** An identifier, defined in ITU-T Rec. X.225 | ISO/IEC 8327-1, that indicates the type of information contained in its associated parameter field. The associated parameter field may consist of a set of PI units.
- 3.4.23 PGI unit:** An element of an SPDU that contains a PGI field together with its associated LI field and parameter field.
- 3.4.24 parameter value (PV):** Information that represents the value of the parameter identified by either a PI or PGI.
- 3.4.25 local variable:** A local variable within the SPM which is used as a means of clarifying the effects of certain actions and clarifying the conditions under which certain actions are permitted.

4 Abbreviations

For the purposes of this Recommendation | International Standard, the following abbreviations apply.

4.1 Data units

SPDU	session-protocol-data-unit
SSDU	session-service-data-unit
TSDU	transport-service-data-unit

4.2 SPDU fields

SI	SPDU identifier (see 3.4.17)
LI	Length indicator (see 3.4.18)
PI	Parameter identifier (see 3.4.20)
PGI	Parameter group identifier (see 3.4.22)
PV	Parameter value (see 3.4.24)

4.3 Timer variables

TIM	Disconnection and abort timer
-----	-------------------------------

4.4 Miscellaneous

PICS	Protocol Implementation Conformance Statement
SPM	Session Protocol Machine (see 3.4.1)
SS	session-service
SSAP	session-service-access-point
TSAP	transport-service-access-point

4.5 Local variables

Vact	See 5.9.1
Vnextact	See 5.9.2
V(A)	See 5.9.3.1
V(M)	See 5.9.3.2
V(R)	See 5.9.3.3
Vsc	See 5.9.3.4 and 5.9.4.4
V(Ado)	See 5.9.3.5
V(Adi)	See 5.9.3.6
V(As), V(Ar)	See 5.9.4.1
V(Ms), V(Mr)	See 5.9.4.2
V(Rs), V(Rr)	See 5.9.4.3

5 Overview of the session protocol

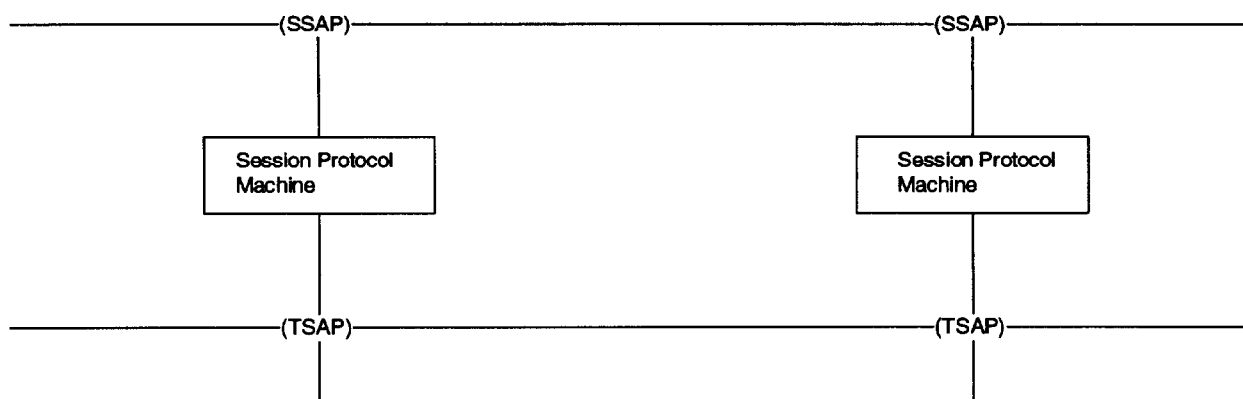
5.1 Model of the session layer

The SPM (see the Note) within the session layer communicates with the SS-user through an SSAP by means of the service primitives as defined by the session service definition ITU-T Rec. X.215 | ISO/IEC 8326. Service primitives will cause or be the result of session protocol data unit exchanges between the peer SPMs using a transport connection. These protocol exchanges are effected using the services of the transport layer as defined by the transport service definition ITU-T Rec. X.214 | ISO/IEC 8072 through two TSAPs.

Session connection endpoints are identified in end systems by an internal, implementation dependent, mechanism so that the SS-user and the SPM can refer to each session connection.

The model of the session layer is illustrated in Figure 1.

NOTE – A session entity is comprised of one or more SPMs.



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Figure 1 – Model for the session layer

5.2 Services provided by the session layer

The protocol specified in this Recommendation | International Standard supports the session service defined in ITU-T Rec. X.215 | ISO/IEC 8326. Information is transferred to and from the SS-user using the session service primitives listed in Table 1. Table 1 also defines the SPDUs associated with each of the service primitives.

Table 1 – Session service primitives

Service	Primitives	Associated SPDUs
Session Connection	S-CONNECT request S-CONNECT indication S-CONNECT (accept) response S-CONNECT (accept) confirm S-CONNECT (reject) response S-CONNECT (reject) confirm	CONNECT SPDU CONNECT SPDU ACCEPT SPDU ACCEPT SPDU REFUSE SPDU REFUSE SPDU
Normal Data Transfer	S-DATA request S-DATA indication	DATA TRANSFER SPDU DATA TRANSFER SPDU
Expedited Data Transfer	S-EXPEDITED-DATA request S-EXPEDITED-DATA indication	EXPEDITED DATA SPDU EXPEDITED DATA SPDU
Typed Data Transfer	S-TYPED-DATA request S-TYPED-DATA indication	TYPED DATA SPDU TYPED DATA SPDU
Capability Data Exchange	S-CAPABILITY-DATA request S-CAPABILITY-DATA indication S-CAPABILITY-DATA response S-CAPABILITY-DATA confirm	CAPABILITY DATA SPDU CAPABILITY DATA SPDU CAPABILITY DATA ACK SPDU CAPABILITY DATA ACK SPDU
Give Tokens	S-TOKEN-GIVE request S-TOKEN-GIVE indication	GIVE TOKENS SPDU GIVE TOKENS SPDU
Please Tokens	S-TOKEN-PLEASE request S-TOKEN-PLEASE indication	PLEASE TOKENS SPDU PLEASE TOKENS SPDU
Give Control	S-CONTROL-GIVE request S-CONTROL-GIVE indication	GIVE TOKENS CONFIRM SPDU GIVE TOKENS CONFIRM SPDU
Minor Synchronization Point	S-SYNC-MINOR request S-SYNC-MINOR indication S-SYNC-MINOR response S-SYNC-MINOR confirm	MINOR SYNC POINT SPDU MINOR SYNC POINT SPDU MINOR SYNC ACK SPDU MINOR SYNC ACK SPDU
Symmetric Synchronize	S-SYNC-MINOR request S-SYNC-MINOR indication S-SYNC-MINOR response S-SYNC-MINOR confirm	MINOR SYNC POINT SPDU MINOR SYNC POINT SPDU MINOR SYNC ACK SPDU MINOR SYNC ACK SPDU
Major Synchronization Point	S-SYNC-MAJOR request S-SYNC-MAJOR indication S-SYNC-MAJOR response S-SYNC-MAJOR confirm	MAJOR SYNC POINT SPDU MAJOR SYNC POINT SPDU MAJOR SYNC ACK SPDU MAJOR SYNC ACK SPDU
Resynchronize	S-RESYNCHRONIZE request S-RESYNCHRONIZE indication S-RESYNCHRONIZE response S-RESYNCHRONIZE confirm	RESYNCHRONIZE SPDU RESYNCHRONIZE SPDU RESYNCHRONIZE ACK SPDU RESYNCHRONIZE ACK SPDU
P-Exception Report	S-P-EXCEPTION-REPORT indication	EXCEPTION REPORT SPDU
U-Exception Reporting	S-U-EXCEPTION-REPORT request S-U-EXCEPTION-REPORT indication	EXCEPTION DATA SPDU EXCEPTION DATA SPDU
Activity Start	S-ACTIVITY-START request S-ACTIVITY-START indication	ACTIVITY START SPDU ACTIVITY START SPDU
Activity Resume	S-ACTIVITY-RESUME request S-ACTIVITY-RESUME indication	ACTIVITY RESUME SPDU ACTIVITY RESUME SPDU

Table 1 – Session service primitives (concluded)

Service	Primitives	Associated SPDUs
Activity Interrupt	S-ACTIVITY-INTERRUPT request S-ACTIVITY-INTERRUPT indication S-ACTIVITY-INTERRUPT response S-ACTIVITY-INTERRUPT confirm	ACTIVITY INTERRUPT SPDU ACTIVITY INTERRUPT SPDU ACTIVITY INTERRUPT ACK SPDU ACTIVITY INTERRUPT ACK SPDU
Activity Discard	S-ACTIVITY-DISCARD request S-ACTIVITY-DISCARD indication S-ACTIVITY-DISCARD response S-ACTIVITY-DISCARD confirm	ACTIVITY DISCARD SPDU ACTIVITY DISCARD SPDU ACTIVITY DISCARD ACK SPDU ACTIVITY DISCARD ACK SPDU
Activity End	S-ACTIVITY-END request S-ACTIVITY-END indication S-ACTIVITY-END response S-ACTIVITY-END confirm	ACTIVITY END SPDU ACTIVITY END SPDU ACTIVITY END ACK SPDU ACTIVITY END ACK SPDU
Orderly Release	S-RELEASE request S-RELEASE indication S-RELEASE (accept) response S-RELEASE (accept) confirm S-RELEASE (reject) response S-RELEASE (reject) confirm	FINISH SPDU FINISH SPDU DISCONNECT SPDU DISCONNECT SPDU NOT FINISHED SPDU NOT FINISHED SPDU
U-Abort	S-U-ABORT request S-U-ABORT indication	ABORT SPDU ABORT SPDU
P-Abort	S-P-ABORT indication	ABORT SPDU

5.3 Services assumed from the transport layer

The protocol specified in this Recommendation | International Standard assumes the use of the connection-oriented transport service defined in ITU-T Rec. X.214 | ISO/IEC 8072.

Information is transferred to and from the TS provider in the transport service primitives listed in Table 2.

5.4 Functions of the session layer

5.4.1 Overview of functions

The functions in the Session Layer are those necessary to bridge the gap between the services available from the Transport Layer and those offered to the SS-users.

The functions in the Session Layer are concerned with dialogue management, data flow synchronization, and data flow resynchronization.

These functions are described below; the descriptions are grouped into those concerned with the connection establishment phase, the data transfer phase, and the release phase.

5.4.2 Connection establishment phase

The purpose of the connection establishment phase is to establish a session connection between two SS-users, and:

- to map session addresses onto transport addresses;
- to select transport quality of service parameters needed (see 6.1.4);
- to negotiate session parameters (see 7.1, 7.2 and 7.4);
- to transfer session selectors (see 7.1 and 7.4) if required;
- to distinguish between session connections (see 7.1 and 7.4);

- f) to transfer transparent user data (see 7.1, 7.2, 7.3 and 7.4);
- g) to select a protocol version (see the Note).

NOTE – This Recommendation | International Standard specifies the following protocol versions:

- a) Protocol Version 1 which imposes restrictions on the length of the user data field;
- b) Protocol Version 2 which imposes no explicit restrictions on the length of the user data field.

Annex D identifies the differences between Protocol Version 1 and Protocol Version 2.

Table 2 – Transport service primitives

Primitive	X/Y	Parameters
T-CONNECT request T-CONNECT indication	X	Called Address Calling Address Expedited Data option Quality of Service TS-user-data
T-CONNECT response T-CONNECT confirm	X	Quality of Service Responding Address Expedited Data option TS-user-data
T-DATA request T-DATA indication	X	TS-user-data
T-EXPEDITED-DATA request T-EXPEDITED-DATA indication	Y	TS-user-data
T-DISCONNECT request	X	TS-user-data
T-DISCONNECT indication	X	Disconnect reason TS-user-data
X The session protocol assumes that this service is always available. Y The session protocol assumes that this service is provided by the transport layer when requested by the SPM during the session connection establishment phase.		

5.4.3 Data transfer phase

The purpose of the data transfer phase is to transport SSDUs between two SS-users connected by a session connection. This purpose is achieved by means of transmission of SPDUs and by the following functions, each of which may or may not be used, depending on the functional units selected in the session connection establishment phase. These concepts are defined in ITU-T Rec. X.215 | ISO/IEC 8326:

- a) Normal data transfer (see 7.11), which may involve segmenting of SSDUs into SPDUs and reassembly by the destination SPM; and concatenation and separation of certain SPDUs. There are two modes of operation.
 - 1) half-duplex, when the right to send data is restricted to the owner of the data token;
 - 2) duplex, when there is no restriction on the right to send data.
- b) Token management (see 7.16 to 7.19), to enable the SS-users to request and transfer tokens which control the exclusive right to exercise certain functions (see Table 5).
- c) Exception reporting (see 7.27 and 7.28), to enable the SS-provider or the SS-user to report exception conditions that are less severe than those requiring abort.
- d) Typed data transfer (see 7.13), to enable transfer of information which is not subject to assignment of the data token.

- e) Minor synchronization point (see 7.20 and 7.21), to enable the SS-users to define minor synchronization points in the normal data flow. These minor synchronization points may optionally be confirmed, but have no implications on the data flow. Minor synchronization points are identified by synchronization point serial numbers. The serial number is incremented by one on each occasion that a minor synchronization point is placed in the data flow, and each time a minor synchronization point is received, such that both SS-users have the same serial numbers for the same synchronization point.
- f) Symmetric synchronization (see 7.18 to 7.23), to enable the SS-users to define synchronization points independently on their sending flows. These synchronization points may optionally be confirmed, but have no implications on the data flow. Two serial numbers are provided: one to identify points on each direction of data flow. The appropriate serial number is incremented each time a synchronization point is sent or received. The ability to define a minor symmetric synchronization point is not token controlled.
- g) Data separation is used in association with either minor synchronization or symmetric synchronization. This allows the user to set specific minor synchronization points which have the property of protecting the flow sent before these points from being purged by a subsequent resynchronize. When such a point is set in the data flow, SPDUs received by the requesting SPM before this point has been acknowledged will not be discarded by a subsequent resynchronize.
- h) Major synchronization point [see 7.22 and 7.23 and e) above], to enable the SS-users to define major synchronization points in the normal data flow. These major synchronization points are required to be confirmed before the requesting SS-user is permitted to send any subsequent data on either the normal flow or the expedited flow and as such clearly separate the dialogue units.
- i) Resynchronize (see 7.24 and 7.25), a function that allows a session connection to be set or reset to a defined synchronization point and reassign the tokens.
- j) Expedited data transfer (see 7.12), a function used to convey a limited amount of user data with special handling. Such data may bypass normal data en route, but will be delivered prior to any data subsequently sent on the transport normal flow or the transport expedited flow.
- k) Activity management (see 7.29 to 7.36) provides a means explicitly to start, end, resume, interrupt or discard an activity. This provides a way:
 - 1) to identify the entered activity and commence synchronization point serial numbering;
 - 2) to identify the continued activity and reset the synchronization point serial number in case of resumption.
- l) Capability data exchange (see 7.14 and 7.15), to provide a confirmed transfer of SS-user data.

5.4.4 Connection release phase

The purpose of the release phase is to provide disconnection of the session connection, by using the following functions:

- a) orderly release (negotiated and non-negotiated);
- b) abort (provider and user initiated);
- c) transfer of transparent user data.

5.5 Protocol version numbers

Protocol Version 1 of the session protocol is a subset of Protocol Version 2. Both protocol versions are both specified in this edition of this Recommendation | International Standard (see the Note).

Protocol Version 1 imposes restrictions on the length of the user data field. Protocol Version 2 imposes no explicit restrictions on the length of the user data field.

The restrictions defining Protocol Version 1 are specified in clauses 6, 7 and 8. Annex D lists, for information, the differences between the two protocol versions.

NOTE – Edition 1 of this Recommendation | International Standard, (Rec.X.225 (1984) | ISO 8327-1: 1987), defined only Protocol Version 1 of the session protocol.

5.6 Functional units

Functional units are logical groupings of related elements of procedure defined by this Recommendation | International Standard for the purpose of:

- a) negotiation for use during session connection establishment;
- b) specification of conformance requirements.

The SPDUs associated with elements of procedure for each functional unit are specified in Table 3. This table does not take account of additional SPDUs (GT SPDU and PT SPDU) required by the concatenation rules (see 6.3.7).

Tokens are associated with functional units (see 5.7).

5.6.1 Kernel functional unit

The kernel functional unit supports the basic protocol elements of procedure required to establish a session connection, transfer normal data and release the session connection.

5.6.2 Negotiated release functional unit

The negotiated release functional unit supports the negotiated release service which enables the SS-users to negotiate the orderly release of the session connection. If this functional unit has been selected, an attempt to release the session connection may be refused by the accepting SS-user.

5.6.3 Half-duplex functional unit

The half-duplex functional unit is used to control the right to send data. It is not valid to select both this functional unit and the duplex functional unit for use on the same session connection.

5.6.4 Duplex functional unit

The duplex functional unit is used when the right to send data is not controlled. It is not valid to select both this functional unit and the half-duplex functional unit for use on the same session connection.

5.6.5 Expedited data functional unit

The expedited data functional unit supports the expedited data service and allows the transfer of a limited amount of SS-user data.

The services supported by this functional unit can only be requested when the transport expedited flow is available to this session connection.

5.6.6 Typed data functional unit

The typed data functional unit enables the SS-users to transfer data in a manner which is not subject to the control imposed by the availability of the data token.

5.6.7 Capability data exchange functional unit

The capability data functional unit supports the capability data exchange service, which allows a confirmed transfer of SS-user data when the activity management functional unit has been selected, but when no activity is in progress.

5.6.8 Minor synchronize functional unit

The minor synchronize functional unit supports the minor synchronization service which enables the SS-user to request that the SPM places minor synchronization points in the normal data flow. These minor synchronization points are identified by serial numbers. It is not valid to select both this functional unit and the symmetric synchronize functional unit for use on the same session connection.

5.6.9 Symmetric synchronize functional unit

The symmetric synchronize functional unit supports the symmetric synchronize service which enables SS-users to independently define minor synchronization points in their respective sending flows. These sync points are identified by serial numbers; two serial numbers are provided, each representing points in one direction of flow. The synchronize-minor token is not available. It is not valid to select both this functional unit and the minor synchronize functional unit for use on the same session connection.

5.6.10 Data separation functional unit

The data separation functional unit is always associated with either the minor synchronize functional unit or the symmetric synchronize functional unit. It allows the user to define minor synchronization points which clearly separate the normal flow before and after these points and which are protected against possible discard by a subsequent resynchronize. It is not valid to select both this functional unit and the activity management functional unit for use on the same session connection.

Table 3 – Functional units

Functional unit	SPDU code	SPDU name	Reference
Kernel	CN	CONNECT (see Note 1)	7.1
	OA	OVERFLOW ACCEPT (see Note 2)	7.2
	CDO	CONNECT DATA OVERFLOW (see Note 2)	7.3
	AC	ACCEPT (see Note 1)	7.4
	RF	REFUSE (see Note 1)	7.5
	FN	FINISH	7.6
	DN	DISCONNECT	7.7
	AB	ABORT	7.9
	AA	ABORT ACCEPT (see Note 3)	7.10
	DT	DATA TRANSFER	7.11
	PR	PREPARE (see Note 7)	7.26
Negotiated release	NF	NOT FINISHED	7.8
	GT	GIVE TOKENS (see Note 5)	7.16
	PT	PLEASE TOKENS (see Note 5)	7.17
Half-duplex	GT	GIVE TOKENS (see Note 4)	7.16
	PT	PLEASE TOKENS (see Note 4)	7.17
Duplex		No additional associated SPDUs	
Expedited data	EX	EXPEDITED DATA	7.12
Typed data	TD	TYPED DATA	7.13
Capability data exchange	CD	CAPABILITY DATA	7.14
	CDA	CAPABILITY DATA ACK	7.15
Minor synchronize	MIP	MINOR SYNC POINT	7.20
	MIA	MINOR SYNC ACK	7.21
	GT	GIVE TOKENS (see Note 6)	7.16
	PT	PLEASE TOKENS (see Note 6)	7.17
Symmetric synchronize	MIP	MINOR SYNC POINT	7.20
	MIA	MINOR SYNC ACK	7.21
Data separation		No additional associated SPDUs	
Major synchronize	MAP	MAJOR SYNC POINT	7.22
	MAA	MAJOR SYNC ACK	7.23
	PR	PREPARE (see Note 7)	7.26
	GT	GIVE TOKENS (see Note 8)	7.16
	PT	PLEASE TOKENS (see Note 8)	7.17
Resynchronize	RS	RESYNCHRONIZE	7.24
	RA	RESYNCHRONIZE ACK	7.25
	PR	PREPARE (see Note 7)	7.26
Exceptions	ER	EXCEPTION REPORT	7.27
	ED	EXCEPTION DATA	7.28
Activity management	AS	ACTIVITY START	7.29
	AR	ACTIVITY RESUME	7.30
	AI	ACTIVITY INTERRUPT	7.31
	AIA	ACTIVITY INTERRUPT ACK	7.32
	AD	ACTIVITY DISCARD	7.33
	ADA	ACTIVITY DISCARD ACK	7.34
	AE	ACTIVITY END	7.35
	AEA	ACTIVITY END ACK	7.36
	PR	PREPARE (see Note 7)	7.26
	GT	GIVE TOKENS (see Note 8)	7.16
	PT	PLEASE TOKENS (see Note 8)	7.17
	GTC	GIVE TOKENS CONFIRM (see Note 9)	7.18
	GTA	GIVE TOKENS ACK (see Note 9)	7.19

Table 3 – Functional units (concluded)**NOTES**

- 1 An implementation (see clause 9) is required to be able to:
 - a) send a CONNECT SPDU and receive an ACCEPT SPDU or a REFUSE SPDU
 - b) receive a CONNECT SPDU and send an ACCEPT SPDU or a REFUSE SPDU
 - c) send and receive both.
- 2 These SPDUs are only used when the SSDU passed in the S-CONNECT request is segmented [see 6.3.5 b)].
- 3 Reception and correct action is mandatory; transmission is optional if the transport connection is not to be reused (see 7.10.2).
- 4 Used to manage the data token.
- 5 Used to manage the release token.
- 6 Used to manage the synchronize-minor token.
- 7 PREPARE SPDU is mandatory if the transport expedited flow is available to this session connection.
- 8 Used to manage the major/activity token.
- 9 Used only on session connections on which activity management has been selected.

5.6.11 Major synchronize functional unit

The major synchronize functional unit supports the major synchronize service which enables the SS-user to request that the SPM places major synchronization points in the normal data flow. These major synchronization points are identified by serial numbers, and clearly separate the data flow before and after the major synchronization point.

5.6.12 Resynchronize functional unit

The resynchronize functional unit supports the resynchronize service which enables the SS-users to modify the synchronization point serial number and reassign the tokens.

5.6.13 Exceptions functional unit

The exceptions functional unit allows both the SPM and the SS-users to report detected errors, rather than aborting the session connection.

This functional unit can only be selected when the half-duplex functional unit has been selected.

5.6.14 Activity management functional unit

The activity management functional unit supports the activity management services which allow the SS-users to manage synchronized logical pieces of work.

5.7 Tokens

Table 4 specifies those functional units that have tokens associated with them.

The SPM may only send an SPDU listed in Table 5 (and accept the associated service primitive) subject to the availability and assignment of tokens defined in that table.

Table 4 – Tokens associated with functional units

Functional unit	Token
Negotiated release	release token
Half-duplex	data token
Minor synchronize	synchronize-minor token
Major synchronize	major/activity token
Activity management	major/activity token

Table 5 – Token restrictions

SPDU _s	data token	synchronize minor token	major/activity token	release token
FINISH SPDU NOT FINISHED SPDU	2 nr	2 nr	2 nr	2 0
DATA TRANSFER SPDU (half-duplex) DATA TRANSFER SPDU (duplex)	1 3	nr nr	nr nr	nr nr
CAPABILITY DATA SPDU	2	2	1	nr
GIVE TOKEN SPDU (data token) (synchronize-minor token) (major/activity token) (release token)	1 nr nr nr	nr 1 nr nr	nr nr 1 nr	nr nr nr 1
PLEASE TOKEN SPDU (data token) (synchronize-minor token) (major/activity token) (release token)	0 nr nr nr	nr 0 nr nr	nr nr 0 nr	nr nr nr 0
GIVE TOKENS CONFIRM SPDU	2	2	1	2
MINOR SYNC POINT SPDU (minor synchronize) MINOR SYNC POINT SPDU (symmetric synchronize) MAJOR SYNC POINT SPDU	2 nr 2	1 3 2	nr nr 1	nr nr nr
EXCEPTION REPORT SPDU EXCEPTION DATA SPDU	0 0	nr nr	nr nr	nr nr
ACTIVITY START SPDU ACTIVITY RESUME SPDU ACTIVITY INTERRUPT SPDU ACTIVITY DISCARD SPDU ACTIVITY END SPDU	2 2 nr nr 2	2 2 nr nr 2	1 1 1 1 1	nr nr nr nr nr
0 Token available and not assigned to the SS-user who initiated the associated service primitive. 1 Token available and assigned to the SS-user who initiated the associated service primitive. 2 Token not available or token assigned to the SS-user who initiated the associated service primitive. 3 Token not available. nr No restriction.				

5.8 Negotiation

Negotiation takes place between both SPMs during session connection establishment according to the following rules.

5.8.1 Negotiation of functional units

Each SPM proposes use or non-use of each functional unit, except for the kernel functional unit, based on requirements from the SS-users. The functional unit is selected only if both the initiator and the responder propose use of the functional unit.

The capability data functional unit can only be proposed if the activity management functional unit is also proposed.

The exceptions functional unit can only be proposed if the half-duplex functional unit is also proposed.

The data separation functional unit can only be proposed if the minor synchronize functional unit or the symmetric synchronize functional unit is proposed.

5.8.2 Negotiation of initial token settings

When the initiator proposes use of a functional unit that requires a token, it also proposes the initial token setting:

- a) initiator's side;

- b) responder's side;
- c) called SS-user's choice.

If use of the functional unit is selected, the token is set to the side proposed by the initiator. If the initiator proposed "called SS-user choice", the responder's proposed token setting is selected.

5.8.3 Negotiation of initial serial number

When the initiator proposes any of the minor synchronize, symmetric synchronize, major synchronize or resynchronize functional units but does not propose the activity functional unit, it also proposes values for the initial serial number(s). Two initial serial numbers are proposed if the symmetric synchronize functional unit is proposed; otherwise one initial serial number is proposed.

When the initiator proposes any of the minor synchronize, symmetric synchronize, major synchronize, or resynchronize functional units and also proposes the activity management functional unit, it may also propose initial serial number(s).

In all other cases, the initiator does not propose an initial serial number.

When the responder proposes any of the minor synchronize, symmetric synchronize, major synchronize or resynchronize functional units but does not propose the activity management functional unit, it also proposes an initial serial number, which is the first serial number to be used. Two initial serial numbers are proposed if the symmetric synchronize functional unit is proposed; otherwise one initial serial number is proposed.

In all other cases, the responder does not propose an initial serial number.

5.8.4 Negotiation of upper limit serial number

When the initiator proposes an initial serial number (see 5.8.3), it may also propose an upper limit serial number. When the responder proposes an initial serial number (see 5.8.3), it may also propose an upper limit serial number. The responders proposal is used to define the upper limit of the serial number.

The means by which the upper limit serial number is passed between the SS-user and its SPM is a local matter.

5.8.5 Negotiation of protocol version number

Each SPM indicates all the appropriate versions of the protocol that it is capable of supporting. The highest common version number is used.

5.8.6 Negotiation of maximum TSDU size

Each SPM proposes a maximum TSDU size that the initiator is permitted to send. The lesser of the two numbers is used. A zero value is interpreted to mean unlimited TSDU size. If either SPM proposes zero, the initiator may not send segmented data or typed data SSDUs on the session connection.

Each SPM also proposes a maximum TSDU size that the responder is permitted to send. The lesser of the two numbers is used. A zero value is interpreted to mean unlimited TSDU size. If either SPM proposes zero, the responder may not send segmented data or typed data SSDUs on the session connection.

5.9 Local variables

This Recommendation | International Standard uses local variables as a means of clarifying the effect of certain actions and clarifying the conditions under which certain actions are valid.

5.9.1 Vact

Vact is used by the SPM to determine if an activity is in progress when the activity management functional unit has been selected:

- Vact = true: an activity is in progress;
- Vact = false: no activity is in progress.

5.9.2 Vnextact

Vnextact is used by the SPM when the activity management functional unit has been selected:

- Vnextact = true: a MAJOR SYNC POINT SPDU has been sent or received;
- Vnextact = false: an ACTIVITY END SPDU has been sent or received.

5.9.3 Synchronization point variables for use without the symmetric synchronize functional unit

This subclause defines the synchronization variables used by the SPM when the symmetric synchronize functional unit has not been selected for use on the session connection.

5.9.3.1 V(A)

When the symmetric synchronize functional unit has not been selected, V(A) is used by the SPM and is the lowest serial number to which a synchronization point confirmation is expected. No confirmation is expected when $V(A) = V(M)$.

5.9.3.2 V(M)

When the symmetric synchronize functional unit has not been selected, V(M) is used by the SPM and is the next serial number to be used.

5.9.3.3 V(R)

When the symmetric synchronize functional unit has not been selected, V(R) is used by the SPM and is the lowest serial number to which resynchronization restart is permitted.

5.9.3.4 Vsc

When the symmetric synchronize functional unit has not been selected, Vsc is used by the SPM to determine whether or not the SS-user has the right to send minor synchronization point responses. Vsc has the following values:

- Vsc = true: the SS-user has the right to issue minor synchronization point responses when V(A) is less than V(M);
- Vsc = false: the SS-user does not have the right to issue minor synchronization point responses.

NOTE – The manipulation of V(A), V(M), V(R) and Vsc and the circumstances under which they are updated are specified in clause 7 and are summarized in Table A.4.

5.9.3.5 V(Ado)

V(Ado) is used by the SPM and is the highest synchronization point serial number which was sent in a MINOR SYNCHRONIZATION POINT SPDU with the data separation parameter set to true. Received SPDUs cannot be discarded in case of resynchronization when V(Ado) is greater than or equal to V(A).

5.9.3.6 V(Adi)

V(Adi) is used by the SPM and is the highest synchronization point serial number which was received in a MINOR SYNCHRONIZATION POINT SPDU with the data separation parameter set to true.

5.9.4 Synchronization point variables for use with symmetric synchronize functional unit

This subclause defines the synchronization variables used by the SPM when the symmetric synchronize functional unit has been selected for use on the session connection.

The synchronization variables V(A), V(M), and V(R) are each dual number variables (an ordered pair) when the symmetric synchronize functional unit has been selected.

5.9.4.1 V(As), V(Ar)

V(As) and V(Ar) are used by the SPM to manage synchronization point confirmations.

V(As) is the lowest serial number on the SPM's sending data flow to which a synchronization point confirmation is expected to be received. No confirmation is expected to be received when $V(As) = V(Ms)$. V(Ar) is the lowest serial number on the SPM's receiving data flow for which a confirmation has not yet been sent. No confirmation will be sent by the SPM when $V(Ar) = V(Mr)$.

5.9.4.2 V(Ms), V(Mr)

V(Ms) and V(Mr) are used by the SPM to maintain the next serial number to be used on the sending and receiving data flows.

V(Ms) is the serial number of the next synchronization point to be sent. V(Mr) is the serial number of the next synchronization point to be received.

5.9.4.3 V(Rs), V(Rr)

V(Rs) and V(Rr) are used by the SPM to maintain the lowest serial numbers to which resynchronization restart is permitted.

V(Rs) is the lowest serial number on the SPM's sending data flow to which resynchronization restart is permitted.

V(Rr) is the lowest serial number on the SPM's receiving data flow to which resynchronization restart is permitted.

5.9.4.4 Vsc

Vsc is not used if the symmetric synchronize functional unit has been selected.

NOTE – The manipulation of V(As), V(Ar), V(Ms), V(Mr), V(Rs) and V(Rr) and the circumstances under which they are updated are specified in clause 7 and are summarized in Table A.5.

SECTION 2 – SESSION PROTOCOL SPECIFICATION

6 Use of the transport service

This clause defines the way that the transport service primitives are used by the SPM.

6.1 Assignment of a session connection to the transport connection

6.1.1 Purpose

Assignment of a session connection to a transport connection.

6.1.2 Transport service primitives

The procedure uses the following transport service primitives:

- T-CONNECT request;
- T-CONNECT indication;
- T-CONNECT response;
- T-CONNECT confirm;
- T-DISCONNECT request;
- T-DISCONNECT indication.

6.1.3 SPDUs used

No SPDUs are used during assignment to a transport connection.

6.1.4 Description

A session connection is assigned to an existing transport connection suitable for reuse, or a new transport connection is created for the purpose. This assignment is based on the quality of service (see ITU-T Rec. 215 | ISO/IEC 8326) requested by the SS-user in the S-CONNECT request.

If a transport connection is established with the transport expedited data option, the transport expedited flow is available for the duration of the transport connection. Use of transport expedited data is specified in 6.4.

The transport expedited flow is requested by the SPM when the T-CONNECT request is issued if:

- a) the SS-user requested the expedited data functional unit; or
- b) the SS-user requested an extended control QOS for the session connection.

Only the initiator of the transport connection is permitted to issue the CONNECT SPDU.

When a session connection is terminated, the underlying transport connection is also terminated, unless reuse of the transport connection has been agreed.

Use of the TS-user data parameter in T-CONNECT request, indication, response and confirm is reserved for future use. When a T-CONNECT request or a T-CONNECT response is issued, this parameter is empty. When a T-CONNECT indication or T-CONNECT confirm is received, this parameter is ignored.

6.2 Reuse of the transport connection

6.2.1 Purpose

To allow the transport connection to be retained for reuse by another session connection.

6.2.2 Transport service primitives

The procedure uses the following transport service primitives:

- T-DATA request;
- T-DATA indication.

6.2.3 SPDUs used

The following SPDUs are related to reuse of the transport connection:

- REFUSE SPDU (see 7.5);
- FINISH SPDU (see 7.6);
- DISCONNECT SPDU (see 7.7);
- ABORT SPDU (see 7.9);
- ABORT ACCEPT SPDU (see 7.10).

6.2.4 Description

When a session connection is refused, or has been successfully connected and subsequently disconnected, by abort or orderly release, the supporting transport connection may be either disconnected or reused.

The transport connection may be kept for reuse provided that the transport expedited flow is not available, and either:

- a) the SPM which established the transport connection requests retention of the transport connection by parameter in an ABORT SPDU or a FINISH SPDU; or
- b) the SPM which established the transport connection receives a REFUSE SPDU or an ABORT SPDU which indicates by parameter that the transport connection is to be retained.

To avoid contention for a retained transport connection, only the transport connection initiator may reuse the transport connection by sending a CONNECT SPDU to establish a new session connection.

6.3 Use of transport normal data

6.3.1 Purpose

To convey SPDUs in user data fields of transport service normal data primitives.

6.3.2 Transport service primitives

The procedure uses the following transport service primitives:

- T-DATA request;
- T-DATA indication.

6.3.3 SPDUs used

The following SPDUs are sent on the transport normal flow:

- CONNECT SPDU (see 7.1);
- OVERFLOW ACCEPT SPDU (see 7.2);
- CONNECT DATA OVERFLOW SPDU (see 7.3);
- ACCEPT SPDU (see 7.4);
- REFUSE SPDU (see 7.5);
- FINISH SPDU (see 7.6);
- DISCONNECT SPDU (see 7.7);
- NOT FINISHED SPDU (see 7.8);
- ABORT ACCEPT SPDU (see 7.10);

- DATA TRANSFER SPDU (see 7.11);
- TYPED DATA SPDU (see 7.13);
- CAPABILITY DATA SPDU (see 7.14);
- CAPABILITY DATA ACK SPDU (see 7.15);
- GIVE TOKENS SPDU (see 7.16);
- PLEASE TOKENS SPDU (see 7.17);
- GIVE TOKENS CONFIRM SPDU (see 7.18);
- GIVE TOKENS ACK SPDU (see 7.19);
- MINOR SYNC POINT SPDU (see 7.20);
- MINOR SYNC ACK SPDU (see 7.21);
- MAJOR SYNC POINT SPDU (see 7.22);
- MAJOR SYNC ACK SPDU (see 7.23);
- RESYNCHRONIZE SPDU (see 7.24);
- RESYNCHRONIZE ACK SPDU (see 7.25);
- EXCEPTION REPORT SPDU (see 7.27);
- EXCEPTION DATA SPDU (see 7.28);
- ACTIVITY START SPDU (see 7.29);
- ACTIVITY RESUME SPDU (see 7.30);
- ACTIVITY INTERRUPT SPDU (see 7.31);
- ACTIVITY INTERRUPT ACK SPDU (see 7.32);
- ACTIVITY DISCARD SPDU (see 7.33);
- ACTIVITY DISCARD ACK SPDU (see 7.34);
- ACTIVITY END SPDU (see 7.35);
- ACTIVITY END ACK SPDU (see 7.36).

If the SS-user data exceeds 9 octets or if the transport expedited flow is not available, the following additional SPDU is sent on the transport normal flow:

- ABORT SPDU (see 7.9).

6.3.4 Transfer of SPDUs

The SPDUs listed in 6.3.3 are transferred using the transport normal data transfer service.

6.3.5 Segmenting

Segmenting of SSDUs takes place under the following circumstances:

- a) when a maximum TSDU size has been selected, in which case a data SSDU or a typed data SSDU may be mapped onto more than one SPDU;
- b) when Protocol Version 2 is proposed or selected and either:
 - 1) the SPDU size would exceed the maximum TSDU size; or
 - 2) the SPDU size would exceed 65539 octets for an SPDU to be sent on the transport normal flow or 16 octets for an SPDU to be sent on the transport expedited flow,

in which case SSDUs other than data SSDUs, typed data SSDUs and expedited data SSDUs are mapped onto more than one SPDU.

In all other cases, each SSDU is mapped one-to-one onto an SPDU.

NOTE – Implementors should note that when segmenting is selected:

- a) the control information of each SPDU indicates whether or not it contains the first or last segment of the SSDU;
- b) the size of the segments of the SSDU is constrained by the maximum TSDU size selected for that direction of transfer.

6.3.6 Maximum TSDU size

When a maximum TSDU size has been selected, the SPDU size may not exceed the maximum TSDU size selected for that direction of transfer and a sequence of concatenated SPDUs may not exceed the maximum TSDU size selected for that direction of transfer.

6.3.7 Concatenation

Each SPDU is defined in Table 6 as belonging to one of the following categories:

- a) Category 0 SPDUs which may be mapped one-to-one onto a TSDU or may be concatenated with one or more category 2 SPDUs;
- b) Category 1 SPDUs which are always mapped one-to-one onto a TSDU;
- c) Category 2 SPDUs which are never mapped one-to-one onto a TSDU.

Basic concatenations of a category 0 SPDU with a single category 2 SPDU, defined as valid and in the order indicated in Table 7, may always be mapped onto a single TSDU.

If the receiving SPM has indicated that it can accept extended concatenation, the sending SPM may map a category 0 SPDU with one or more category 2 SPDUs (as specified in Table 8) onto a single TSDU.

In the case where this concatenated sequence does not fit into a single TSDU, extended concatenation cannot be applied.

The valid mappings of SPDUs onto TSDUs are illustrated in Figure 2.

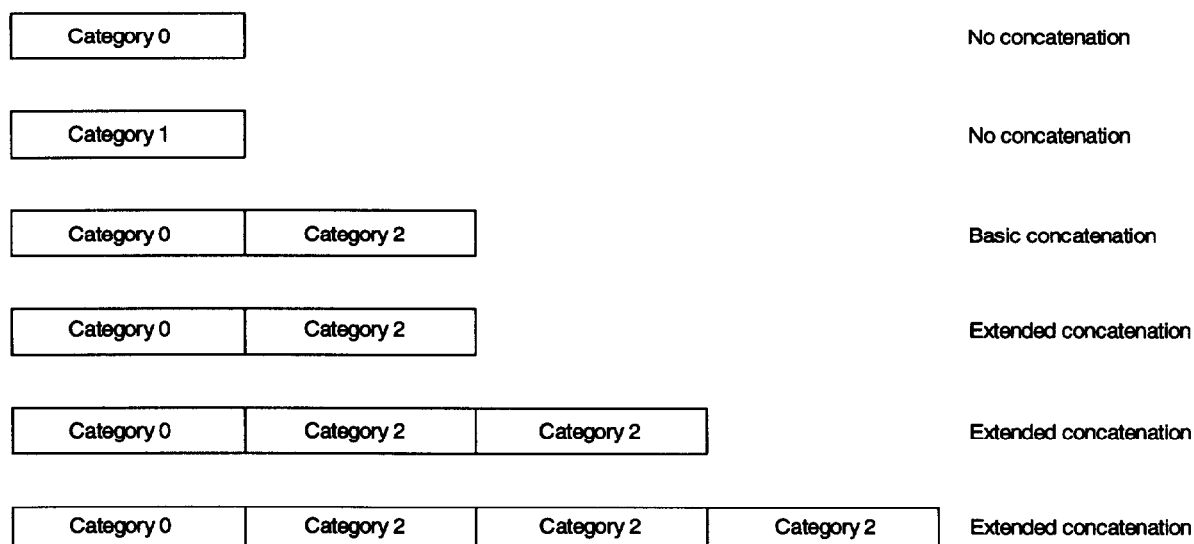
Any other concatenation of SPDUs is defined as invalid.

Table 6 – Category 0, 1 and 2 SPDUs

Category 0 SPDUs	Category 1 SPDUs	Category 2 SPDUs
GIVE TOKENS SPDU PLEASE TOKENS SPDU	CONNECT SPDU OVERFLOW ACCEPT SPDU CONNECT DATA OVERFLOW SPDU ACCEPT SPDU REFUSE SPDU FINISH SPDU DISCONNECT SPDU NOT FINISHED SPDU ABORT SPDU ABORT ACCEPT SPDU GIVE TOKENS CONFIRM SPDU GIVE TOKENS ACK SPDU PREPARE SPDU TYPED DATA SPDU	DATA TRANSFER SPDU MINOR SYNC POINT SPDU MINOR SYNC ACK SPDU MAJOR SYNC POINT SPDU MAJOR SYNC ACK SPDU RESYNCHRONIZE SPDU RESYNCHRONIZE ACK SPDU ACTIVITY START SPDU ACTIVITY RESUME SPDU ACTIVITY DISCARD SPDU ACTIVITY DISCARD ACK SPDU ACTIVITY INTERRUPT SPDU ACTIVITY INTERRUPT ACK SPDU ACTIVITY END SPDU ACTIVITY END ACK SPDU CAPABILITY DATA SPDU CAPABILITY DATA ACK SPDU EXCEPTION REPORT SPDU EXCEPTION DATA SPDU

Table 7 – Valid basic concatenation of SPDUs

First SPDU	Second SPDU
GIVE TOKENS SPDU	DATA TRANSFER SPDU
GIVE TOKENS SPDU PLEASE TOKENS SPDU	MINOR SYNC POINT SPDU MINOR SYNC ACK SPDU
GIVE TOKENS SPDU PLEASE TOKENS SPDU	MAJOR SYNC POINT SPDU MAJOR SYNC ACK SPDU
GIVE TOKENS SPDU ^{a)} PLEASE TOKENS SPDU	RESYNCHRONIZE SPDU RESYNCHRONIZE ACK SPDU
GIVE TOKENS SPDU PLEASE TOKENS SPDU	ACTIVITY START SPDU ACTIVITY RESUME SPDU
GIVE TOKENS SPDU ^{a)} PLEASE TOKENS SPDU	ACTIVITY DISCARD SPDU ACTIVITY DISCARD ACK SPDU
GIVE TOKENS SPDU ^{a)} PLEASE TOKENS SPDU	ACTIVITY INTERRUPT SPDU ACTIVITY INTERRUPT ACK SPDU
GIVE TOKENS SPDU PLEASE TOKENS SPDU	ACTIVITY END SPDU ACTIVITY END ACK SPDU
GIVE TOKENS SPDU ^{a)} PLEASE TOKENS SPDU	CAPABILITY DATA SPDU CAPABILITY DATA ACK SPDU
PLEASE TOKENS SPDU PLEASE TOKENS SPDU	EXCEPTION REPORT SPDU EXCEPTION DATA SPDU
^{a)} Indicates that the Token Item parameter is not present in the GIVE TOKENS SPDU. In all other cases, the Token Item parameter may or may not be present. In all cases, the Token Item parameter may only be present in the first SPDU if the second SPDU contains either a complete SSDU, or the last segment of a segmented SSDU. Basic concatenation of a PLEASE TOKENS SPDU or a GIVE TOKENS SPDU with a second SPDU is only permitted when the user data parameter is not present in the PLEASE TOKENS SPDU or the GIVE TOKENS SPDU.	



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Figure 2 – Illustration of TSDU structures

6.3.7.1 Processing order of concatenated SPDUs

On receipt of SPDUs that have been concatenated using basic concatenation, the category 2 SPDUs are processed before the category 0 SPDU.

On receipt, SPDUs that have been concatenated using extended concatenation are processed in the following order:

- a) ACTIVITY START SPDU; or
ACTIVITY RESUME SPDU;
- b) DATA TRANSFER SPDU;
- c) MINOR SYNC POINT SPDU; or
MINOR SYNC ACK SPDU; or
MAJOR SYNC POINT SPDU; or
MAJOR SYNC ACK SPDU; or
ACTIVITY END SPDU; or
ACTIVITY END ACK SPDU;
- d) GIVE TOKENS SPDU; or
PLEASE TOKENS SPDU.

Table 8 – Valid extended concatenation of SPDUs

First SPDU	Second SPDU	Third SPDU	Fourth SPDU	Status
GIVE TOKENS SPDU GIVE TOKENS SPDU	MINOR SYNC ACK SPDU MAJOR SYNC ACK SPDU			
GIVE TOKENS SPDU	ACTIVITY END ACK SPDU			
GIVE TOKENS SPDU GIVE TOKENS SPDU GIVE TOKENS SPDU ^{a)} GIVE TOKENS SPDU ^{a)} GIVE TOKENS SPDU ^{a)} GIVE TOKENS SPDU ^{a)}	ACTIVITY START SPDU ACTIVITY RESUME SPDU ACTIVITY START SPDU ACTIVITY RESUME SPDU ACTIVITY START SPDU ACTIVITY RESUME SPDU	MINOR SYNC POINT SPDU MINOR SYNC POINT SPDU ACTIVITY END SPDU ACTIVITY END SPDU MAJOR SYNC POINT SPDU MAJOR SYNC POINT SPDU		
GIVE TOKENS SPDU GIVE TOKENS SPDU GIVE TOKENS SPDU GIVE TOKENS SPDU	MINOR SYNC POINT SPDU MINOR SYNC ACK SPDU MAJOR SYNC POINT SPDU MAJOR SYNC ACK SPDU	DATA TRANSFER SPDU DATA TRANSFER SPDU DATA TRANSFER SPDU DATA TRANSFER SPDU		CL CL CL CL
GIVE TOKENS SPDU GIVE TOKENS SPDU	ACTIVITY START SPDU ACTIVITY RESUME SPDU	DATA TRANSFER SPDU DATA TRANSFER SPDU		CF CF
GIVE TOKENS SPDU GIVE TOKENS SPDU	ACTIVITY END SPDU ACTIVITY END ACK SPDU	DATA TRANSFER SPDU DATA TRANSFER SPDU		CL CL
GIVE TOKENS SPDU GIVE TOKENS SPDU GIVE TOKENS SPDU ^{a)} GIVE TOKENS SPDU ^{a)} GIVE TOKENS SPDU ^{a)} GIVE TOKENS SPDU ^{a)}	ACTIVITY START SPDU ACTIVITY RESUME SPDU ACTIVITY START SPDU ACTIVITY RESUME SPDU ACTIVITY START SPDU ACTIVITY RESUME SPDU	MINOR SYNC POINT SPDU MINOR SYNC POINT SPDU ACTIVITY END SPDU ACTIVITY END SPDU MAJOR SYNC POINT SPDU MAJOR SYNC POINT SPDU	DATA TRANSFER SPDU DATA TRANSFER SPDU DATA TRANSFER SPDU DATA TRANSFER SPDU DATA TRANSFER SPDU DATA TRANSFER SPDU	C C C C C C
^{a)} Indicates that the Token Item parameter is not present in the GIVE TOKENS SPDU. CL The DATA TRANSFER SPDU contains a complete SSDU or the last segment of an SSDU. CF The DATA TRANSFER SPDU contains a complete SSDU or the first segment of an SSDU. In the latter case, the Token Item parameter is not present in the GIVE TOKENS SPDU. C The DATA TRANSFER SPDU contains a complete SSDU.				

6.4 Use of transport expedited data

6.4.1 Purpose

To convey SPDUs on a separate transport flow.

6.4.2 Transport service primitives

The procedure uses the following transport service primitives:

- T-EXPEDITED-DATA request;
- T-EXPEDITED-DATA indication.

6.4.3 SPDUs used

The following SPDUs are sent on the transport expedited flow when it is available:

- ABORT SPDU (see 7.9);
- EXPEDITED DATA SPDU (see 7.12);
- PREPARE SPDU (see 7.26).

6.4.4 Description

The SPDUs listed in 6.4.3 are sent on the transport expedited flow if it is selected, and may be used to bypass any flow control restrictions or congestion on the transport normal flow. SPDUs sent on the transport expedited flow may be delivered to the accepting SS-user earlier than SSDUs submitted previously by the sending SS-user and sent on the transport normal flow, but no later than subsequently submitted SSDUs.

When the transport expedited flow is not available:

- a) EXPEDITED DATA SPDUs are not sent;
- b) ABORT SPDUs are sent on the transport normal flow;
- c) PREPARE SPDUs are not sent.

6.5 Flow control

There is no peer flow control in the session layer. To prevent the SS-users from being overloaded with data, the receiving SPM may apply back pressure across the transport connection, using the transport flow control. The decision on when or how back pressure is applied is a local matter.

6.6 Transport disconnection

6.6.1 Purpose

To release a transport connection.

6.6.2 Transport service primitives

The procedure uses the following transport service primitives:

- T-DISCONNECT request;
- T-DISCONNECT indication.

6.6.3 SPDUs used

No SPDUs are used.

6.6.4 Description

After the session connection has been released or aborted and the transport connection is not to be reused, the transport connection is disconnected.

When a T-DISCONNECT indication is received, as a result of an error detected by the transport service provider, the SPM issues an S-P-ABORT indication to the local SS-user.

When issuing a T-DISCONNECT request, the SPM may optionally use the T-DISCONNECT user data field to indicate the reason for the transport disconnection to the remote SPM. The reason code consists of one octet with the following values:

- a) 0 – Session protocol error for which an ABORT SPDU could not be sent.
- b) 1 – Normal transport disconnection when the transport connection is not to be reused.
- c) 2 – Normal transport disconnection when the transport connection was to be reused, but reuse is not possible for local reasons.

The use of the Disconnect Reason parameter in T-DISCONNECT indication is a local matter.

7 Elements of procedure related to SPDUs

This clause defines valid sequences of operation of the protocol.

A more precise definition of procedures is contained in Annex A which incorporates all the checks to determine the validity of a particular event at a particular point in time. In case of arbitration or dispute, Annex A takes precedence over this clause.

The elements of procedure specified in 7.4 to 7.8, 7.14 to 7.18, 7.20 to 7.25 and 7.28 to 7.36 do not consider the case where an SSDU is segmented. (The circumstances under which an SSDU may be segmented are specified in 6.3.5.) Additional elements of procedure for segmented SSDUs are specified in 7.37.

7.1 CONNECT SPDU

The CONNECT SPDU is transmitted by the initiator of the transport connection on a previously assigned transport connection in order to initiate a session connection.

7.1.1 Content of CONNECT SPDU

The CONNECT SPDU contains:

- a) A Connection Identifier parameter group, which is supplied by the calling SS-user, to enable the SS-users to identify this specific session connection. This parameter group has no effect on the SPM. It contains:
 - 1) a Calling SS-user Reference parameter;
 - 2) a Common Reference parameter;
 - 3) An Additional Reference Information parameter.
- b) A Connect/Accept Item parameter group containing:
 - 1) A Protocol Options parameter which enables the initiator to indicate its ability to receive extended concatenated SPDUs;
 - 2) A TSDU maximum size parameter which, if present and not zero, indicates the initiator's proposed values for the maximum TSDU sizes for each direction of transfer (see 5.8.6, 6.3.5). If this parameter is not present or is zero, the TSDU size is not limited.
 - 3) A Version Number parameter to identify all versions of this protocol which are supported and are suitable for this session connection.

NOTE – Protocol Version 1 is not suitable if there are more than 512 octets of SS-user data in this SPDU.

- 4) An Initial Serial Number parameter which is proposed by the calling SS-user in the case where the activity management functional unit is not proposed and any of the minor synchronize, symmetric synchronize, major synchronize, or resynchronize functional units are proposed. As an SS-user option, the Initial Serial Number parameter may be proposed even if the activity management

functional unit is proposed provided that any of the minor synchronize, symmetric synchronize, major synchronize or resynchronize functional units are also proposed. When the symmetric synchronize functional unit is proposed, the Initial Serial Number parameter is the proposed value of the First Initial Serial Number which is associated with the calling SS-user's sending direction of flow. This parameter is not present if the Upper Limit Serial Number parameter is present.

- 5) A Token Setting Item parameter supplied by the calling SS-user, which proposes the initial token positions for each token available on this connection, as derived from the functional units proposed in the Session User Requirements parameter (see Table 4). The initial token positions can be specified to be on the initiator's side or on the acceptor's side or the initiator can specify that the decision is to be made by the called SS-user.
- 6) A Second Initial Serial Number parameter which is proposed by the calling SS-user in the case where the activity management functional unit is not proposed and the symmetric synchronize functional unit is proposed. As an SS-user option, the Second Initial Serial Number parameter may be proposed even if the activity management functional unit is proposed provided that the symmetric synchronize functional unit is also proposed. The Second Initial Serial Number parameter proposes the serial number associated with the called SS-user's sending direction of flow. This parameter is not present if the Upper Limit Serial Number parameter is present.
- 7) An Upper Limit Serial Number parameter which can be proposed by the calling SS-user under the conditions where an Initial Serial Number can be proposed [see 7.1.1, b), 4)]. The Upper Limit Serial Number parameter is used to define the maximum value of the serial number. When the symmetric synchronize functional unit is proposed, the maximum value of the serial number applies to both directions of flow.
- 8) A Large Initial Serial Number parameter which can be proposed by the calling SS-user under the conditions where an Initial Serial Number can be proposed [see 7.1.1, b), 4)]. This parameter shall only be present if the Upper Limit Serial Number parameter is present.
- 9) A Large Second Initial Serial Number parameter which can be proposed by the calling SS-user under the conditions where a Second Initial Serial Number can be proposed [see 7.1.1, b), 4)]. This parameter shall only be present if the Upper Limit Serial Number parameter is present.
- c) A Session User Requirements parameter containing a list of the functional units proposed by the calling SS-user. At least one of the half-duplex and the duplex functional units shall be proposed. The SPM is required to provide the associated protocol functions.
- d) Calling Session Selector and Called Session Selector parameters corresponding to the calling SS-user and the called SS-user may be present and are derived from session addresses provided by the calling SS-user.
- e) Either:
 - 1) a User Data parameter which allows a limited (512 or less octets) amount of transparent user data to be passed from the calling SS-user to the called SS-user; or
 - 2) an Extended User Data parameter which allows between 513 and 10 240 octets of transparent user data to be passed from the calling SS-user to the called SS-user. This parameter shall not be present if Protocol Version 1 is proposed.

Only one of these two parameters may be used on the CONNECT SPDU.
- f) A Data Overflow parameter which shall be present if and only if there is more than 10 240 octets of SS-user data and which indicates to the responder that there is more SS-user data to follow. The first 10 240 octets of SS-user data are sent in the Extended User Data parameter. This parameter shall not be present if Protocol Version 1 is proposed.

7.1.2 Sending the CONNECT SPDU

An S-CONNECT request results in the assignment of a transport connection. When the transport connection is established, a CONNECT SPDU is sent on the transport normal flow. If the Data Overflow parameter was not present in the CONNECT SPDU, the SPM waits until it receives an ACCEPT SPDU or a REFUSE SPDU. If the Data Overflow parameter was present in the CONNECT SPDU, the SPM waits until it receives an OVERFLOW ACCEPT SPDU or a REFUSE SPDU.

7.1.3 Receiving the CONNECT SPDU

A valid incoming CONNECT SPDU which is acceptable to the receiving SPM and does not contain the Data Overflow parameter results in an S-CONNECT indication to an SS-user, according to the Called Session Selector parameter of the CONNECT SPDU. The SPM then waits for an S-CONNECT response from the called SS-user.

A valid incoming CONNECT SPDU which is acceptable to the receiving SPM, contains the Data Overflow parameter and provided that Protocol Version 2 is to be selected, results in the SPM sending an OVERFLOW ACCEPT SPDU; the SPM then waits until it receives a CONNECT DATA OVERFLOW SPDU. Otherwise the SPM sends a REFUSE SPDU (see 7.5).

7.2 OVERFLOW ACCEPT SPDU

The OVERFLOW ACCEPT SPDU is used by the SPM to request the remainder of the S-CONNECT request SS-user data. This SPDU shall not be used if Protocol Version 1 is proposed.

7.2.1 Content of the OVERFLOW ACCEPT SPDU

The OVERFLOW ACCEPT SPDU contains:

- a) A TSDU Maximum Size parameter which, if present and not zero indicates that segmenting has been proposed by the responder (see 6.3.5). The responder proposes alternative values for the maximum TSDU sizes for each direction of transfer (see 5.8.6). These values may be larger than, smaller than or equal to the values supplied by the initiator in the CONNECT SPDU. The smaller value for each direction of transfer is used for the maximum TSDU size for that direction of transfer.
- b) A Version Number parameter indicating that Protocol Version 2 is proposed (and selected).

7.2.2 Sending the OVERFLOW ACCEPT SPDU

A valid incoming CONNECT SPDU which contains the Data Overflow parameter results in the SPM sending an OVERFLOW ACCEPT SPDU. The SPM then waits until it receives a CONNECT DATA OVERFLOW SPDU.

7.2.3 Receiving the OVERFLOW ACCEPT SPDU

A valid incoming OVERFLOW ACCEPT SPDU results in the SPM sending one or more CONNECT DATA OVERFLOW SPDUs. When the last CONNECT DATA OVERFLOW SPDU has been sent, the SPM waits until it receives an ACCEPT SPDU or a REFUSE SPDU.

7.3 CONNECT DATA OVERFLOW SPDU

The CONNECT DATA OVERFLOW SPDU is used by the initiator to send subsequent segments of the User Data associated with an S-CONNECT request. This SPDU shall not be used if Protocol Version 1 has been selected.

7.3.1 Content of the CONNECT DATA OVERFLOW SPDU

The CONNECT DATA OVERFLOW SPDU contains:

- a) an Enclosure Item parameter to indicate whether the SPDU is the middle or the end of the SSDU;
- b) a User Data parameter which allows a maximum of 65 528 octets of transparent user data to be transferred.

7.3.2 Sending the CONNECT DATA OVERFLOW SPDU

A valid incoming OVERFLOW ACCEPT SPDU results in the SPM sending one or more CONNECT DATA OVERFLOW SPDUs. These SPDUs will be sent as an ordered sequence with the appropriate value for the Enclosure Item parameter until the complete SSDU has been transferred.

7.3.3 Receiving the CONNECT DATA OVERFLOW SPDU

A valid incoming CONNECT DATA OVERFLOW SPDU with Enclosure Item parameter indicating "end of SSDU" results in an S-CONNECT indication to pass the entire SSDU to the SS-user, according to the Called Session selector parameter of the CONNECT SPDU. The SPM then waits for an S-CONNECT response from the called SS-user.

If the Enclosure Item parameter in a valid incoming CONNECT DATA OVERFLOW SPDU indicates "not end of SSDU", the SPM waits for a subsequent valid CONNECT DATA OVERFLOW SPDU.

7.4 ACCEPT SPDU

An SPM receiving a CONNECT SPDU with the Data Overflow parameter absent may accept a proposal to establish a session connection by transferring an ACCEPT SPDU (after receiving an S-CONNECT response primitive) to the initiator, on the same transport connection.

An SPM which has previously issued an OVERFLOW ACCEPT SPDU in response to a CONNECT SPDU with the Data Overflow parameter present and which subsequently receives the sequence of CONNECT DATA OVERFLOW SPDUs which complete the segmented SSDU may accept a proposal to establish a session connection by transferring an ACCEPT SPDU (after receiving an S-CONNECT response primitive) to the initiator, on the same transport connection. An SPM receiving a CONNECT SPDU may accept a proposal to establish a session connection by transferring an ACCEPT SPDU to the initiator, on the same transport connection.

7.4.1 Content of ACCEPT SPDU

The ACCEPT SPDU contains:

- a) A Connection Identifier parameter group, which is supplied by the called SS-user, to enable the SS-users to identify this specific session connection. This parameter group has no effect on the SPM. It contains:
 - 1) a Called SS-user Reference parameter;
 - 2) a Common Reference parameter;
 - 3) an Additional Reference Information parameter.
- b) A Connect/Accept Item parameter group containing:
 - 1) A Protocol Options parameter which allows the responder to indicate its ability to receive extended concatenated SPDUs.
 - 2) A TSDU Maximum Size parameter which, if present and not zero, indicates the responder's proposed values for the maximum TSDU sizes for each direction of transfer (see 5.8.6 and 6.3.5). These values may be larger than, smaller than or equal to the values supplied by the initiator in the CONNECT SPDU. The smaller value is used for the maximum TSDU size for each direction of transfer. If an OVERFLOW ACCEPT SPDU has previously been sent on this session connection then:
 - i) if the TSDU Maximum Size parameter was present in the OVERFLOW ACCEPT SPDU, then it shall also be present in the ACCEPT SPDU, with the same values as were given in the OVERFLOW ACCEPT SPDU;
 - ii) if the TSDU Maximum Size parameter was not present in the OVERFLOW ACCEPT SPDU, then it shall not be present in the ACCEPT SPDU.
 - 3) A Version Number parameter to identify all versions of this protocol which are supported and are suitable for this session connection. The highest version number indicated by both initiator and responder is used. If an OVERFLOW ACCEPT SPDU has been previously sent on this session connection, then the Version Number parameter shall be present in the ACCEPT SPDU, with the same value as was given in the OVERFLOW ACCEPT SPDU.

NOTE 1 – Protocol Version 1 is not suitable if there are more than 512 octets of User Data in this SPDU.

- 4) An Initial Serial Number parameter which is present if the activity management functional unit is not selected and any of the minor synchronize, symmetric synchronize, major synchronize, or resynchronize functional units are selected regardless of whether or not the activity management functional unit is proposed. The called SS-user proposes the value, which is the value of the first serial number to be used. If the symmetric synchronize functional unit is selected, it is the value of the first serial number to be used on the calling SS-user's sending direction of flow. This parameter is not present if the Upper Limit Serial Number parameter is present.
- 5) A Token Setting Item parameter supplied by the called SS-user, which indicates the initial token positions for each token available on this session connection, as derived from the selected functional units. A token is only available if any functional unit which requires that token has been selected for use on this session connection (see Table 4), regardless of the settings of the Token Setting Item parameter in the CONNECT SPDU [see 7.1.1, b), 4)]. If a token-controlled functional unit has been selected, then in the case where the calling SS-user has indicated that the initial assignment of the related token is the called SS-user's choice, this parameter contains a value chosen by the called SS-user. Otherwise, the values indicated by the calling SS-user in the CONNECT SPDU are selected and shall be returned.
- 6) A Second Initial Serial Number parameter which is present if the activity management functional unit is not selected and the symmetric synchronize functional unit is selected regardless of whether or not the activity management functional unit is proposed. The called SS-user proposes the value, which is the value of the first serial number to be used on the called SS-user's sending direction of flow. This parameter is not present if the Upper Limit Serial Number parameter is present.

- 7) An Upper Limit Serial Number parameter which can be proposed by the called SS-user under the conditions where an Initial Serial Number can be proposed [see 7.4.1, b), 4)]. The Upper Limit Serial Number parameter is used to define the maximum value of the serial number. When the symmetric synchronize functional unit is proposed, the maximum value of the serial number applies to both directions of flow.
- 8) A Large Initial Serial Number parameter which can be proposed by the called SS-user under the conditions where an Initial Serial Number can be proposed [see 7.4.1, b), 4)]. This parameter shall only be present if the Upper Limit Serial Number parameter is present.
- 9) A Large Second Initial Serial Number parameter which can be proposed by the called SS-user under the conditions where a Second Initial Serial Number can be proposed [see 7.4.1, b), 4)]. This parameter shall only be present if the Upper Limit Serial Number parameter is present.
- c) A Token Item parameter which allows the called SS-user to request tokens which have been assigned to the calling SS-user in the CONNECT SPDU.
 NOTE 2 – This allows an implementation to convey a request for tokens in an ACCEPT SPDU, in the case when an S-CONNECT (accept) response is consecutively followed by an S-TOKEN-PLEASE request.
- d) A Session User Requirements parameter which contains a list indicating the functional units proposed by the called SS-user and can be supported by the responder. The functional units selected for use on this session connection are the intersection of this set and the set proposed in the CONNECT SPDU (i.e. only those functional units indicated in both the CONNECT SPDU and the ACCEPT SPDU are selected). If both the half-duplex functional unit and the duplex functional unit were indicated in the CONNECT SPDU, then the ACCEPT SPDU shall propose which one is to be available. If only one of these functional units was indicated in the CONNECT SPDU, then the ACCEPT SPDU shall indicate that the same functional unit is to be used (or the connection attempt must be rejected). If both the minor synchronize and the symmetric synchronize functional units were indicated in the CONNECT SPDU, then the ACCEPT SPDU shall propose at most one of these two functional units.
- e) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- f) A Calling Session Selector parameter corresponding to the calling SS-user may be present, in which case it will have the same value as in the CONNECT SPDU. A Responding Session Selector parameter corresponding to the called SS-user may be present and is derived from the Responding Session Address provided by the called SS-user.
- g) A User Data parameter which allows transparent user data to be passed from the called SS-user to the calling SS-user.

7.4.2 Sending the ACCEPT SPDU

An S-CONNECT (accept) response results in an ACCEPT SPDU. This SPDU is sent on the transport normal flow. After this successful connection, the SPM enters the data transfer phase and can receive any service request or SPDU that is allowed by the selected functional units and current token positions. If any of the minor synchronize, major synchronize or resynchronize functional units are selected but the symmetric synchronize functional unit is not selected and the activity management functional unit is not selected, the SPM sets V(A) and V(M) to the Initial Serial Number proposed by the called SS-user, which is the serial number to be used for the first synchronization point. V(R) is set to zero. Vsc is set false.

If the symmetric synchronize functional unit is selected but the activity management functional unit is not selected, the SPM sets V(Ar) and V(Mr) to the Initial Serial Number proposed by the called SS-user, which is the serial number to be used for the first received synchronization point. The SPM sets V(As) and V(Ms) to the Second Initial Serial Number proposed by the called SS-user, which is the serial number to be used for the first synchronization point to be sent. V(Rs) and V(Rr) are set to zero.

If the activity management functional unit has been selected, Vact is set false.

7.4.3 Receiving the ACCEPT SPDU

A valid incoming ACCEPT SPDU results in an S-CONNECT (accept) confirm. After this successful connection, the SPM enters the data transfer phase and can receive any service request or SPDU that is allowed by the selected functional units and current token positions. If any of the minor synchronize, major synchronize or resynchronize functional units are selected but the symmetric synchronize functional unit is not selected and the activity management functional unit is not selected, the SPM sets V(A) and V(M) to the Initial Serial Number contained in the ACCEPT SPDU, which is the serial number to be used for the first synchronization point. V(R) is set to zero. Vsc is set false.

If the symmetric synchronize functional unit is selected but the activity management functional unit is not selected, the SPM sets V(As) and V(Ms) to the Initial Serial Number contained in the ACCEPT SPDU, which is the serial number to be used for the first synchronization point to be sent. The SPM sets V(Ar) and V(Mr) to the Second Initial Serial Number contained in the ACCEPT SPDU, which is the serial number to be used for the first received synchronization point. V(Rs) and V(Rr) are set to zero.

If the activity management functional unit has been selected, Vact is set false.

If the ACCEPT SPDU contains the Token Item Parameter [see 7.4.1, c)], this shall be regarded by the SPM as if an ACCEPT SPDU had been received, followed by a PT SPDU. Therefore, when the Token Item parameter is present in the ACCEPT SPDU, an S-CONNECT (accept) confirm is followed by an S-TOKEN-PLEASE indication.

7.5 REFUSE SPDU

A REFUSE SPDU is used by the responder to reject an attempt to establish a session connection.

7.5.1 Content of REFUSE SPDU

The REFUSE SPDU contains:

- a) A Connection Identifier parameter group, which is supplied by the called SS-user, to enable the SS-users to identify this specific session connection. This parameter group has no effect on the SPM. It contains:
 - 1) a Called SS-user Reference parameter;
 - 2) a Common Reference parameter;
 - 3) an Additional Reference Information parameter.
- b) A Transport Disconnect parameter which indicates whether or not the transport connection is to be kept.
- c) A Session User Requirements parameter which contains a list of the functional units supported by the sending SPM, and required by the called SS-user.
- d) A Version Number parameter to identify which versions of this protocol have been implemented by the sending SPM.
- e) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- f) A Reason Code parameter giving the reason for refusal of the attempt to establish a session connection, together with transparent user data.

7.5.2 Sending the REFUSE SPDU

An S-CONNECT (reject) response results in a REFUSE SPDU. This SPDU is sent on the transport normal flow. No session connection is established. If the Transport Disconnect parameter indicates that the transport connection can be reused, the SPM waits for a CONNECT SPDU. Otherwise, the SPM starts the timer, TIM, and waits for a T-DISCONNECT indication. If the timer expires before receipt of a T-DISCONNECT indication, the SPM requests transport disconnection with a T-DISCONNECT request. The timer is cancelled on receipt of a T-DISCONNECT indication.

NOTE – The value of TIM is a local implementation dependent matter, related to Quality of Service.

7.5.3 Receiving the REFUSE SPDU

A valid incoming REFUSE SPDU results in an S-CONNECT (reject) confirm with the Responding Session Address parameter set to the value of the Called Session Address provided in the S-CONNECT request. No session connection is established. If the Transport Disconnect parameter indicates that retention of the transport connection has been requested by the called SPM, and this is acceptable to the calling SPM, the SPM waits for an S-CONNECT request. Otherwise, the SPM releases the transport connection, by making a T-DISCONNECT request.

7.6 FINISH SPDU

Orderly release is initiated by transfer of a FINISH SPDU, which may be transferred during the data transfer phase. It requests as a response either:

- a) a DISCONNECT SPDU to complete the release of the session connection; or
- b) a NOT FINISHED SPDU to refuse the release of the session connection if the release token is available.

The FINISH SPDU is transferred in sequence with any normal data being transferred. The right to issue a FINISH SPDU is restricted to the owner of all available tokens.

7.6.1 Content of FINISH SPDU

The FINISH SPDU contains:

- a) A Transport Disconnect parameter which indicates whether or not the transport connection is to be kept, subject to the restrictions specified in 6.2.4.
- b) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- c) A User Data parameter which allows transparent user data to be transferred.

7.6.2 Sending the FINISH SPDU

An S-RELEASE request results in a FINISH SPDU. This SPDU is sent on the transport normal flow. After transferring a FINISH SPDU, the SPM may not send any further SPDUs (except ABORT SPDU or, in the case of collision of FINISH SPDUs, a DISCONNECT SPDU) unless a NOT FINISHED SPDU or a RESYNCHRONIZE SPDU is received, after which the data transfer phase may be resumed. Receipt of a DISCONNECT SPDU signals completion of orderly session release.

7.6.3 Receiving the FINISH SPDU

A valid incoming FINISH SPDU results in an S-RELEASE indication. The user data is passed to the SS-user. The SPM waits for an S-RELEASE response.

7.7 DISCONNECT SPDU

After receipt of a FINISH SPDU, a DISCONNECT SPDU may be transferred. Receipt of a DISCONNECT SPDU after transferring a FINISH SPDU signals the orderly release of the session connection. The DISCONNECT SPDU is transferred in sequence with any normal data being transferred.

7.7.1 Content of DISCONNECT SPDU

The DISCONNECT SPDU contains:

- a) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- b) A User Data parameter which allows transparent user data to be transferred.

7.7.2 Sending the DISCONNECT SPDU

An S-RELEASE (accept) response results in a DISCONNECT SPDU. This SPDU is sent on the transport normal flow. The session connection ceases to exist.

If the FINISH SPDU indicated that the transport connection is to be kept for reuse, and this is acceptable, the SPM waits for a CONNECT SPDU. Otherwise, the SPM starts the timer, TIM, and waits for a T-DISCONNECT indication. If the timer expires before receipt of a T-DISCONNECT indication, the SPM requests transport disconnection with a T-DISCONNECT request. The timer is cancelled on receipt of a T-DISCONNECT indication.

NOTE – The value of TIM is a local implementation dependent matter, related to Quality of Service.

7.7.3 Receiving the DISCONNECT SPDU

A valid incoming DISCONNECT SPDU results in an S-RELEASE (accept) confirm. The session connection ceases to exist.

If the transport connection is to be kept for reuse (see 6.2.4), the SPM waits for a suitable S-CONNECT request. Otherwise, a T-DISCONNECT request is issued.

NOTES

1 In the case of collision of FINISH SPDU and ABORT SPDU (see 7.9), the ABORT SPDU takes preference and thus the indication in the FINISH SPDU to keep or release the transport connection is ignored.

2 In the case of collision of FINISH SPDUs (data token and release token not available), the transport connection cannot be reused. The SPM receiving the DISCONNECT SPDU issues a T-DISCONNECT request.

7.8 NOT FINISHED SPDU

After receipt of a FINISH SPDU, a NOT FINISHED SPDU may be transferred subject to the token restrictions specified in Table 5. No confirmation is sought.

7.8.1 Content of NOT FINISHED SPDU

The NOT FINISHED SPDU contains:

- a) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- b) A User Data parameter which allows transparent user data to be transferred.

7.8.2 Sending the NOT FINISHED SPDU

An S-RELEASE (reject) response results in a NOT FINISHED SPDU. This SPDU is sent on the transport normal flow. The SPM remains in the data transfer phase and can receive any service request or SPDU that is allowed by the available functional units and current token positions.

7.8.3 Receiving the NOT FINISHED SPDU

A valid incoming NOT FINISHED SPDU results in an S-RELEASE (reject) confirm. The SPM remains in the data transfer phase and can receive any service request or SPDU that is allowed by the available functional units and current token positions.

7.9 ABORT SPDU

The ABORT SPDU is used to reject a session connection establishment attempt, or to cause abnormal release of a session connection at any time. This SPDU is also used by an SPM to release the session connection when a protocol error is detected. The ABORT SPDU may or may not request that the transport connection be released by the receiving SPM. Use of the ABORT SPDU may result in loss of data.

7.9.1 Content of ABORT SPDU

7.9.1.1 If there is no SSDU or segmenting of the SSDU is not required (see 6.3.5), the ABORT SPDU contains:

- a) a Transport Disconnect parameter which indicates whether or not the transport connection is to be kept;
- b) a Reflect Parameter Values parameter which, if present, allows implementation defined information to be transferred;
- c) a User Data parameter which, if present, allows transparent user data to be transferred.

7.9.1.2 If the SSDU is to be segmented, the first ABORT SPDU contains:

- a) a Transport Disconnect parameter which indicates whether or not the transport connection is to be kept;
- b) an Enclosure Item parameter which indicates that this SPDU is the beginning of the SSDU and not the end of the SSDU;
- c) a User Data parameter which allows transparent user data to be transferred.

The second and any subsequent ABORT SPDUs in the sequence of ABORT SPDUs transmitting the SSDU contain:

- d) an Enclosure Item parameter to indicate whether the SPDU is the middle or end of the SSDU;
- e) a User Data parameter which allows transparent user data to be transferred.

7.9.2 Sending the ABORT SPDU

An S-U-ABORT request or the detection of a protocol error in any state of the SPM results in either a single ABORT SPDU or, if the SSDU provided in the S-U-ABORT request is to be segmented (see 6.3.5), a sequence of ABORT SPDUs, which shall not be interrupted.

If the SS-user data does not exceed 9 octets, the ABORT SPDU is sent on the transport expedited flow, if it is available to this session connection. If the transport expedited flow is not available to this session connection, this SPDU is sent on the transport normal flow.

If the SS-user data exceeds 9 octets, the SPDU or sequence of SPDUs are sent on the transport normal flow. If the transport expedited flow is available to this session connection, a PREPARE (ABORT) SPDU is sent on the transport expedited flow simultaneously, or earlier than, the first, or only, ABORT SPDU.

The SPM starts the timer, TIM, and waits for an ABORT ACCEPT SPDU or a T-DISCONNECT indication. Any other SPDUs are discarded. If the timer expires before receipt of an ABORT ACCEPT SPDU or a T-DISCONNECT indication, the SPM shall request transport disconnection with a T-DISCONNECT request. On receipt of a T-DISCONNECT indication, the timer is cancelled.

NOTE – The value of TIM is a local implementation dependent matter, related to Quality of Service.

7.9.3 Receiving the ABORT SPDU

A valid incoming ABORT SPDU, without an Enclosure Item parameter, or an Enclosure item parameter indicating “end of SSDU” results in an S-U-ABORT indication or an S-P-ABORT indication, depending on whether the abort is user generated or provider generated. The session connection ceases to exist. If the Transport Disconnect parameter in the received ABORT SPDU indicates that the transport connection is to be kept for reuse and this is acceptable to the receiving SPM, an ABORT ACCEPT SPDU is sent. If the Transport Disconnect parameter in the received ABORT SPDU indicates that the transport connection is not to be kept for reuse or reuse of the transport connection is not acceptable to the receiving SPM, the receiving SPM either:

- a) releases the transport connection; or
- b) if the transport expedited flow is not available to this session connection, sends an ABORT ACCEPT SPDU (see 7.10).

Receiving an ABORT SPDU sent in response to a CONNECT SPDU results in:

- a) a T-DISCONNECT request, unless retention of the transport connection has been requested in the ABORT SPDU, in which case the ABORT SPDU is acknowledged with an ABORT ACCEPT SPDU (see 7.10); and
- b) an S-P-ABORT indication or an S-U-ABORT indication to the SS-user.

7.10 ABORT ACCEPT SPDU

The ABORT ACCEPT SPDU is used to return a confirmation to the ABORT SPDU when the transport expedited flow is not available to this session connection.

7.10.1 Content of ABORT ACCEPT SPDU

The ABORT ACCEPT SPDU contains no parameters.

7.10.2 Sending the ABORT ACCEPT SPDU

A valid incoming ABORT SPDU results in sending an ABORT ACCEPT SPDU, when the transport connection can be reused, i.e. when:

- a) the transport expedited service is not available to this session connection; and
- b) retention of the transport connection has been requested in the ABORT SPDU and it is acceptable to reuse the transport connection.

The SPM, as a local implementation decision, may send an ABORT ACCEPT SPDU in response to an ABORT SPDU, even if the transport connection is not to be kept, provided that the transport expedited flow is not available to this session connection.

This SPDU is sent on the transport normal flow. The session connection ceases to exist.

7.10.3 Receiving the ABORT ACCEPT SPDU

A valid incoming ABORT ACCEPT SPDU results in resetting the timer, TIM, and:

- a) releasing the transport connection, if release of the transport connection was requested in the previously sent ABORT SPDU;
- b) if retention of the transport connection was requested, the transport connection is now available for reuse by a new session connection, if this SPM was the initiator of the transport connection (see 6.1).

The session connection ceases to exist.

7.11 DATA TRANSFER SPDU

Normal data is transferred by use of the DATA TRANSFER SPDU. If the extended concatenation option was selected during connection establishment, certain concatenations of the DATA TRANSFER SPDU with other SPDUs is allowed (see 6.3.7).

The right to issue a DATA TRANSFER SPDU is subject to the token restrictions specified in Table 5.

7.11.1 Content of DATA TRANSFER SPDU

The DATA TRANSFER SPDU contains:

- a) An Enclosure Item parameter to indicate the beginning and end of SSDU when segmenting has been selected. When segmenting has been selected, the Enclosure Item parameter is always present and indicates whether the SPDU is the beginning, middle or end of the SSDU. When segmenting has not been selected, the Enclosure Item parameter is not present.
- b) A User Information Field to transfer transparent user data whose maximum size is unlimited when segmenting has not been selected and whose maximum size is limited by the maximum TSDU size when segmenting has been selected.

7.11.2 Sending the DATA TRANSFER SPDU

An S-DATA request results in a DATA TRANSFER SPDU unless segmenting has been selected, in which case an ordered sequence of DATA TRANSFER SPDUs will be sent with the appropriate value for the Enclosure Item parameter until the complete SSDU has been transferred.

The concatenation of any segment of an SSDU with any other SPDU will not result in a TSDU larger than the selected maximum TSDU size for that direction of transfer. However, there is no requirement that the resulting TSDU should be of the maximum size for that direction of transfer. All DATA TRANSFER SPDUs, except the last DATA TRANSFER SPDU in a sequence greater than one, must have user information. DATA TRANSFER SPDUs are sent on the transport normal flow.

Sending a segmented SSDU shall be interrupted when the SPM which is sending the segmented SSDU sends or receives one of:

- RESYNCHRONIZE SPDU;
- EXCEPTION REPORT SPDU;
- EXCEPTION DATA SPDU;
- ACTIVITY INTERRUPT SPDU;
- ACTIVITY DISCARD SPDU;
- ABORT SPDU;
- PREPARE (RESYNCHRONIZE) SPDU;
- PREPARE (ABORT) SPDU;

or receives a T-DISCONNECT indication. This will have a destructive effect on the entire SSDU. The SPM is not required to send the remainder of the ordered sequence of SPDUs which comprise the segmented SSDU (but may do so if it wishes).

7.11.3 Receiving the DATA TRANSFER SPDU

A valid incoming DATA TRANSFER SPDU results in an S-DATA indication unless segmenting has been selected. In this case, a valid incoming DATA TRANSFER SPDU, which indicates end of SSDU, results in an S-DATA indication to pass the entire SSDU to the SS-user.

Receiving a segmented SSDU shall be interrupted when the SPM which is receiving the segmented SSDU sends or receives one of:

- RESYNCHRONIZE SPDU;
- EXCEPTION REPORT SPDU;

- EXCEPTION DATA SPDU;
- ACTIVITY INTERRUPT SPDU;
- ACTIVITY DISCARD SPDU;
- ABORT SPDU;
- PREPARE (RESYNCHRONIZE) SPDU,

or receives a T-DISCONNECT indication. This will have a destructive effect on the entire SSDU (i.e. the SPDUs comprising part of the segmented SSDU which have already been received are discarded, and any SPDUs comprising part of the segmented SSDU which are received subsequently are discarded).

It is also valid to receive EXPEDITED SPDUs and PREPARE (MAJOR SYNC ACK) SPDUs and this has no effect on the segmented SSDU being received.

The receipt of any other SPDUs is a protocol error.

7.12 EXPEDITED SPDU

The EXPEDITED SPDU is used to transfer expedited SSDUs.

The right to send expedited data is not associated with any tokens. When this functional unit is selected, both SS-users may send expedited data. An expedited SSDU may be delivered to the receiving SS-user prior to other SSDUs previously transferred on the transport normal flow; it may not be delivered to the receiving SS-user later than any SSDUs transferred after it.

Expedited SSDUs are delivered to the receiving SS-user in the same sequence in which they were issued by the sending SS-user.

7.12.1 Content of EXPEDITED SPDU

The EXPEDITED SPDU contains a User Information Field which allows a limited amount of transparent user data to be transferred.

7.12.2 Sending the EXPEDITED SPDU

An S-EXPEDITED-DATA request results in an EXPEDITED SPDU being sent. This SPDU is sent on the transport expedited flow.

7.12.3 Receiving the EXPEDITED SPDU

A valid incoming EXPEDITED SPDU results in an S-EXPEDITED-DATA indication.

7.13 TYPED DATA SPDU

The TYPED DATA SPDU enables the SS-users to transmit transparent user data, irrespective of the availability or assignment of the data token. In all other respects, the same constraints apply as for normal data (see 7.11). The same rules for segmenting also apply.

7.13.1 Content of TYPED DATA SPDU

The TYPED DATA SPDU contains:

- a) An Enclosure Item parameter to indicate the beginning and end of SSDU when segmenting has been selected. When segmenting has been selected, the Enclosure Item parameter is always present and indicates whether the SPDU is the beginning, middle or end of the SSDU. When segmenting has not been selected, the Enclosure Item parameter is not present.
- b) A User Information Field to transfer transparent user data whose maximum size is unlimited when segmenting has not been selected and whose maximum size is limited by the maximum TSDU size when segmenting has been selected.

7.13.2 Sending the TYPED DATA SPDU

An S-TYPED-DATA request results in the transfer of a TYPED DATA SPDU unless segmenting has been selected, in which case an ordered sequence of TYPED DATA SPDUs will be sent with the appropriate value for the Enclosure Item parameter until the complete SSDU has been transferred. Each SPDU is mapped onto one TSDU and will not be larger than the selected maximum TSDU size for that direction of transfer. However, there is no requirement that the resulting TSDU should be of the maximum size for that direction of transfer. All TYPED DATA SPDUs, except the last TYPED DATA SPDU in a sequence greater than one, must have user information. TYPED DATA SPDUs are sent on the transport normal flow. When segmenting has been selected the rules governing the sending or receipt of SPDUs other than TYPED DATA SPDUs, while sending a segmented TYPED DATA SSDU are the same as for the DATA TRANSFER SPDU (see 7.11.2).

7.13.3 Receiving the TYPED DATA SPDU

A valid incoming TYPED DATA SPDU results in an S-TYPED-DATA indication, unless segmenting has been selected. In this case, a valid incoming TYPED DATA SPDU which indicates end of SSDU results in an S-TYPED-DATA indication to pass the entire SSDU to the SS-user. The current state of the SPM is not changed.

When segmenting has been selected the rules governing the sending or receipt of SPDUs other than TYPED DATA SPDUs, while receiving a segmented TYPED DATA SSDU are the same as for the DATA TRANSFER SPDU (see 7.11.3).

7.14 CAPABILITY DATA SPDU

The CAPABILITY DATA SPDU is used to transfer transparent user data outside activities (i.e. when the activity management functional unit has been selected and Vact is false). The right to send this SPDU is restricted to the side having the right to start the next activity (i.e. the activity management functional unit has been selected and Vact is false and subject to the token restrictions specified in Table 5).

7.14.1 Content of CAPABILITY DATA SPDU

The CAPABILITY DATA SPDU contains:

- a) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- b) A User Data parameter which allows transparent user data to be transferred.

7.14.2 Sending the CAPABILITY DATA SPDU

An S-CAPABILITY-DATA request results in a CAPABILITY DATA SPDU being sent. This SPDU is sent on the transport normal flow. The SS-user is not permitted to issue a further S-CAPABILITY-DATA request until this CAPABILITY DATA SPDU is acknowledged.

7.14.3 Receiving the CAPABILITY DATA SPDU

A valid incoming CAPABILITY DATA SPDU results in an S-CAPABILITY-DATA indication to the SS-user.

7.15 CAPABILITY DATA ACK SPDU

The CAPABILITY DATA ACK SPDU is used to complete the capability data exchange.

7.15.1 Content of CAPABILITY DATA ACK SPDU

The CAPABILITY DATA ACK SPDU contains:

- a) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- b) A User Data parameter which allows transparent user data to be transferred.

7.15.2 Sending the CAPABILITY DATA ACK SPDU

The SS-user generates an S-CAPABILITY-DATA response which results in a CAPABILITY DATA ACK SPDU. This SPDU is sent on the transport normal flow.

7.15.3 Receiving the CAPABILITY DATA ACK SPDU

A valid incoming CAPABILITY DATA ACK SPDU results in an S-CAPABILITY-DATA confirm. This allows the SS-user to issue a further S-CAPABILITY-DATA request.

7.16 GIVE TOKENS SPDU

The GIVE TOKENS SPDU is used:

- a) to introduce a concatenated sequence of SPDUs; and/or
- b) to cause assignment of currently owned tokens to be changed.

If the GIVE TOKENS SPDU does not contain any parameter fields, it is used to indicate concatenation without assignment of tokens and, in this case, the sending and receiving procedures do not apply.

7.16.1 Content of GIVE TOKENS SPDU

The GIVE TOKENS SPDU contains:

- a) A Token Item parameter which indicates which tokens are being transferred from the sending SS-user to the receiving SS-user;
- b) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected;
- c) A User Data parameter which allows transparent user data to be transferred. This parameter shall not be present if either:
 - 1) Protocol Version 1 is selected; or
 - 2) the GIVE TOKENS SPDU is being used to introduce a concatenated sequence of SPDUs.

7.16.2 Sending the GIVE TOKENS SPDU

An S-TOKEN-GIVE request results in a GIVE TOKENS SPDU. This SPDU is sent on the transport normal flow.

7.16.3 Receiving the GIVE TOKENS SPDU

A valid incoming GIVE TOKENS SPDU results in an S-TOKEN-GIVE indication.

7.17 PLEASE TOKENS SPDU

The PLEASE TOKENS SPDU is used:

- a) to introduce a concatenated sequence of SPDUs; and/or
- b) to request that the token assignments be changed to permit the requestor to be authorized to perform a function associated with the requested tokens.

If the PLEASE TOKENS SPDU does not contain any parameter fields, it is used to indicate concatenation without requesting tokens and, in this case, the sending and receiving procedures do not apply.

7.17.1 Content of PLEASE TOKENS SPDU

The PLEASE TOKENS SPDU contains:

- a) A Token Item parameter which indicates which tokens are being requested by the sending SS-user.
- b) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- c) A User Data parameter which allows transparent user data to be transferred. This parameter shall not be present if the PLEASE TOKENS SPDU is being used to introduce a concatenated sequence of SPDUs.

7.17.2 Sending the PLEASE TOKENS SPDU

An S-TOKEN-PLEASE request results in a PLEASE TOKENS SPDU. This SPDU is sent on the transport normal flow.

7.17.3 Receiving the PLEASE TOKENS SPDU

A valid incoming PLEASE TOKENS SPDU results in an S-TOKEN-PLEASE indication. Receiving a PLEASE TOKENS SPDU for tokens which are not currently assigned to the accepting SS-user is not a protocol error.

7.18 GIVE TOKENS CONFIRM SPDU

The GIVE TOKENS CONFIRM SPDU is used as a result of an S-CONTROL-GIVE request to cause assignment of all of the currently assigned tokens to be changed when Vact is false. Receipt of the GIVE TOKENS CONFIRM SPDU by the receiving SPM is acknowledged by the GIVE TOKENS ACK SPDU.

7.18.1 Content of GIVE TOKENS CONFIRM SPDU

The GIVE TOKENS CONFIRM SPDU contains:

- a) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- b) A User Data parameter which allows transparent user data to be transferred. This parameter shall not be present if Protocol Version 1 is selected.

7.18.2 Sending the GIVE TOKENS CONFIRM SPDU

An S-CONTROL-GIVE request when Vact is false results in a GIVE TOKENS CONFIRM SPDU. The SPM then waits for a GIVE TOKENS ACK SPDU before permitting further SPDUs, associated with the available tokens, to be sent or received. SPDUs not associated with tokens (e.g. TYPED DATA SPDU) may be sent or received as normal. This SPDU is sent on the transport normal flow.

7.18.3 Receiving the GIVE TOKENS CONFIRM SPDU

A valid incoming GIVE TOKENS CONFIRM SPDU results in an S-CONTROL-GIVE indication, followed by a GIVE TOKENS ACK SPDU.

7.19 GIVE TOKENS ACK SPDU

The GIVE TOKENS ACK SPDU is used to acknowledge receipt of a GIVE TOKENS CONFIRM SPDU. The GIVE TOKENS ACK SPDU can only be sent when Vact is false.

7.19.1 Content of GIVE TOKENS ACK SPDU

The GIVE TOKENS ACK SPDU contains no parameters.

7.19.2 Sending the GIVE TOKENS ACK SPDU

A valid incoming GIVE TOKENS CONFIRM SPDU results in a GIVE TOKENS ACK SPDU (see also 7.18.3). The SPM may now transmit SPDUs associated with the token controlled functional units. This SPDU is sent on the transport normal flow.

7.19.3 Receiving the GIVE TOKENS ACK SPDU

After receiving a valid incoming GIVE TOKENS ACK SPDU, the SPM is now prepared to receive any SPDUs associated with the token controlled functional units.

7.20 MINOR SYNC POINT SPDU

The MINOR SYNC POINT SPDU is used to define a minor synchronization point. When the symmetric synchronize functional unit has been selected, the MINOR SYNC POINT SPDU is used to define a minor synchronization point on one direction of data flow. A confirmation may be returned by the receiver but is not required by the SPM (see 7.21). All acknowledgement rules are defined by the SS-users. In particular, whether confirmation is requested or not is transparent to the SPM. The right to issue a MINOR SYNC POINT SPDU is subject to the token restrictions specified in Table 5.

The serial numbers are managed by the SS-provider and given to the SS-user. The right to issue a MINOR SYNC POINT SPDU is not subject to any token restrictions with the symmetric synchronize functional unit.

7.20.1 Content of MINOR SYNC POINT SPDU

The MINOR SYNC POINT SPDU contains:

- a) A Sync Type Item parameter which is used to indicate:
 - 1) if an explicit confirmation is required (see 7.21);
 - 2) if data separation is requested.
- b) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- c) A Serial Number parameter which indicates the serial number of this minor synchronization point. This parameter is set by the sending SPM to the current value of $V(M_s)$ when symmetric synchronize functional unit has been selected, and to the current value of $V(M)$ when the symmetric synchronize functional unit has not been selected.
- d) A User Data parameter which allows transparent user data to be transferred.

7.20.2 Sending the MINOR SYNC POINT SPDU

An S-SYNC-MINOR request results in a MINOR SYNC POINT SPDU. This SPDU is sent on the transport normal flow. When the symmetric synchronize functional unit has been selected, $V(M_s)$ is incremented by one. When the symmetric synchronize functional unit is not selected, variables are processed as follows. If V_{sc} is true, $V(A)$ is set equal to $V(M)$ and V_{sc} is set false. If the Sync Type parameter has the value "data separation", $V(Ado)$ is set to $V(M)$. $V(M)$ is incremented by one.

7.20.3 Receiving the MINOR SYNC POINT SPDU

A valid incoming MINOR SYNC POINT SPDU results in an S-SYNC-MINOR indication. When the symmetric synchronize functional unit has been selected, $V(M_r)$ is incremented by one. When the symmetric synchronize functional unit is not selected, variables are processed as follows. If V_{sc} is false, $V(A)$ is set equal to $V(M)$ and V_{sc} is set true. $V(M)$ is incremented by one.

7.21 MINOR SYNC ACK SPDU

The MINOR SYNC ACK SPDU is used to return a confirmation to minor synchronization points. The SPM sends a MINOR SYNC ACK SPDU for each S-SYNC-MINOR response. When the symmetric synchronize functional unit has been selected, the local variable V_{sc} is not defined and its associated restrictions do not apply.

7.21.1 Content of MINOR SYNC ACK SPDU

The MINOR SYNC ACK SPDU contains:

- a) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- b) A Serial Number parameter, provided by the SS-user which indicates the serial number of the minor synchronization point which is being confirmed.
- c) A User Data parameter which allows transparent user data to be transferred.

7.21.2 Sending the MINOR SYNC ACK SPDU

A valid S-SYNC-MINOR response results in sending a MINOR SYNC ACK SPDU. When the symmetric synchronize functional unit has been selected, the serial number is greater than or equal to $V(A_r)$ and less than $V(M_r)$; the SPM sets $V(A_r)$ equal to the serial number plus one. When the symmetric synchronize functional unit has not been selected, V_{sc} is true and the serial number is greater than or equal to $V(A)$ and less than $V(M)$; the SPM sets $V(A)$ equal to the serial number plus one. The MINOR SYNC ACK SPDU is sent on the transport normal flow.

7.21.3 Receiving the MINOR SYNC ACK SPDU

A valid incoming MINOR SYNC ACK SPDU results in an S-SYNC-MINOR confirm. When the symmetric synchronize functional unit has been selected, the received serial number is greater than or equal to $V(A_s)$ and less than $V(M_s)$; the SPM sets $V(A_s)$ equal to the received serial number plus one. When the symmetric synchronize functional unit has not been selected, V_{sc} is false and the received serial number is greater than or equal to $V(A)$ and less than $V(M)$; the SPM sets $V(A)$ equal to the received serial number plus one.

7.22 MAJOR SYNC POINT SPDU

The MAJOR SYNC POINT SPDU is used to define a major synchronization point. A confirmation has to be received before more data can be sent on the normal and expedited flows. The right to issue a MAJOR SYNC POINT SPDU is subject to the token restrictions specified in Table 5.

If the symmetric synchronize functional unit has been selected, a major synchronization point is defined by two correlated serial numbers, one for each direction of data flow. One serial number is defined by the MAJOR SYNC POINT SPDU; this number is associated with the sending data flow of the requestor of the major synchronization point. The other serial number is defined in the MAJOR SYNC ACK SPDU. This number is associated with the receiving data flow of the requestor of the major synchronization point. Together these two serial numbers completely separate the data flow before and after the major synchronization point. Both serial numbers are managed by the SS-provider and given to the SS-user.

7.22.1 Content of MAJOR SYNC POINT SPDU

The MAJOR SYNC POINT SPDU contains:

- a) A Sync Type Item parameter which is only present when indicating that this major synchronization point is not the end of the current activity.
- b) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- c) A Serial Number parameter which indicates the serial number of this major synchronization point. When the symmetric synchronize functional unit has been selected, this parameter indicates the First Serial Number, which is associated with the sending flow of the requestor of the major synchronization point, and is set by the sending SPM to the current value of $V(M_s)$. It is set to the current value of $V(M)$ when the symmetric synchronize functional unit has not been selected.
- d) A User Data parameter which allows transparent user data to be transferred.

7.22.2 Sending the MAJOR SYNC POINT SPDU

An S-SYNC-MAJOR request results in a MAJOR SYNC POINT SPDU. This SPDU is sent on the transport normal flow. If the symmetric synchronize functional unit has been selected, $V(M_s)$ is incremented by one. Otherwise, V_{sc} , $V(A)$, and $V(M)$ are updated as follows. If V_{sc} is true, $V(A)$ is set equal to $V(M)$ and V_{sc} is set false. $V(M)$ is incremented by one.

If the activity management functional unit has been selected, $V_{nextact}$ is set true. If the transport expedited flow is available to this session connection, the SPM waits for a PREPARE (MAJOR SYNC ACK) SPDU, followed by a MAJOR SYNC ACK SPDU. Otherwise, just a MAJOR SYNC ACK is expected. Any other SPDUs received prior to the MAJOR SYNC ACK SPDU will result in the appropriate service indications being given to the SS-user.

7.22.3 Receiving the MAJOR SYNC POINT SPDU

A valid incoming MAJOR SYNC POINT SPDU results in an S-SYNC-MAJOR indication. When the symmetric synchronize functional unit has been selected, the received serial number must be equal to $V(M_r)$; and $V(M_r)$ is incremented by one. If the symmetric synchronize functional unit has not been selected, the received serial number must be equal to $V(M)$; and V_{sc} , $V(A)$, and $V(M)$ are updated as follows. If V_{sc} is false, $V(A)$ is set equal to $V(M)$. $V(M)$ is incremented by one.

If the activity management functional unit has been selected, $V_{nextact}$ is set true.

7.23 MAJOR SYNC ACK SPDU

The MAJOR SYNC ACK SPDU is used to return a confirmation to a major synchronization point. If the symmetric synchronize functional unit has been selected, this SPDU defines the serial number for the MAJOR SYNC POINT requestor's receiving flow.

7.23.1 Content of MAJOR SYNC ACK SPDU

The MAJOR SYNC ACK SPDU contains:

- a) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- b) A Serial Number parameter which indicates the serial number of the major synchronization point which is being confirmed [which is equal to $V(M)$ minus one]. This parameter is only present with the symmetric synchronize functional unit has not been selected.
- c) A Second Serial Number parameter which indicates the serial number of the major synchronization point for the receiving flow of the requestor of the major synchronization point, which is the direction of flow on which the MAJOR SYNC ACK SPDU travels. This number is set by the SPM to the current value of $V(Ms)$. This parameter is only present when the symmetric synchronize functional unit has been selected.
- d) A User Data parameter which allows transparent user data to be transferred.

7.23.2 Sending the MAJOR SYNC ACK SPDU

An S-SYNC-MAJOR response results in a MAJOR SYNC ACK SPDU. This SPDU is sent on the transport normal flow. If the transport expedited flow is available to this session connection, a PREPARE (MAJOR SYNC ACK) SPDU is sent simultaneously, or earlier, on the transport expedited flow. If the symmetric synchronize functional unit has been selected, $V(Ms)$ is incremented by one; $V(As)$ and $V(Rs)$ are set to $V(Ms)$; and $V(Ar)$ and $V(Rr)$ are set to $V(Mr)$. If the symmetric synchronize functional unit has not been selected, $V(A)$ and $V(R)$ are set equal to $V(M)$. If the activity management functional unit has been selected, $Vact$ is set to $Vnextact$.

7.23.3 Receiving the MAJOR SYNC ACK SPDU

A valid incoming MAJOR SYNC ACK SPDU results in an S-SYNC-MAJOR confirm. When the symmetric synchronize functional unit has been selected, the received Second Serial Number must be equal to $V(Mr)$. When the symmetric synchronize functional unit has not been selected, the received Serial Number must be equal to $V(M)$ minus one.

If the transport expedited flow is available to this session connection, two successive SPDUs will be received:

- a) PREPARE (MAJOR SYNC ACK) SPDU on the transport expedited flow, followed by
- b) MAJOR SYNC ACK SPDU on the transport normal flow.

When the symmetric synchronize functional unit has been selected, $V(Mr)$ is incremented; $V(As)$ and $V(Rs)$ are set equal to $V(Ms)$; and $V(Ar)$ and $V(Rr)$ are set equal to $V(Mr)$. When the symmetric synchronize functional unit has not been selected, $V(A)$ and $V(R)$ are set equal to $V(M)$. If the activity management functional unit has been selected, $Vact$ is set to $Vnextact$.

7.24 RESYNCHRONIZE SPDU

The RESYNCHRONIZE SPDU is used to provide the SS-users with a selective means to resynchronize the exchange of data to a synchronization point and to reposition the tokens to an agreed side. Use of this procedure may result in loss of data.

This SPDU can also be used to "purge" the session connection, since that is a particular case of resynchronization. The following options are provided:

- a) abandon;
- b) set;
- c) restart.

When the symmetric synchronize functional unit is selected, the SS-users may resynchronize the exchange of data to new serial numbers for both directions of flow, or they may resynchronize only one direction of flow. The SS-user specifies an option for each direction of flow on which resynchronization is requested. Except in the case where the option is abandon, the SS-user also specifies a serial number for each direction of flow on which resynchronization is requested.

Since the resynchronization protocol provides a repositioning of the tokens a particular use of it is the destructive way to get the tokens.

When used with activity management, the RESYNCHRONIZE SPDU can only be sent when Vact is true.

7.24.1 Content of RESYNCHRONIZE SPDU

The RESYNCHRONIZE SPDU contains:

- a) An Enclosure Item parameter to indicate whether the SPDU is the beginning, middle or end of the SSDU (see also 7.37.1). This parameter shall not be present when Protocol Version 1 has been selected.
- b) A Token Setting Item which indicates the requestor's proposed token positions for all available tokens.
- c) A Resync Type parameter which indicates the resynchronize option (abandon, set or restart). If the symmetric synchronize functional unit has been selected, it indicates the First Resync Type, which is the resynchronize option for the requestor's sending flow.
- d) A Serial Number parameter which indicates a serial number to which resynchronization is being requested. If the symmetric synchronize functional unit has been selected, it indicates the First Serial Number, which is the value of the serial number for the sending flow of the requestor of the Resynchronize. This parameter is supplied by the SS-user if the Resync Type is set or restart. If the Resync Type is abandon, the serial number is set to the value of V(Ms) of the sending SPM if the symmetric synchronize functional unit is selected, and to the value of V(M) if it is not selected.
- e) A Second Resync Type parameter which indicates the resynchronize option for the requestor's receiving flow (abandon, set or restart). This parameter may only be present if the symmetric synchronize functional unit has been selected.
- f) A Second Serial Number parameter which indicates the serial number for the requestor's receiving flow to which resynchronization is being requested. This serial number is supplied by the SS-user if the Second Resync Type is set or restart. If the Second Resync Type is abandon, the serial number is set to the value of V(Mr) of the sending SPM. This parameter may only be present if the symmetric synchronize functional unit has been selected.
- g) A User Data parameter which allows transparent user data to be transferred.

7.24.2 Sending/receiving the RESYNCHRONIZE SPDU without symmetric synchronization

This subclause defines how the RESYNCHRONIZE SPDU is sent and received when the symmetric synchronize functional unit has not been selected.

7.24.2.1 Sending the RESYNCHRONIZE SPDU without symmetric synchronization

An S-RESYNCHRONIZE request [with serial number greater than or equal to V(R) and less than or equal to V(M) if the resynchronize option is restart] results in a RESYNCHRONIZE SPDU. This SPDU is sent on the transport normal flow. If the transport expedited flow is available to this session connection and the data separation functional unit has not been selected, a PREPARE (RESYNCHRONIZE) SPDU is sent simultaneously, or earlier, on the transport expedited flow. If the transport expedited flow is available to this session connection and the data separation functional unit has been selected, one of the following applies:

- a) if a previously sent MINOR SYNCHRONIZATION POINT SPDU with the Sync Type Item having the value "data separation" has not been acknowledged, then a PREPARE (RESYNCHRONIZE) SPDU shall not be sent;
- b) otherwise, a PREPARE (RESYNCHRONIZE) SPDU may be sent, as a local matter.

The SPM goes into a state where incoming SPDUs are discarded in the following way:

- a) if the data separation functional unit is not selected or if there is no unacknowledged minor synchronization point with the Sync Type item having the value "data separation" (previously sent by the local SPM), all SPDUs are discarded except: PREPARE (RESYNCHRONIZE), RESYNCHRONIZE, PREPARE (RESYNCHRONIZE ACK), RESYNCHRONIZE ACK, ACTIVITY DISCARD, ACTIVITY INTERRUPT and ABORT SPDUs.
- b) if the data separation functional unit is selected and there are unacknowledged minor synchronization points with the Sync Type item having the value "data separation" (previously sent by the local SPM), only the following SPDUs are discarded: PREPARE (MAJOR SYNC ACK) SPDUs, MAJOR SYNC ACK SPDUs (see the Note).

NOTE – The MAJOR SYNC ACK SPDU is discarded (and therefore does not result in an S-SYNC-MAJOR confirm) because the previously issued S-RESYNC request prevented the completion of the dialogue unit. It is not possible to deliver the S-SYNC-MAJOR confirm because this would cause V(R) to be updated and this may be a later value than that to which the resynchronize is occurring.

If a RESYNCHRONIZE, PREPARE (RESYNCHRONIZE), ACTIVITY INTERRUPT or ACTIVITY DISCARD SPDU is received when the SPM is in this state, a resynchronization contention situation has occurred and is dealt with as specified in 7.24.2.3.

7.24.2.2 Receiving the RESYNCHRONIZE SPDU without symmetric synchronization

Except when a resynchronization contention situation has occurred, a valid incoming RESYNCHRONIZE SPDU (with received serial number greater than or equal to V(R) if the resynchronize option is restart) results in an S-RESYNCHRONIZE indication. If the resynchronize option is abandon, this indication contains a serial number which is equal to V(M) or the received serial number, whichever is higher; V(M) is set to this value. If the transport expedited flow is available to this session connection, two successive SPDUs will be received:

- a) PREPARE (RESYNCHRONIZE) SPDU on the transport expedited flow, followed by
- b) RESYNCHRONIZE SPDU on the transport normal data flow.

When the PREPARE(RESYNCHRONIZE) SPDU is received, the SPM goes into a state where incoming SPDUs are discarded in the following way:

- a) if the data separation functional unit is not selected or if there is no outstanding minor synchronization point with the Sync Type item having the value "data separation", all SPDUs are discarded, until the RESYNCHRONIZE SPDU is received, except for ABORT SPDUs.
- b) if the data separation functional unit is selected and there are one or more outstanding minor synchronization points with the Sync Type item having the value "data separation" (previously sent by the SPM), only the following SPDUs are discarded, until the RESYNCHRONIZE SPDU is received: PREPARE (MAJOR SYNC ACK) SPDUs, MAJOR SYNC ACK SPDUs (see the Note).

NOTE – The MAJOR SYNC ACK SPDU is discarded (and therefore does not result in an S-SYNC-MAJOR confirm) because the previously issued S-RESYNC request prevented the completion of the dialogue unit. It is not possible to deliver the S-SYNC-MAJOR confirm because this would cause V(R) to be updated and this may be a later value than that to which the resynchronize is occurring.

The SPM now waits for an S-RESYNCHRONIZE response.

If a resynchronization contention situation has occurred, only the contention loser (see 7.24.2.3) passes an S-RESYNCHRONIZE indication to the SS-user.

7.24.2.3 Resynchronization contention without symmetric synchronization

The contention between two RESYNCHRONIZE, ACTIVITY INTERRUPT, or ACTIVITY DISCARD SPDUs is resolved according to Table 9. This table defines the contention winner whose SPDU is taken into account; the other SPDU is discarded.

If an incoming RESYNCHRONIZE SPDU is not acceptable, the receiving SS-user may issue another if it prevails over the original proposal according to the decision rules.