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B-ISDN SIGNALLING ATM ADAPTATION LAYER – SERVICE SPECIFIC COORDINATION FUNCTION FOR SUPPORT OF SIGNALLING AT THE USER NETWORK INTERFACE (SSFC AT UNI)

ITU-T Recommendation Q.2130

(Previously "CCITT Recommendation")

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation Q.2130 was prepared by ITU-T Study Group 11 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 29th of July 1994.

NOTE

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

CONTENTS

SUMMARY

The ATM Adaptation Layer (AAL) is defined to enhance the services provided by the ATM layer to support the functions required by the next higher layer. Different AALs support various protocols to suit the different needs of a range of AAL service users. One particular type of AAL service is the signalling AAL (SAAL), which comprises AAL functions necessary to support a signalling entity. The structure of the SAAL is defined in Recommendation Q.2100.

The SAAL consists of a Segmentation and Reassembly function (SAR), and a Convergence Sublayer which is divided into two sublayers: a Common Part Convergence Sublayer (CPCS) and a Service Specific Convergence Sublayer (SSCS). The common part protocol is defined in clause 6/I.363 and is used as the underlying protocol for the service specific part for signalling. The SSCS is functionally divided into two parts: The Service Specific Connection Oriented Protocol (SSCOP), which provides an assured data transfer service, and the Service Specific Coordination Function (SSCF). The SSCOP is defined in Recommendation Q.2110 and is equally well suited for use by various SSCFs. This Recommendation specifies the SSCF for signalling at the User-to-Network Interface (UNI).

The SSCF at the UNI performs a coordination function between the service required by the signalling layer 3 (Recommendation Q.2931) user and the service provided by SSCOP.

This Recommendation describes for SSCF at the UNI the mapping of primitives from layer 3 to signals of the SSCOP and vice versa.

KEYWORDS

ATM Asynchronous Transfer Mode

AAL ATM Adaptation Layer

B-ISDN Broadband Integrated Services Digital Network

CPCS Common Part Convergence Sublayer

SAAL Signalling AAL

SAP Service Access Point

SAR Segmentation And Reassembly

SSCF Service Specific Coordination Function

SSCOP Service Specific Connection Oriented Protocol

SSCS Service Specific Convergence Sublayer

UNI User'Network Interface

B-ISDN SIGNALLING ATM ADAPTATION LAYER – SERVICE SPECIFIC COORDINATION FUNCTION FOR SUPPORT OF SIGNALLING AT THE USER-NETWORK INTERFACE (SSCF AT UNI)

(Geneva, 1994)

1 Scope

The intent of this Recommendation is to provide a function which is part of the ATM Adaptation Layer for the support of signalling (SAAL) at the UNI of the B-ISDN. This function is used to map the service of the Service Specific Connection Oriented Protocol (SSCOP) of the AAL to the needs of layer 3 protocols for access signalling across the UNI (e.g. Recommendation Q.2931). This function is called Service Specific Coordination Function (SSCF) for signalling at the UNI.

This Recommendation specifies the Service Specific Coordination Function for support of signalling at the UNI (SSCF at UNI). It covers the aspects of the SSCF of the complete AAL structure for signalling applications at the UNI defined in Recommendation Q.2100 [8], and describes the relationship to the protocol entity for access signalling defined in Recommendation Q.2931 [5] and the Service Specific Connection Oriented Protocol Q.2110 [9].

This Recommendation is applicable to equipment to be attached at either side of B-ISDN User-Network Interface (UNI) when B-ISDN access signalling is to be supported.

2 Normative references

The following Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision: all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of currently valid ITU-T Recommendations is regularly published.

[1] CCITT Recommendation X.200, *Reference model of open systems interconnection for CCITT applications*.

[2] CCITT Recommendation X.210, *OSI layer service conventions*.

[3] ITU-T Recommendation I.150, *B-ISDN Asynchronous Transfer Mode Functional Characteristics*.

[4] ITU-T Recommendation I.361, *B-ISDN Asynchronous Transfer Mode (ATM) Layer specification*.

[5] ITU-T Recommendation Q.2931, *B-ISDN – Digital Subscriber Signalling System No. 2 (DSS2) – User network interface layer 3 specification for basic call/connection control*.

[6] ITU-T Recommendation Q.704, *Signalling Network Functions and Messages*.

[7] ITU-T Recommendation I.363, *B-ISDN ATM Adaptation Layer (AAL) specification*.

[8] ITU-T Recommendation Q.2100 - B-ISDN signalling ATM Adaptation Layer (SAAL) overview description.

[9] ITU-T Recommendation Q.2110, *B-ISDN ATM Adaptation Layer – Service Specific Connection Oriented Protocol (SSCOP)*.

[10] ITU-T Recommendation X.290, *OSI conformance testing methodology and framework for protocol Recommendations for CCITT applications – General concepts*.

3 Abbreviations

AA	ATM Adaptation
AAL	ATM Adaptation Layer
ATM	Asynchronous Transfer Mode
BGAK	Begin Acknowledge (PDU)
BGN	Begin (PDU)
B-ISDN	Broadband Integrated Services Digital Network
BR	Buffer Release
BSVC	Broadcast Signalling Virtual Channel
CES	Connection Endpoint Suffix
CPCS	Common Part Convergence Sublayer
END	End (PDU)
ENDAK	End Acknowledge (PDU)
MAA	Management ATM Adaptation
MaxCC	Maximum Connection Control (Count)
MaxPD	Maximum Poll Data (Count)
MSVC	Meta-Signalling Virtual Channel
MU	Message Unit
NNI	Network Node Interface
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statement
PR	Poll Request
PSVC	Point-to-point Signalling Virtual Channel
RESYNC	Resynchronization (Primitive)
RS	Resynchronization
SAAL	Signalling ATM Adaptation Layer
SAR	Segmentation And Reassembly
SD	Sequenced Data (PDU)
SDU	Service Data Unit
SN	Sequence Number
SPC	Semi Permanent Connection
SSCF	Service Specific Coordination Function
SSCOP	Service Specific Connection Oriented Protocol
SSCS	Service Specific Convergence Sublayer
STAT	Solicited Status (PDU)
SVC	Switched Virtual Connection
UD	Unumbered Data (PDU)
UNI	User Network Interface
UNIT DATA	Unit Data (Primitive)
USTAT	Unsolicited Status (PDU)
UU	User-to-User
VR	Receiver State Variable

4 General

The ATM Adaptation Layer used to support signalling (SAAL) is a combination of two sublayers: a common part and service specific part. The common part protocol is defined in clause 6/I.363 [7]. The service specific part is further split into two parts: the Service Specific Coordination Function (SSCF) and the Service Specific Connection Oriented Protocol (SSCOP). Recommendation Q.2100 [8] provides an overview of this structure. Recommendation Q.2110 [9] specifies the SSCOP. This Recommendation specifies the SSCF at UNI.

The purpose of the SAAL is to convey information between layer 3 entities across the UNI and NNI using Asynchronous Transfer Mode (ATM) virtual channels. The purpose of the SSCF at UNI is to map the UNI layer 3 protocol (Recommendation Q.2931) to the service of the next lower layer.

The definition of the SAAL takes into consideration the principles and terminology of Recommendations X.200 [1] and X.210 [2] – the reference model and layer service conventions for Open Systems Interconnection (OSI). The SAAL is a protocol which operates at the data link layer of the OSI architecture.

NOTES

1 The ATM layer is currently defined in Recommendations I.150 [3] and I.361 [4]. Layer 3 is defined in Recommendation Q.2931[5].

2 The term "layer 3" is used to indicate the layer above the SAAL, the user of the SAAL services.

5 Services of the SAAL at the UNI

The following services are provided by the SAAL at the UNI:

a) *Unacknowledged Transfer of Data* – The SAAL service provides for the unacknowledged transfer of SAAL service data units on point-to-point and point-to-multipoint ATM connections. The SAAL supports the transfer of octet aligned SDUs up to a maximum of 4096 octets (i.e. maximum information size k in UD-PDU). The SAAL unacknowledged data transfer service does not relieve the user from loss or insertion of data which may occur.

b) *Assured Transfer of Data* – The SAAL service provides for the assured transfer of SAAL service data units on point-to-point ATM connections. The SAAL supports the transfer of octet aligned SDUs up to a maximum of 4096 octets (i.e. maximum information size k in SD PDU). The SAAL service relieves the user from loss, insertion, corruption, and misordering of data which may occur. In some cases due to unrecoverable errors in the ATM adaptation layer, duplication or loss of SDUs may occur.

c) *Transparency of Transferred Information* – The SAAL service provides for the transparent transfer of SAAL service data units. It does not restrict the content, format or coding of information, nor does it ever need to interpret its structure or meaning.

d) *Establishment and Release of SAAL Connections for Assured Transfer of Data* – The SAAL service provides a means to establish and release SAAL connections which operate in the assured mode. In some cases, the SAAL service provider may release the SAAL connection. Depending on the conditions, release of an SAAL connection may result in loss of SAAL user-data.

6 Functions of the SSCF at the UNI and signalling protocol stack

The SSCF performs a coordination function between the service required by the signalling layer 3 (Recommendation Q.2931) user and the service provided by SSCOP.

Figure 1 relates AAL information flows to different types of signalling virtual channels defined within the ATM Layer at the UNI. The figure also depicts how various functional blocks in a protocol stack are related to their "neighbours".

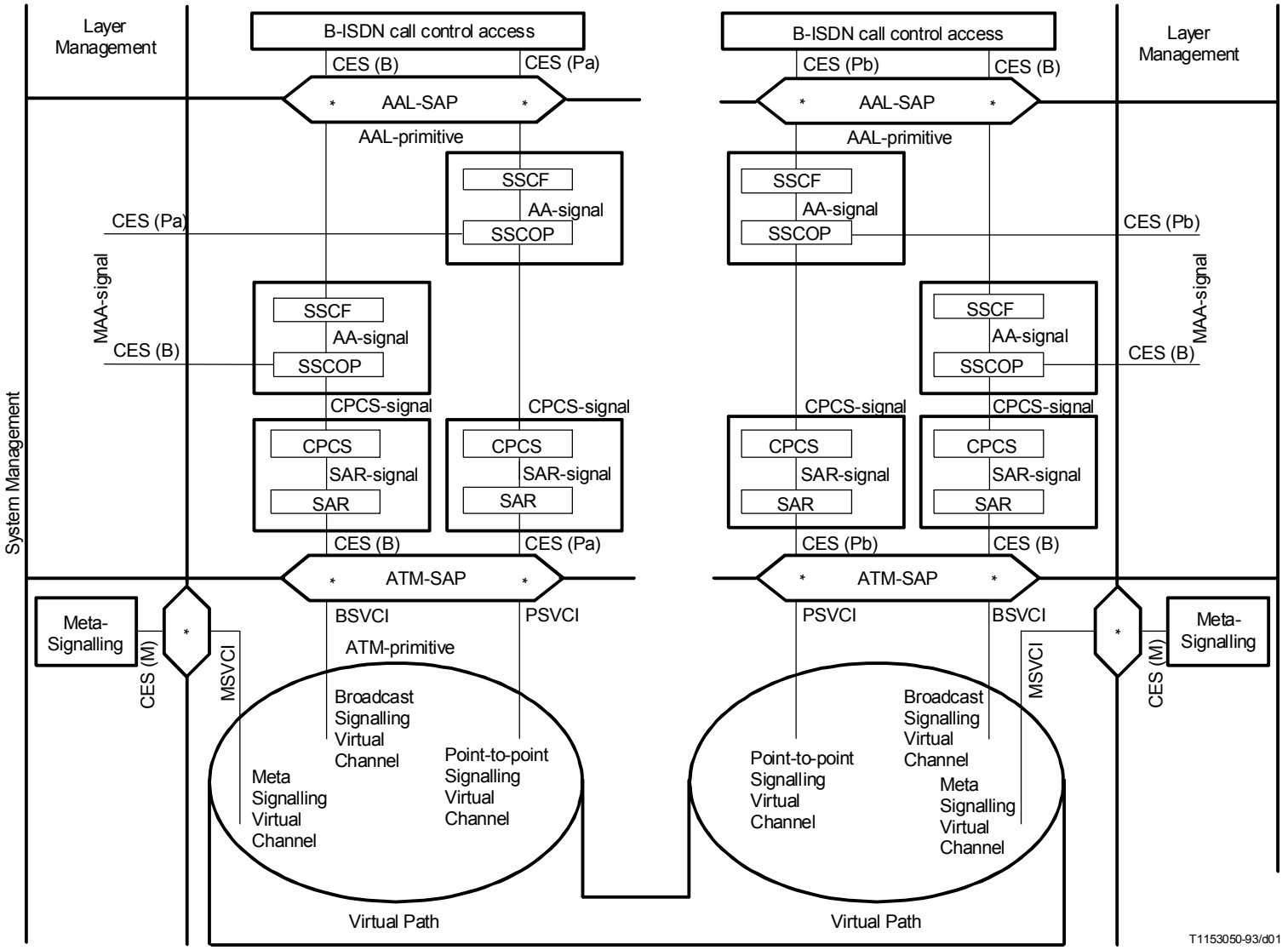


FIGURE 1/Q.2130

Signalling protocol stack for UNI

The properties of the protocol structure shown in Figure 1 are:

1) For support of signalling there is a one-to-one correspondence between a connection endpoint within the AAL-SAP and a connection endpoint within the ATM-SAP.

2) Any distribution of information associated with one AAL-connection within the AAL has to be made based on PDU type (bottom up direction) or primitive type (top down direction).

3) Two types of connections are available to the AAL user, broadcast and point-to-point. The broadcast connection provides unacknowledged information transfer while the point-to-point connection primarily provides assured information transfer, and may provide (no signalling application is known currently, making use of this capability) unacknowledged information transfer. In this case, the discrimination between the two information flows is done based on AAL-primitives with AAL-UNITDATA primitives for unacknowledged and AAL-ESTABLISH, -RELEASE, and -DATA primitives for assured information transfer.

7 Definition of the boundary of SSCF with layer 3 at the UNI

7.1 Primitives

The primitives required to support the SAAL user at the UNI are shown in Table 1/Q.2130.

TABLE 1/Q.2130

SAAL primitives used at the UNI

Generic Name	Type				Contents of Primitive Parameter Data
	Request	Indication	Response	Confirm	
AAL-ESTABLISH	X (Parameter Data) (Note)	X (Parameter Data) (Note)		X (Parameter Data) (Note)	L3 peer-to-peer message
AAL-RELEASE	X (Parameter Data) (Note)	X (Parameter Data) (Note)		X	L3 peer-to-peer message
AAL-DATA	X (Parameter Data)	X (Parameter Data)			L3 peer-to-peer message
AAL-UNITDATA	X (Parameter Data)	X (Parameter Data)			L3 peer-to-peer message
NOTE – The use of Parameter Data in this primitive is not specifically required by applications identified at the time this Recommendation is published; however, its use by future signalling applications is not excluded.					

The definition of these primitives is as follows:

- The **AAL-ESTABLISH request/indication/confirm**: This is used for establishing assured information transfer between AAL entities at the UNI. This is only required in conjunction with point-to-point signalling virtual connections.

- The **AAL-RELEASE request/indication/confirm**: This is used for terminating assured information transfer between AAL entities at the UNI. This is only required in conjunction with point-to-point signalling virtual connections.

- The **AAL-DATA request/indication**: This is used in conjunction with assured SDU data transfer at the UNI. It is assumed that assured information transfer was initiated with the ESTABLISH primitive. This is only required in conjunction with point-to-point signalling virtual connections.

- The **AAL-UNITDATA request/indication**: This is used in conjunction with unacknowledged SDU data transfer at the UNI. This is required in conjunction with broadcast and point-to-point signalling virtual connections.

7.2 State transition diagrams

7.2.1 General

State transition diagrams for sequences of primitives across a connection endpoint define primitive procedures which specify the interactions between adjacent layers to invoke and provide a service. The service primitives represent the elements of the procedures.

7.2.2 Layer 3 – AAL interactions

The states of an AAL connection endpoint may be derived from the internal states of the Service Specific Convergence Sublayer entities (SSCS entities) supporting this type of an AAL connection.

Point-to-point states are defined as follows:

- AAL connection released state (state 1);

- awaiting establish state (state 2);

- awaiting release state (state 3);

- AAL connection established state (state 4).

The primitives provide the procedural means to specify conceptually how an AAL service user can invoke a service.

This subclause defines the constraints on the sequences in which the primitives may occur. The sequences are related to the states at one point-to-point AAL connection endpoint.

The possible overall sequences of primitives at a point-to-point AAL connection endpoint are defined in the state transition diagram, Figure 2. The AAL connection released and AAL connection established states are stable states while the awaiting establish and awaiting release states are transition states.

It is the responsibility of the AAL user to decide, in accordance with the specification of the primitive procedures, if in a certain AAL connection endpoint state an AAL-request primitive is issued.

The model illustrates the behaviour of the AAL as seen by layer 3. This model assumes that the primitives passed between layers are implemented using a first in first out queue. In this model, “collisions” of request and indication primitives can occur thereby illustrating actions that seem to be in conflict with the actual AAL protocol description. In some implementations, these collisions could occur.

If the AAL issues an AAL-ESTABLISH indication (this applies to the case of AAL initiated or peer system initiated re-establishment), AAL-RELEASE confirm or AAL-RELEASE indication, this indicates possible loss of data. The SSCOP discards any AAL service data units or AAL-DATA request still in SSCOP.

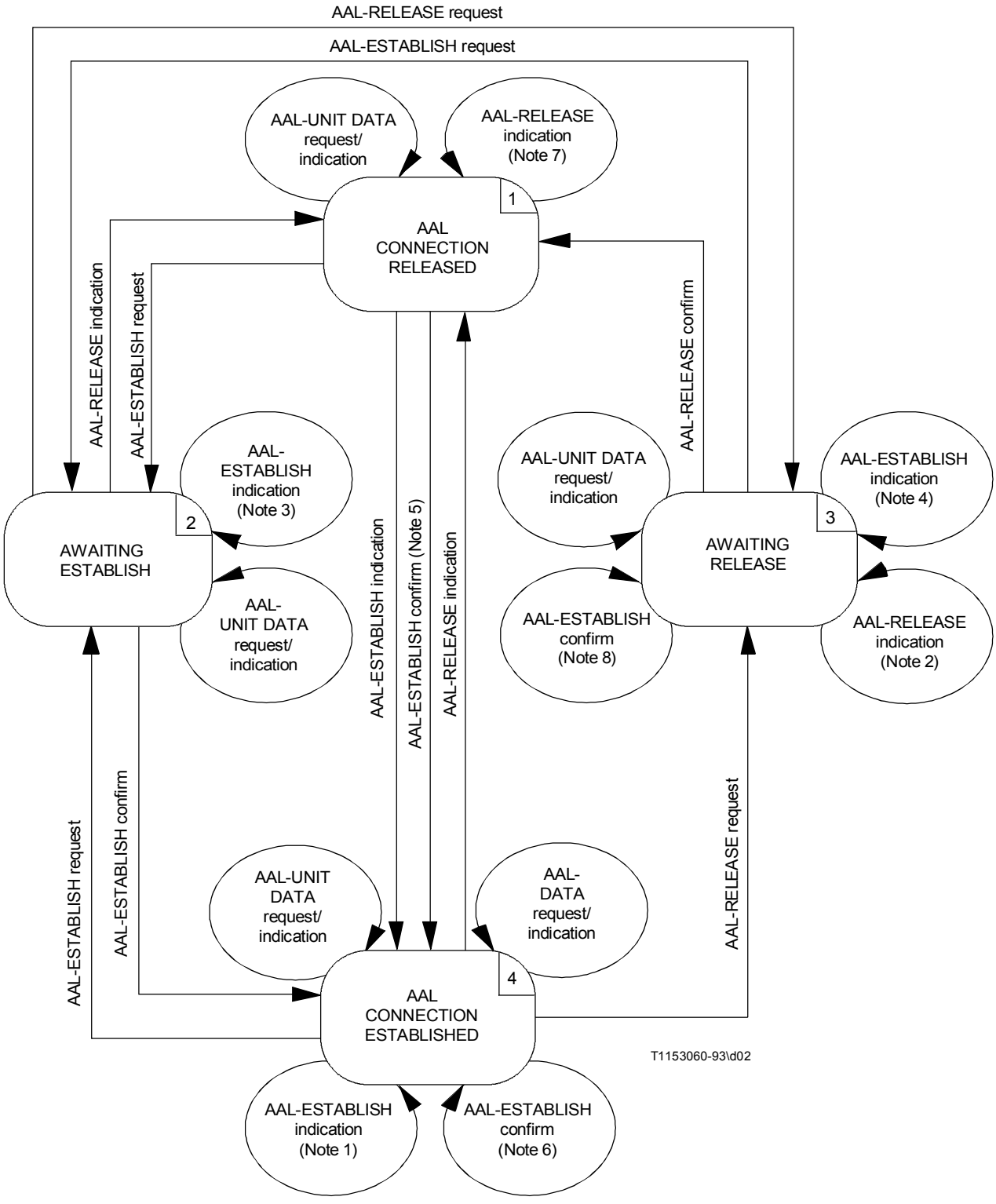


FIGURE 2/Q.2130

State transition diagram for sequences of primitives across an SAAL connection endpoint at the UNI

NOTES to Figure 2

1 This primitive notifies layer 3 of AAL connection re-establishment.

2 This primitive will occur if an AAL-RELEASE request collides with an AAL-RELEASE indication.

3 This primitive will occur if an AAL-ESTABLISH request collides with an AAL-ESTABLISH indication.

4 This primitive will occur if an AAL-RELEASE request collides with an AAL-ESTABLISH indication.

5 This primitive will occur if an AAL-ESTABLISH request (this applies to the case of layer 3 initiated re-establishment) collides with an AAL-RELEASE indication. Since this AAL-RELEASE indication is not related to the AAL-ESTABLISH request, the AAL will establish the AAL connection and issue an AAL-ESTABLISH confirm.

6 This primitive will occur as a result of multiple collisions of primitives. If a first AAL-ESTABLISH request collides with an AAL-RELEASE indication, the AAL will establish the AAL connection and issue an AAL-ESTABLISH confirm (see Note 5). This AAL-ESTABLISH confirm (it is related to the first AAL-ESTABLISH request) would collide with a subsequent AAL-ESTABLISH request which may be issued since layer 3 is not aware that the AAL-RELEASE indication was not related to the first AAL-ESTABLISH request. Since layer 3 relates this AAL-ESTABLISH confirm to the subsequent AAL-ESTABLISH request it assumes the AAL in the AAL connection established state, but the AAL will re-establish the AAL connection and issue again an AAL-ESTABLISH confirm.

7 This primitive will occur if an AAL-ESTABLISH request (this applies to the case of layer 3 initiated re-establishment) collides with an AAL-RELEASE indication. Since this AAL-RELEASE indication is not related to the AAL-ESTABLISH request, the AAL will try to establish the AAL connection and if this is not possible, it issues an AAL-RELEASE indication.

8 This primitive will occur as a result of multiple collisions of primitives. If a first AAL-ESTABLISH request collides with an AAL-RELEASE indication, the AAL will establish the AAL connection and issue an AAL-ESTABLISH confirm (see Note 5). This AAL-ESTABLISH confirm may collide with a subsequent AAL-ESTABLISH request and the AAL will re-establish the AAL connection and issue again an AAL-ESTABLISH confirm (see Note 6). This second AAL-ESTABLISH confirm (it is related to the second AAL-ESTABLISH request) may collide with a subsequent AAL-RELEASE request which may be issued since layer 3 is not aware that the AAL-RELEASE indication was not related to the first AAL-ESTABLISH request. Since layer 3 relates this first AAL-ESTABLISH confirm to the subsequent AAL-ESTABLISH request it assumes the AAL in the AAL connection established state, but the AAL will re-establish the AAL connection and issue again an AAL-ESTABLISH confirm (see Note 6).

8 Definition of the boundary of SSCF with SSCOP

8.1 Signals

The signals between SSCF and SSCOP are defined in order to allow the specification of the block SSCF for the UNI. The term “signal” is used instead of “primitive” in order to reflect the fact that between SSCF and SSCOP there is no service access point defined.

The following repertoire of AA-signals between SSCF and SSCOP is defined:

TABLE 2/Q.2130

Signals with allowed parameters between SSCOP and SSCF at the UNI

Generic name	Type			
	Request	Indication	Response	Confirm
AA-ESTABLISH	SSCOP-UU[b)] BR	SSCOP-UU[b)]	SSCOP-UU[a)] BR	SSCOP-UU[b)]
AA-RECOVER	Not defined	–	–	Not defined
AA-RELEASE	SSCOP-UU[b)]	SSCOP-UU[b)] Source[a)]	Not defined	–
AA-DATA	MU	MU SN[a)]	Not defined	Not defined
AA-RESYNC	SSCOP-UU[b)]	SSCOP-UU[b)]	–	–
AA-UNITDATA	MU	MU	Not defined	Not defined
AA-RETRIEVE	Not Used	Not Used	Not defined	Not defined
AA-RETRIEVE COMPLETE	Not defined	Not Used	Not defined	Not defined

– The signal has no parameters.

Not Used This signal is not used by this SSCF.

a) This parameter is not utilized by this SSCF.

b) The use of SSCOP-UU parameter in this signal is not specifically required by applications identified at the time this Recommendation is published; however, its use by future signalling applications is not excluded.

The definition of these signals is as follows:

a) The **AA-ESTABLISH signals** are used to establish assured, point-to-point information transfer between peer user entities.

b) The **AA-RECOVER signals** are used to recover, if assured, point-to-point information transfer capability between peer user entities was lost due to SSCOP internal problems.

c) The **AA-RELEASE signals** are used to terminate assured, point-to-point information transfer between peer user entities.

d) The **AA-DATA signals** are used for the assured, point-to-point transfer of SSCOP-SDUs between peer user entities.

e) The **AA-RESYNC signals** are used to resynchronize the SSCOP connection.

f) The **AA-UNITDATA signals** are used for the non-assured, point-to-point and broadcast transfer of SSCOP-SDUs between peer user entities.

g) The AA-RETRIEVE and AA-RETRIEVE COMPLETE signals are not used by the SAAL for the UNI.

8.2 Parameters

The definition of the parameters is as follows:

a) The **Message Unit (MU) parameter** is used during information transfer to convey a variable-length message. In AA-DATA request and AA-UNITDATA request signals, this parameter is mapped transparently into the Information field of an SSCOP PDU. For AA-DATA indication and AA-UNITDATA indication signals, this parameter contains the contents of the Information field of the received SSCOP PDU. The MU is an integral multiple of one octet.

b) The **SSCOP User-to-User Information (SSCOP-UU) parameter** allows during connection control to convey a variable-length user-to-user message.

c) The **Source parameter** indicates to the SSCOP user whether the SSCOP layer or the peer SSCOP user originated the connection release. The Source parameter is not used by this SSCF and therefore ignored in any received AA-RELEASE indication signal.

d) The **Buffer Release (BR) parameter** indicates whether the transmitter may release its buffers upon release of the connection. This parameter also allows for the release of selectively acknowledged messages. A value of "Yes" indicates that the transmission buffer and transmission queue may be released, and a value of "No" indicates that the transmission buffer and transmission queue may not be released. Since the data retrieval service is not utilized by the SAAL at the UNI, this parameter is always set to the value "Yes".

e) The **Sequence Number (SN) parameter** indicates the value of the N(S) PDU parameter in associated SD PDU. The SN parameter is not used by this SSCF and therefore ignored in any received AA-DATA indication signal.

8.3 Sequences of Signals between SSCF and SSCOP

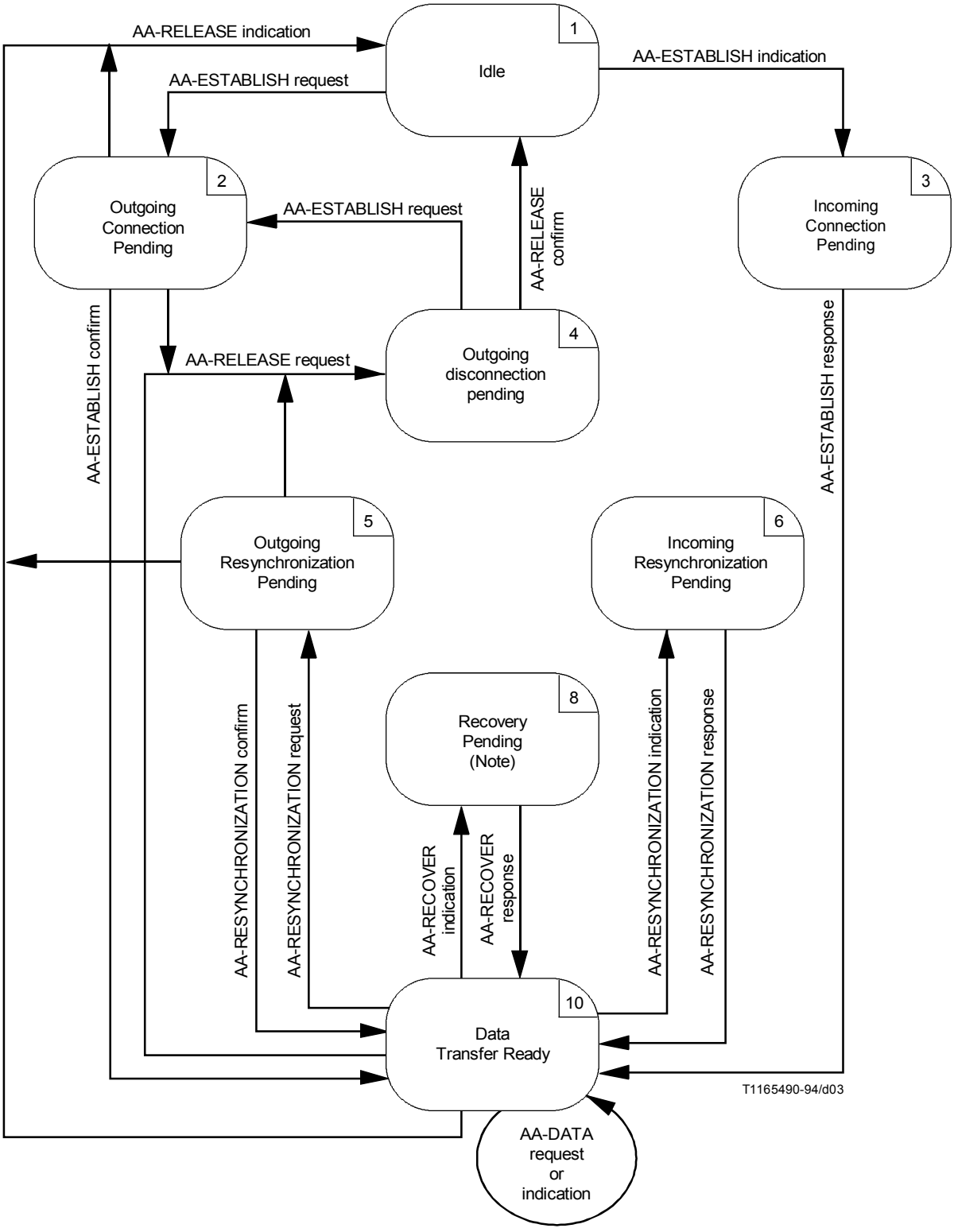
The possible overall sequences of signals between SSCF and SSCOP in relation to a specific connection are defined in the state transition diagram, in Figure 3. In the diagram:

a) the signals AA-UNITDATA request and AA-UNITDATA indication are associated with Unacknowledged Data Transfer and thus permitted in any state. They are not shown;

b) any other signal which is not shown as resulting in a transition (from one state to the same state, or from one state to a different state) is not permitted in that state;

c) it is assumed that the signals passed between SSCOP and an SSCF are coordinated so that collisions do not occur;

d) the Idle state (state 1) reflects the absence of a connection. It is the initial and final state of any sequence, and once it has been re-entered, the connection is released.



NOTE – The SSCOP connection endpoint state Recovery Pending (state 8) covers the SSCOP states Recovery Response Pending (state 8) and Incoming Recovery Pending (state 9). Which one of these applies is not visible at the boundary between SSCF and SSCOP. The state Outgoing Recovery Pending (state 7) is never visible at the boundary between SSCF and SSCOP.

FIGURE 3/Q.2130

State transition diagram for sequences of signals between SSCF and SSCOP at UNI

9 State transition table of SSCF for supporting signalling at UNI

This clause contains the state transition table of the SSCF at UNI, Table 3, in support of an AAL service which is provided at an AAL connection endpoint, making use of sequences of primitives according to the state transition diagram defined in Figure 2. The SSCF is using the services provided by the SSCOP Sub-Layer which are being invoked by means of AA-signals in accordance with the state transition diagram for sequences of signals defined in Figure 3.

The SSCF performs primitive-signal mapping by issuing the appropriate primitive (upper boundary) and/or signal (lower boundary) as result of the receipt of a primitive from the service user (AAL-primitive) and/or the receipt of a signal from the service provider (AA-signal). The state transition table relinquishes to any partitioning. It is conceptual and does not prevent a designer from partitioning in an implementation. The actions to some events are the same for several states and an implementation may take advantage of this.

The events shown in Table 3 are primitives at the upper and signals at the lower boundary. The compound state numbers are ordered pairs P/Q where P is the state of the SSCF as perceived by its user (i.e. Recommendation Q.2931) after a sequence of AAL-primitives and Q is the state of SSCOP as perceived by SSCF after a sequence of AA signals. Combinations of states other than those shown in Table 3 are not possible.

Some of the events identified in Table 3 as illegal and associated with a compound state, could be the result of collisions at the boundary between SSCF and SSCOP which, as assumed here, do not occur [see 8.3, item c)].

TABLE 3/Q.2130

Compound State transition table of SSCF in support of signalling at the UNI

Compound State / Event	1/1	2/2	4/10	3/4	2/5
AAL-ESTABLISH request {Parameter Data} (Note 6)	AA-ESTABLISH request {BR := Yes, SSCOP-UU := Parameter Data} (Note 6) State 2/2	Illegal	AA-RESYNC request {SSCOP-UU := Parameter Data} (Note 6) State 2/5	AA-ESTABLISH request {BR := Yes, SSCOP-UU := Parameter Data} (Note 6) State 2/2	Illegal
AAL-RELEASE request {Parameter Data} (Note 6)	AAL-RELEASE confirm State 1/1 (Note 1)	AA-RELEASE request {SSCOP-UU := Parameter Data} (Note 6) State 3/4	AA-RELEASE request {SSCOP-UU := Parameter Data} (Note 6) State 3/4	Illegal	AA-RELEASE request {SSCOP-UU := Parameter Data} (Note 6) State 3/4
AAL-DATA request {Parameter Data}	State 1/1 (Note 2)	Illegal	AA-DATA request {MU := Parameter Data} State 4/10	Illegal	Illegal

TABLE 3/Q.2130 (*continued*)

Compound State transition table of SSCF in support of signalling at the UNI

Compound State / Event	1/1	2/2	4/10	3/4	2/5
AAL-UNITDATA request {Parameter Data}	AA-UNITDATA request {MU := Parameter Data} State 1/1	AA-UNITDATA request {MU := Parameter Data} State 2/2	AA-UNITDATA request {MU := Parameter Data} State 4/10	AA-UNITDATA request {MU := Parameter Data} State 3/4	AA-UNITDATA request {MU := Parameter Data} State 2/5
AA-ESTABLISH indication {SSCOP-UU}	AA-ESTABLISH response {BR := Yes, SSCOP-UU := null} AAL-ESTABLISH indication {Parameter Data := SSCOP-UU} (Note 6) State 4/10 (Note 3)	Illegal	Illegal	Illegal	Illegal
AA-ESTABLISH confirm {SSCOP-UU}	Illegal	AAL-ESTABLISH confirm {Parameter Data := SSCOP-UU} (Note 6) State 4/10	Illegal	Illegal	Illegal
AA-RECOVER Indication	Illegal	Illegal	AA-RECOVER response AAL-ESTABLISH indication {Parameter Data := null} (Note 6) State 4/10 (Note 4)	Illegal	Illegal
AA-RELEASE indication {SSCOP-UU, Source}	Illegal	AAL-RELEASE indication {Parameter Data := SSCOP-UU} (Note 6) State 1/1	AAL-RELEASE indication {Parameter Data := SSCOP-UU} (Note 6) State 1/1	Illegal	AAL-RELEASE indication {Parameter Data := SSCOP-UU} (Note 6) State 1/1
AA-RELEASE confirm	Illegal	Illegal	Illegal	AAL-RELEASE confirm State 1/1	Illegal
AA-DATA indication {MU, SN}	Illegal	Illegal	AAL-DATA indication {Parameter Data := MU} State 4/10	Illegal	Illegal
AA-RESYNC indication {SSCOP-UU}	Illegal	Illegal	AA-RESYNC response AAL-ESTABLISH indication {Parameter Data := SSCOP-UU} (Note 6) State 4/10 (Note 5)	Illegal	Illegal

TABLE 3/Q.2130 (*end*)

Compound State transition table of SSCF in support of signalling at the UNI

Compound State / Event	1/1	2/2	4/10	3/4	2/5
AA-RESYNC confirm	Illegal	Illegal	Illegal	Illegal	AAL-ESTABLISH confirm {Parameter Data := null} (Note 6) State 4/10
AA-UNITDATA indication {MU}	AAL-UNITDATA indication {Parameter Data := MU} State 1/1	AAL-UNITDATA indication {Parameter Data := MU} State 2/2	AAL-UNITDATA indication {Parameter Data := MU} State 4/10	AAL-UNITDATA indication {Parameter Data := MU} State 3/4	AAL-UNITDATA indication {Parameter Data := MU} State 2/5

NOTES

1 The event AAL-RELEASE request occurs in the case of a collision with the AAL-RELEASE indication primitive which was issued by SSCF when a transition into state 1/1 took place as a result of the receipt of an AA-RELEASE indication signal from SSCOP while in state 4/10 or state 2/2. The AAL-RELEASE confirm primitive is issued in order to comply with the AAL-primitive sequences according to Figure 2 (see Note 2 to Figure 2).

2 The event AAL-DATA.request occurs in the case of a collision with the AAL-RELEASE indication primitive which was issued by SSCF when a transition from state 4/10 into state 1/1 took place as a result of the receipt of an AA-RELEASE indication signal from SSCOP while in state 4/10.

3 SSCOP actually makes two state transitions. The first is from 1, Idle, to 3, Incoming Connection Pending, and is made due to the receipt of a BGN PDU from its peer. The compound state of SSCF is "momentarily" 1/3. On receiving the AA-ESTABLISH indication signal from SSCOP, the SSCF for UNI signalling sends both an AAL-ESTABLISH indication primitive to its user and AA-ESTABLISH response signal to SSCOP which causes SSCOP to transition to 10, Data Transfer Ready.

4 This situation is related to recovery from protocol errors, which in any case is SSCOP initiated. SSCOP actually makes different state transitions, depending on the initiator of recovery, which can be local or peer:

- If it is the peer entity, the first state transition within SSCOP is from 10, Data Transfer Ready, to 9, Incoming Recovery Pending, and is made due to receipt of a ER PDU from the peer. The compound state of SSCF is "momentarily" 4/8. On receiving the AA-RECOVER indication signal from SSCOP, the SSCF for UNI signalling sends both an AAL-ESTABLISH indication primitive to its user and AA-RECOVER response signal to SSCOP which causes SSCOP to transition to 10, Data Transfer Ready.
- If it is the local entity, the first state transition within SSCOP is from 10, Data Transfer Ready, to 7, Outgoing Recovery Pending, and is made due to the decision of SSCOP and is never visible to SSCF. The next SSCOP state transition is made due to receipt of a ERAK PDU from the peer. The compound state of SSCF is "momentarily" 4/8. On receiving the AA-RECOVER indication signal from SSCOP, the SSCF for UNI signalling sends both an AAL-ESTABLISH indication primitive to its user and AA-RECOVER response signal to SSCOP which causes SSCOP to transition to 10, Data Transfer Ready.

5 SSCOP actually makes two state transitions. The first is from 10, Data Transfer Ready, to 6, Incoming Resynchronization Pending, and is made due to the receipt of a RS PDU from its peer. The compound state of SSCF is "momentarily" 4/6. On receiving the AA-RESYNC indication signal from SSCOP, the SSCF for UNI signalling sends both an MAAL-ERROR indication primitive to the management plane, and an AA-RESYNC.response signal to SSCOP which causes SSCOP to transition to 10, Data Transfer Ready.

6 The use of Parameter Data and SSCOP-UU in this signal or primitive is not specifically required by applications identified at the time this Recommendation is published; however, its use by future signalling applications is not excluded. If Parameter Data or SSCOP-UU is "null", this implies that there is no data present.

10 Boundary to layer management

No requirements have been identified.

11 Applicability of SSCOP parameters and timers to signalling at the UNI

This clause defines the default SSCOP parameters to be used for supporting UNI signalling. Table 4 summarizes the default protocol parameters. The values are based on a signalling virtual connection operating under 10 kbit/s at the UNI; however, these values provide satisfactory performance over a wider range of operating environments. A proper set of parameters differs depending on the use, condition, link rate, round-trip delay, and receiver resequencing buffer size; therefore, they should be configurable. As a general guide, Timer_POLL should be set to as large a value as possible that still maintains throughput efficiency and satisfies the average and maximum delay requirements for delivery of data.

The tolerance of timers is not addressed in this Recommendation.

TABLE 4/Q.2130

SSCOP Parameter	Default Value
MaxCC	4
Timer_CC	1 Second
Timer_KEEP-ALIVE	2 Seconds (Note 1)
Timer_NO-RESPONSE	7 Seconds
Timer_POLL	750 milliseconds (Note 1)
Timer_IDLE	15 Seconds
k (Maximum SSCOP SDU size)	4096 octets
j (Maximum SSCOP-UU size)	4096 octets (Note 2)
MaxPD	25

NOTES

1 For timers KEEP-ALIVE and POLL it does not matter, if the first expiry occurs in less time than the stated value, but subsequent expiries shall occur within the nominal tolerance of the stated value.

2 Applications identified at the time this Recommendation is published do not specifically require the use of this parameter. However, for the purpose of ensuring compatibility with possible future signalling application requirements, this default value was identified.

Annex A

Protocol Implementation Conformance (PICS) pro forma to Recommendation Q.2130[1)]

(This annex forms an integral part of this Recommendation)

A.1 General

The supplier of a protocol implementation claiming to conform to this Recommendation, shall complete the following Protocol Implementation Conformance Statement (PICS) pro forma and accompany it by the information necessary to identify fully both the supplier and the implementation (see Recommendation X.290 [10]). This PICS pro forma applies to the B-ISDN interfaces.

The PICS is a document specifying the capabilities and options which have been implemented, and any features which have been omitted, so that the implementation can be tested for conformance against relevant requirements, and against those requirements only.

This PICS has several uses, the most important are the static conformance review and test case selection in order to identify which conformance tests are applicable to this product.

The PICS pro forma is a document, in the form of a questionnaire, normally designed by the protocol specifier or conformance test suite specifier which, when completed for an implementation or system, becomes the PICS.

This PICS pro forma applies to the B-ISDN SSCF for UNI Signalling and the SSCOP implementation used to support it. Certain mandatory SSCOP functions are not necessary for support of UNI signalling, but may be needed to support other SSCFs. This PICS identifies such mandatory functions as optional for UNI signalling.

Subsection A.5 covers the SSCOP Q.2110 Protocol Capabilities, Protocol Data Units, and System Parameters. Subsection A.6 covers the SSCOP Q.2110 and SSCF UNI Q.2130 Protocol Capabilities. In Subsection A.6, the SSCOP messages and the primitives of the upper boundary of SSCF UNI are the capabilities highlighted.

NOTE – Annex B is not covered by these PICS pro forma.

A.2 Abbreviations and special symbols

CPE	Customer Premises Equipment
IUT	Implementation Under Test
M	Mandatory
N/A	Not Applicable
O	Optional
O.<n>	Optional, but, if chosen, support is required for either at least one or only one of the options in the group labelled by the same numeral <n>
P	Prohibited
PC	Prefix for the Index number of the Protocol Capabilities group
PD	Prefix for the Index number of the Protocol Data Units group
PICS	Protocol Implementation Conformance Statement
PIXIT	Protocol Implementation Extra Information for Testing
S.<i>	Supplementary Information number i
SP	Prefix for the Index number of the System Parameter group
SUPC	Prefix for the Index number of the SSCOP-SSCF UNI Protocol Capabilities group
X.<i>	Exceptional Information number i

The references noted in the reference column are from Q.2110, unless preceded by Q.2130. Once Q.2130 appears in the referenced cell, all following references are from that document (i.e. Q.2130).

---

1) Copyright release for PICS pro formas:
Users of this document may freely reproduce the PICS pro forma in this annex, so that it may be used for its intended purpose and may further publish the completed PICS.

A.3 Instructions for completing the PICS pro forma

The main part of the PICS pro forma is a fixed-format questionnaire, divided into three sections. Answers to the questionnaire are to be provided in the right most column, either by simply marking an answer to indicate a restricted choice (such as Yes or No), or by entering a value or a set or range of values.

A supplier may also provide additional information, categorized as either Exceptional Information or Supplementary Information (other than PIXIT). When present, each kind of additional information is to be provided as items labelled X.<i> or S.<i> respectively for cross-reference purposes, where <i> is any unambiguous identification for the item. An exception item should contain the appropriate rationale. The Supplementary Information is not mandatory and the PICS is complete without such information. The presence of optional supplementary or exceptional information should not affect test execution, and will in no way affect static conformance verification.

NOTE – Where an implementation is capable of being configured in more than one way, a single PICS may be able to describe all such configurations. However, the supplier has the choice of providing more than one PICS, each covering some subset of the implementation's configuration capabilities, in case this makes for easier or clearer presentation of the information.

A.4 Global statement of conformance

Global statement: The implementation specified in this PICS meets all the mandatory requirements of the referenced standards:

Yes/No

NOTE – Answering "No" to this question indicates non-conformance to this Recommendation. Non-supported mandatory capabilities are to be listed in the PICS below, with an explanation for the abnormal status of the implementation.

The supplier will have fully complied with the requirements for a statement of conformance by completing the statement contained in this subclause. However, the supplier may find it helpful to continue to complete the detailed tabulations in the subclauses which follow.

A.5 SSCOP – Q.2110

A.5.1 Protocol Capabilities (PC) – SSCOP

See Table A.1.

TABLE A.1/Q.2130

ITEM #	Protocol Feature	Status	References	Support
PC1	Does IUT support Keep Alive function?	M	Q.2110 5 e)	Yes:__No:__X:__
PC2	Does IUT support the Local Data Retrieve function?	O	Q.2110 5 f)	Yes:__No:__X:__
PC3	Does the IUT support SSCOP initiated error recovery due to protocol error?	M	Q.2110 5 i)	Yes:__No:__X:__
PC4	Does the IUT recognize the following Messages regardless of state?		Table 2/Q.2110	
	BGN	M		Yes:__No:__X:__
	BGAK	M		Yes:__No:__X:__
	BGREJ	O		Yes:__No:__X:__
	END	M		Yes:__No:__X:__
	ENDAK	M		Yes:__No:__X:__
	ER	M		Yes:__No:__X:__

TABLE A.1/Q.2130 (*end*)

ITEM #	Protocol Feature	Status	References	Support
PC4	Does the IUT recognize the following Messages regardless of state?		Table 2/Q.2110	
	ERAK	M		Yes:__No:__X:__
	POLL	M		Yes:__No:__X:__
	STAT	M		Yes:__No:__X:__
	USTAT	M		Yes:__No:__X:__
	RS	M		Yes:__No:__X:__
	RSAK	M		Yes:__No:__X:__
	SD	M		Yes:__No:__X:__
	UD	M		Yes:__No:__X:__
	MD	O		Yes:__No:__X:__
PC5.1	In the absence of protocol error, does the IUT support assured data transfer with sequence integrity?	M	Q.2110 5 a) h); 7.1 j)	Yes:__No:__X:__
PC5.2	Does IUT support the sending of the Unassured Data PDU?	M	Q.2110 5 h); 7.1 n)	Yes:__No:__X:__
PC5.3	Does IUT support the sending of the Management Data PDU?	O	Q.2110 7.1 o)	Yes:__No:__X:__
PC6	Does IUT support user invoked resynchronization procedures?	M	Q.2110 5 g)	Yes:__No:__X:__
PC7	Does IUT support the establishment procedures for an SSCOP connection?	M	Q.2110 5 g)	Yes:__No:__X:__
PC8	Does IUT support release procedures for an SSCOP connection?	M	Q.2110 5 g)	Yes:__No:__X:__
PC9	Does IUT support polling after retransmission?	O	Q.2110 SDL	Yes:__No:__X:__
PC10	Does IUT support the segmenting of STAT PDUs?	M	7.2.5/Q.2110	Yes:__No:__X:__
PC11	Can the IUT initiate SSCOP connection?	M	Q.2110 5 g)	Yes:__No:__X:__
PC12	Can the IUT reject (BGREJ) the establishment of an SSCOP connection from its peer?	N/A	Q.2110 SDL	Yes:__No:__X:__
PC13	Does IUT support error reporting to layer management?	M	Q.2110 5 d)	Yes:__No:__X:__
PC14	Does IUT support the Protocol error detection function?	M	Q.2110 5 i)	Yes:__No:__X:__
PC15	When no SSCOP connection exists, is a connection established only upon receipt of a BGN or a request from the SSCOP user?	M	Q.2110 SDL	Yes:__No:__X:__
PC16	Does SSCOP permit the conveyance of SSCOP User-to-User Information between users of the SSCOP?	O	Q.2110 5 g); 6.1.2 b)	Yes:__No:__X:__

A.5.2 SSCOP PDUs – Protocol data units (PD)

See Table A.2.

TABLE A.2/Q.2130

ITEM #	Protocol Feature	Status	References	Support
Order of Octet Transmission				
PD1	Ascending numerical order	M	7.2.1/Q.2110	Yes:__No:__X:__
Field Mapping Convention				
PD2	Lowest bit number = Lowest order value	M	7.2.1/Q.2110	Yes:__No:__X:__
PD3	Are PDU formats 32 bit aligned?	M	7.2/Q.2110	Yes:__No:__X:__
PD4	Are all reserved bits coded as zeros?	M	7.2.3/Q.2110	Yes:__No:__X:__

A.5.3 SSCOP system parameters (SP)

See Table A.3.

TABLE A.3/Q.2130

ITEM #	Protocol Feature	Status	References	Support
SP1	Maximum number of transmissions of a BGN, END, ER, or RS PDU (MaxCC)	M	Q.2110 7.7 a); 11/Q.2130 Table 4/Q.2130	Yes:__No:__X:__Value:_
SP2	Maximum number of SD PDUs before transmission of a POLL PDU (MaxPD)	M	Q.2110 7.7 b); 11/Q.2130 Table 4/Q.2130	Yes:__No:__X:__Value:_
SP3	Maximum number of List Elements in a STAT (MaxSTAT)?	M	Q.2110 7.7 c)	Yes:__No:__X:__Value:_
SP4	Maximum SSCOP SDU size	M	Q.2110 7.2.4; 11/Q.2130 Table 4/Q.2130	Yes:__No:__X:__Value:_
SP5	Timer_POLL	M	Q.2110 7.6 a); 11/Q.2130 Table 4/Q.2130	Yes:__No:__X:__Value:_
SP6	Timer_KEEP-ALIVE	M	Q.2110 7.6 b); 11/Q.2130 Table 4/Q.2130	Yes:__No:__X:__Value:_
SP7	Timer_NO-RESPONSE	M	Q.2110 7.6 c); 11/Q.2130 Table 4/Q.2130	Yes:__No:__X:__Value:_
SP8	Timer_IDLE	M	Q.2110 7.6 c); 11/Q.2130 Table 4/Q.2130	Yes:__No:__X:__Value:_
SP9	Timer_CC	M	Q.2110 7.6 d); 11/Q.2130 Table 4/Q.2130	Yes:__No:__X:__Value:_
SP10	If PC16 is supported, what is the maximum size of the SSCOP-UU?	M	Q.2110 6.1.2 b); 11/Q.2130 Table 4/Q.2130	Yes:__No:__X:__Value:_

A.6 SSCOP-SSCF UNI protocol capabilities (SUPC)

This subclause asks questions of the combined SSCOP and SSCF functional block (see Table A.4). This subclause is divided into two subclauses. One is for the establishment and release of an SSCOP connection. The other is for the data transfer. Within these two divisions there are two subdivisions. These two subdivisions concern the direction of information flow through the combined SSCOP and SSCF functional block. The following convention for terminology should be followed:

- The U-UNI represents the upper boundary of the SSCF.
- The primitives exchanged between the SSCF and the SSCOP are shown in [] in the PICS questions. These primitives do not constrain an implementation.
- The SSCOP represents the peer-to-peer messages (e.g. PDUs).

TABLE A.4/Q.2130

ITEM #	Protocol Feature	Status	References	Support
ESTABLISHMENT/RELEASE				
SSCOP -> -> Upper boundary of SSCF UNI (U-UNI)				
SUPC1	Does the receipt of SSCOP PDU BGN [AA-ESTABLISH indication] generate AAL-ESTABLISH indication at U-UNI?	M	Table 3/Q.2130, Figure I.1/Q.2130	Yes:__No:__X:__
SUPC2	In addition to SUPC1, does SSCOP send PDU BGAK [AA-ESTABLISH response] to accept the connection request?	M	Table 3/Q.2130, Figure I.1/Q.2130	Yes:__No:__X:__
SUPC3	On receipt of SSCOP PDU END [AA-RELEASE indication], does IUT generate AAL-RELEASE indication at U-UNI, and does the SSCOP send PDU ENDAK [AA-RELEASE response]?	M	Table 3/Q.2130, Figure I.6/Q.2130	Yes:__No:__X:__
Upper boundary of SSCF UNI (U-UNI) -> -> SSCOP				
SUPC4	Does an AAL-ESTABLISH request (U-UNI) generate an SSCOP PDU BGN [AA-ESTABLISH request]?	M	Table 3/Q.2130, Figure I.1/Q.2130	Yes:__No:__X:__
SUPC5	Does the receipt of an SSCOP PDU BGAK [AA-ESTABLISH confirm] in response to the sending of an SSCOP PDU BGN generate an AAL-ESTABLISH confirm at U-UNI?	M	Table 3/Q.2130, Figure I.1/Q.2130	Yes:__No:__X:__
SUPC6	Does an AAL-RELEASE request (U-UNI) generate an SSCOP PDU END [AA-RELEASE request]?	M	Table 3/Q.2130, Figure I.6/Q.2130	Yes:__No:__X:__
SUPC7	Does the receipt of an SSCOP PDU ENDAK [AA-RELEASE confirm] in response to the sending of an SSCOP END PDU generate a AAL-RELEASE confirm at U-UNI?	M	Table 3/Q.2130, Figure I.6/Q.2130	Yes:__No:__X:__
DATA TRANSFER				
SSCOP -> -> Upper boundary of SSCF UNI (U-UNI)				
SUPC8	Does receipt of an in-sequence SSCOP PDU SD [AA-DATA indication] generate AAL-DATA indication at U-UNI?	M	Table 3/Q.2130	Yes:__No:__X:__
SUPC9	Does receipt of an SSCOP PDU UD [AA-UNITDATA indication] generate AAL-UNITDATA indication at U-UNI?	M	Table 3/Q.2130	Yes:__No:__X:__
Upper boundary of SSCF UNI (U-UNI) -> -> SSCOP				

TABLE A.4/Q.2130 (*end*)

ITEM #	Protocol Feature	Status	References	Support
SUPC10	Does an AAL-UNITDATA request (U-UNI) generate an SSCOP PDU UD [AA-UNITDATA request]?	M	Table 3/Q.2130	Yes:__No:__X:__
SUPC11	Does an AAL-DATA request (U-UNI) generate an SSCOP PDU SD [AA-DATA request] while a connection is established and credit is available?	M	Table 3/Q.2130	Yes:__No:__X:__
RE-ESTABLISHMENT				
SSCOP -> -> Upper boundary of SSCF UNI (U-UNI)				
SUPC12	Does the receipt of SSCOP PDU RS [AA-RESYNC indication] generate AAL-ESTABLISH indication at U-UNI?	M	Table 3/Q.2130, Figure I.10/Q.2130	Yes:__No:__X:__
SUPC13	In addition to SUPC12, does SSCOP send PDU RSAK [AA-RESYNC response] to accept the connection request?	M	Table 3/Q.2130, Figure I.10/Q.2130	Yes:__No:__X:__
SUPC14	On receipt of SSCOP PDU ER [AA-RECOVER indication], does IUT generate AAL-ESTABLISH indication at U-UNI, and does the SSCOP send PDU ERAK [AA-RECOVER response]?	M	Table 3/Q.2130, Figure I.15/Q.2130	Yes:__No:__X:__
SUPC15	On receipt of SSCOP PDU ERAK [AA-RECOVER indication], does IUT generate AAL-ESTABLISH indication at U-UNI?	M	Table 3/Q.2130, Figure I.15/Q.2130	Yes:__No:__X:__
Upper boundary of SSCF UNI (U-UNI) -> -> SSCOP				
SUPC16	Does an AAL-ESTABLISH request (U-UNI) generate an SSCOP PDU RS [AA-RESYNC request]?	M	Table 3/Q.2130, Figure I.10/Q.2130	Yes:__No:__X:__
SUPC17	Does the receipt of an SSCOP PDU RSAK [AA-RESYNC confirm] in response to the sending of an SSCOP PDU RS generate an AAL-ESTABLISH confirm at U-UNI?	M	Table 3/Q.2130, Figure I.10/Q.2130	Yes:__No:__X:__

Annex B

SSCF for Semi-permanent Connection (SPC) control signalling at the UNI

(This annex forms an integral part of this Recommendation)

B.1 Introduction

This annex defines SSCF for SPC control signalling at the UNI. SPC control signalling procedure is specified in Annex G/Q.2931.

B.2 Services of the SAAL at the UNI

The following services are provided by the SAAL at the UNI for supporting SPC control signalling:

a) unacknowledged transfer of data;

b) transparency of transferred information.

B.3 Definition of the boundary of SSCF with layer 3 at the UNI

The primitives required to support the SAAL user at the UNI are shown in Table B.1.

TABLE B.1/Q.2130

SAAL Primitives used at the UNI

Generic Name	Type				Contents of primitive parameter data
	Request	Indication	Response	Confirm	
AAL-UNITDATA	X (Parameter Data)	X (Parameter Data)			L3 peer-to-peer message

B.4 Definition of the boundary of SSCF with SSCOP

The following repertoire of AA-signals between SSCF and SSCOP is defined in Table B.2:

TABLE B.2/Q.2130

Signals with allowed parameters between SSCOP and SSCF at the UNI

Generic Name	Type			
	Request	Indication	Response	Confirm
AA-UNITDATA	MU	MU	Not defined	Not defined

B.5 State transition table of SSCF at UNI

This subclause contains the state transition table Table B.3 of the SSCF at UNI in support of an AAL service.

TABLE B.3/Q.2130

State transition table of SSCF

State	1/1
Event	
AAL-UNITDATA request {Parameter Data}	AA-UNITDATA request {MU := Parameter Data} State 1/1
AA-UNITDATA indication {MU}	AAL-UNITDATA indication {Parameter Data := MU} State 1/1

Appendix I

Protocol data unit and related primitive sequences for establishment and release of AAL connection at UNI

(This appendix does not form part of this Recommendation)

This appendix presents the most relevant sequences for an analysis of the procedures. The peer-to-peer sequences of PDUs are related to AA-signals and AAL-primitives.

The Figure I.1 to Figure I.5 illustrate various establishment cases including collisions and corruption of PDUs. It should be noted that establishment affects the two transmission directions.

The Figure I.6 to Figure I.9 illustrate various release cases including collisions and corruption of PDUs. It should be noted that release affects the two transmission directions.

The Figure I.10 to Figure I.14 illustrate various user initiated re-establishment cases including collisions and corruption of PDUs. The user initiated re-establishment is supported by means of the resynchronization procedures. It should be noted that re-establishment affects the two transmission directions.

The Figure I.15 to Figure I.18 illustrate various recovery cases including collisions and corruption of PDUs. It should be noted that recovery affects the two transmission directions.

The Figure I.19 to Figure I.22 illustrate various cases where there is contention between services invoked, such as release and establish. In particular, these sequences describe how contending service invokes are to be resolved.

The Figure I.23 to Figure I.27 illustrate various cases where a service is invoked while the previously invoked service is not completed yet.

The Figure I.28 to Figure I.30 illustrate various cases where a services are concurrently invoked.

The Figure I.31 to Figure I.32 illustrate two cases where a corruption of PDUs contention and concurrency are combined. These two examples demonstrate efficiency and robustness of SSCOP.

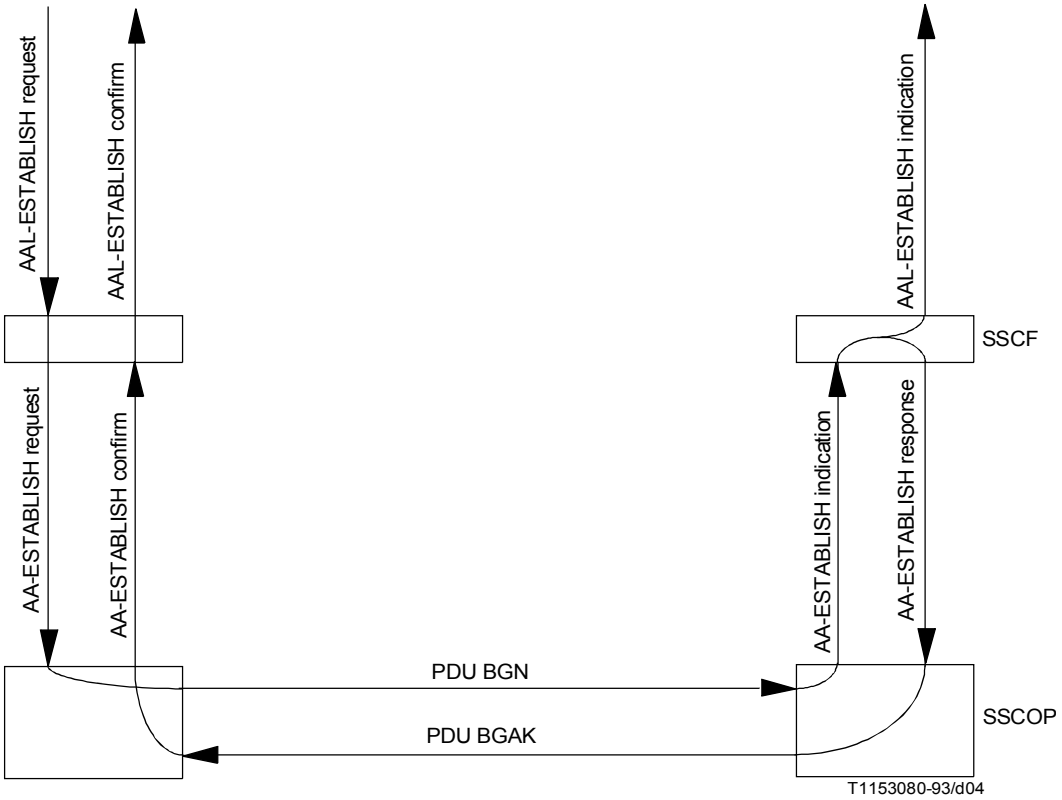


FIGURE I.1/Q.2130

Sequences for establishment of AAL connection

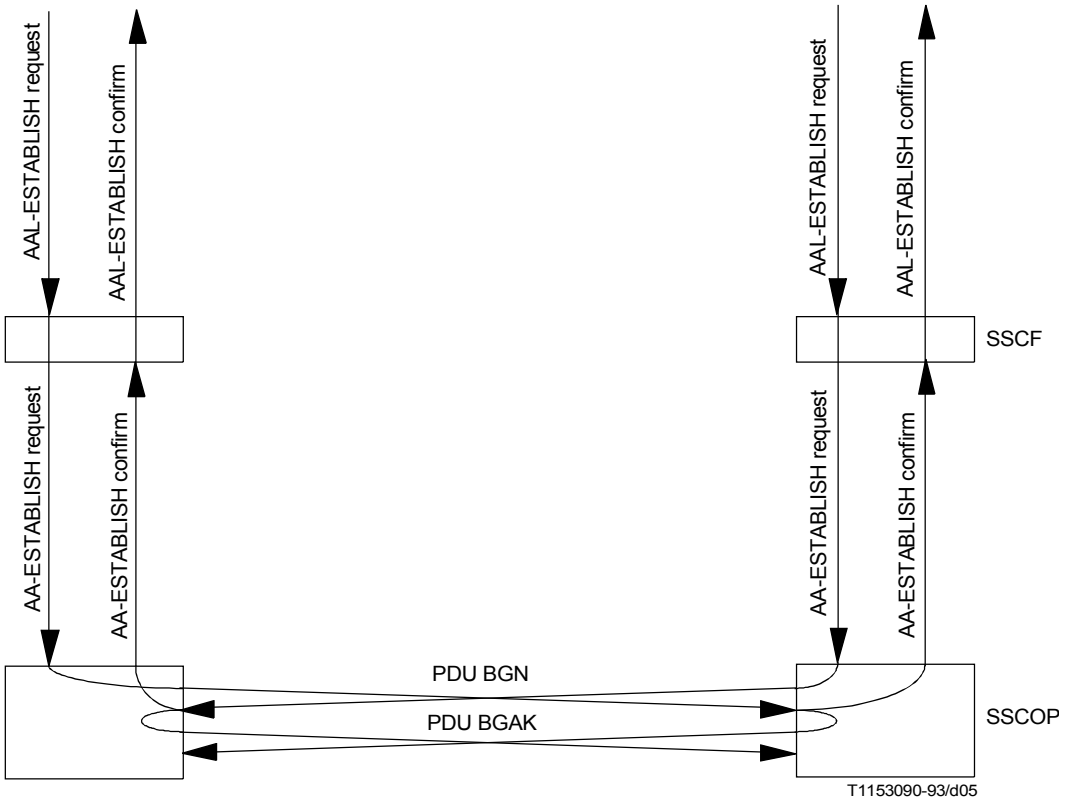


FIGURE I.2/Q.2130

Sequences for establishment of AAL connection in case of peer-to-peer establish collision without corruption of PDU BGN

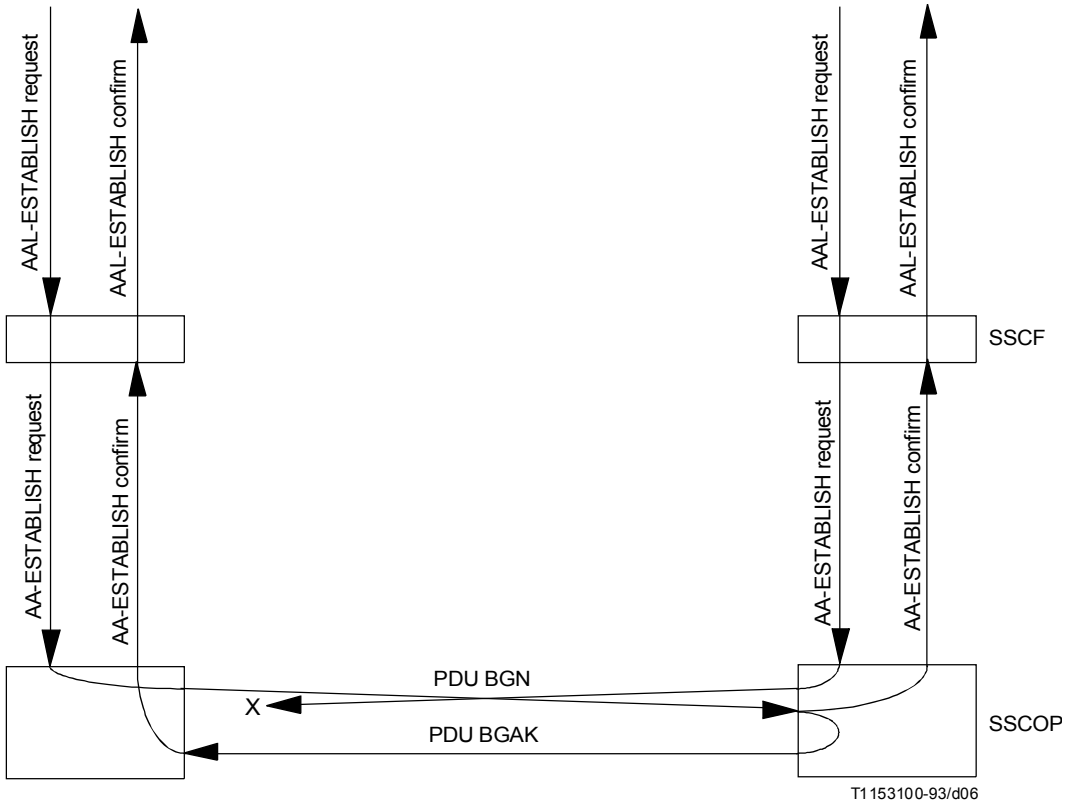


FIGURE I.3/Q.2130

Sequences for establishment of AAL connection in case of peer-to-peer establish collision with corruption of PDU BGN

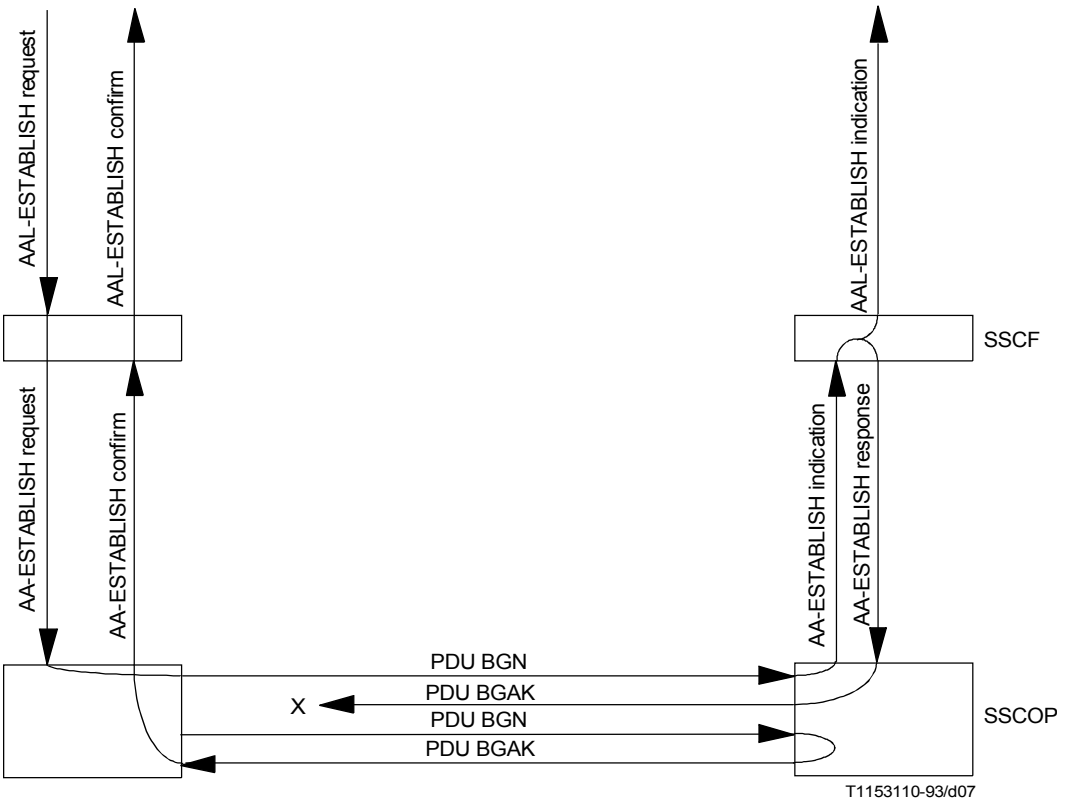


FIGURE I.4/Q.2130

Sequences for establishment of AAL connection in case of corruption of PDU BGAK, but without outstanding PDU SD

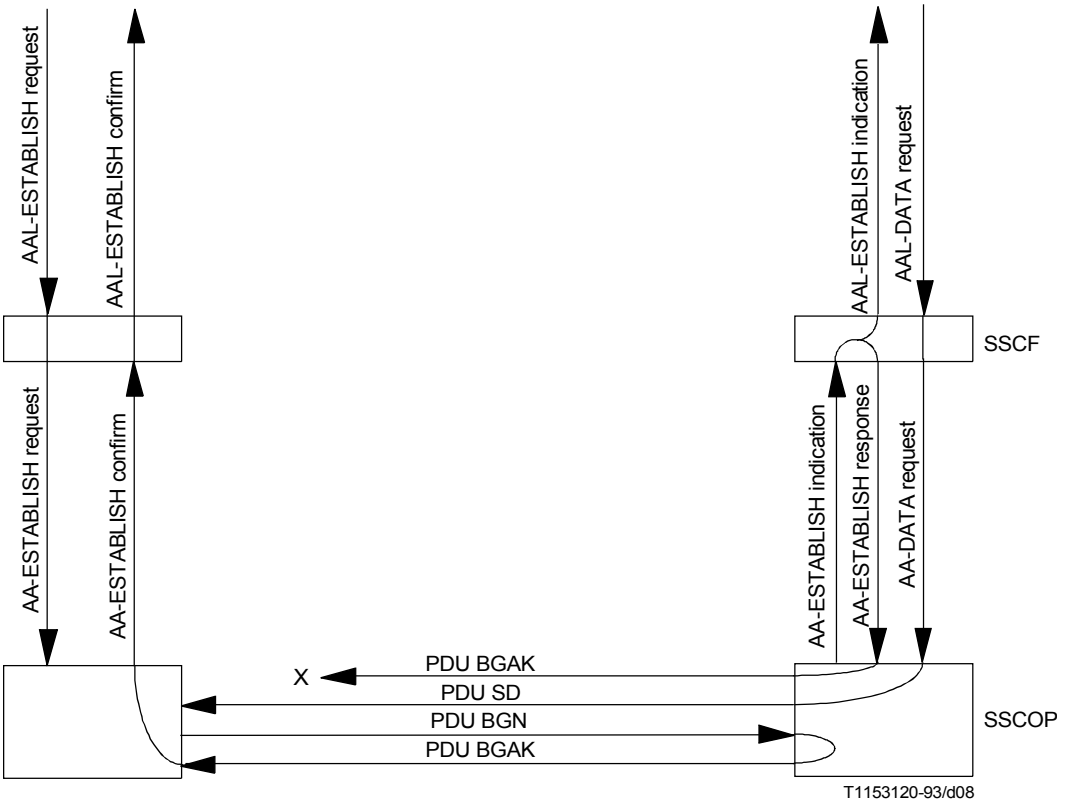


FIGURE I.5/Q.2130

Sequences for establishment of AAL connection in case of corruption of PDU BGAK and with outstanding PDU SD

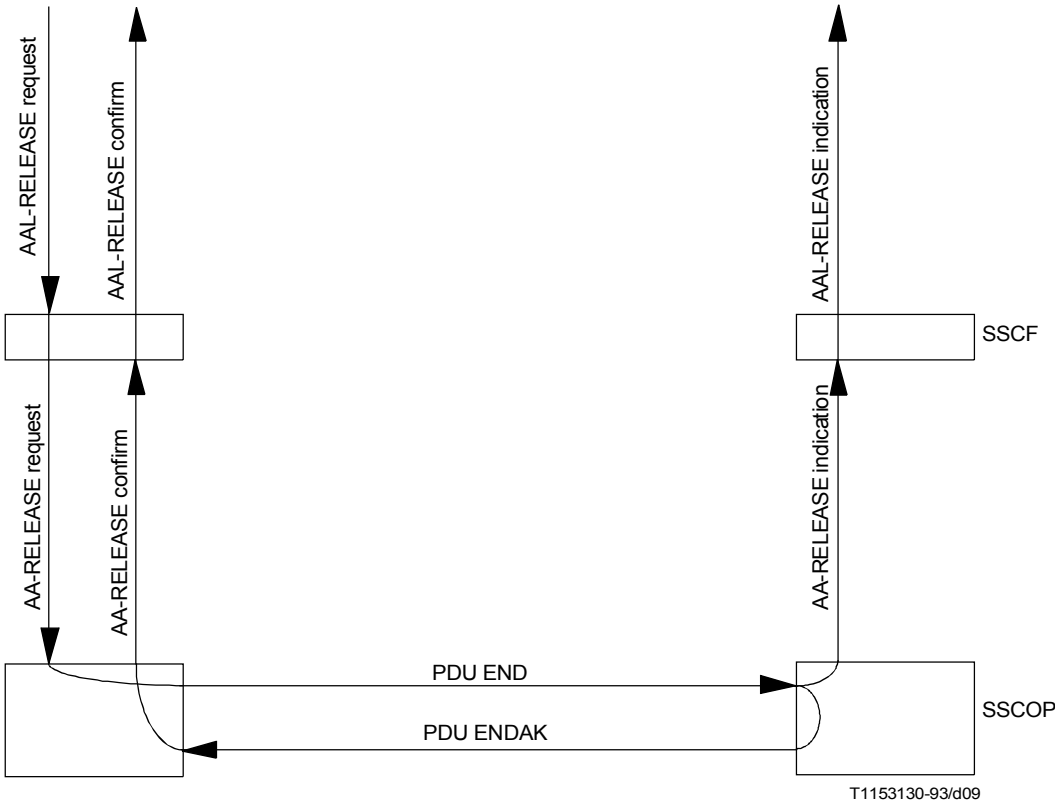


FIGURE I.6/Q.2130

Sequences for release of AAL connection

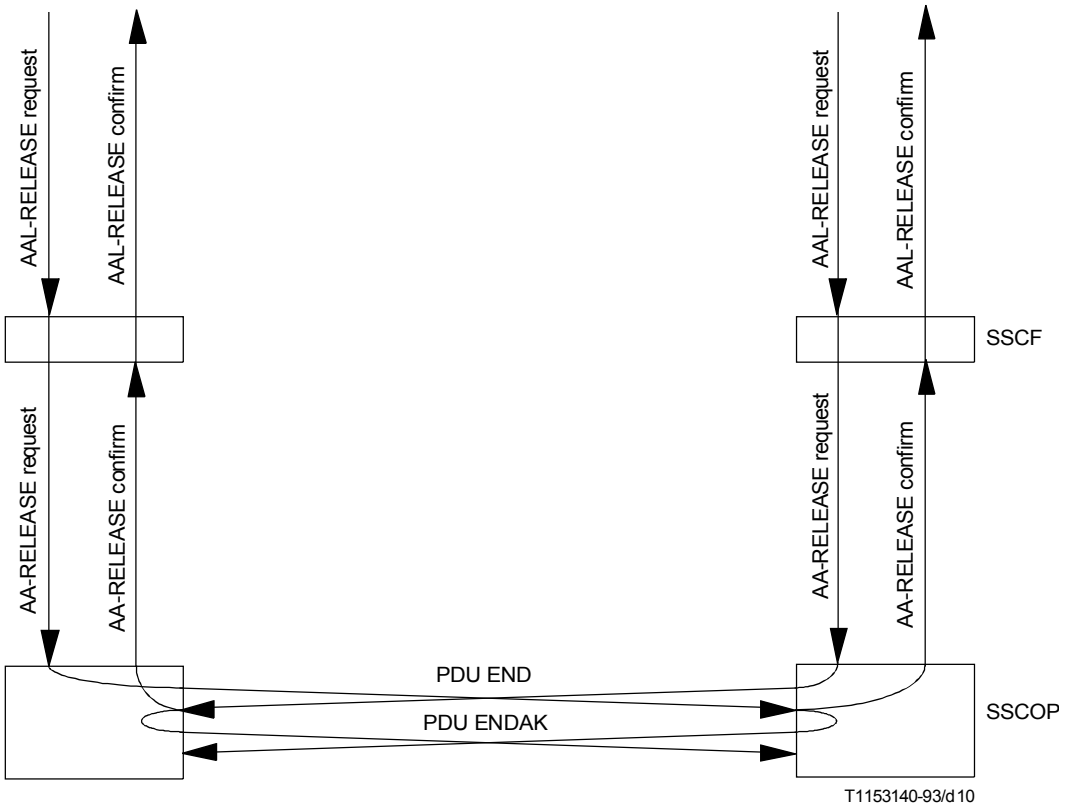


FIGURE I.7/Q.2130

Sequences for release of AAL connection in case of peer-to-peer release collision without corruption of PDU END

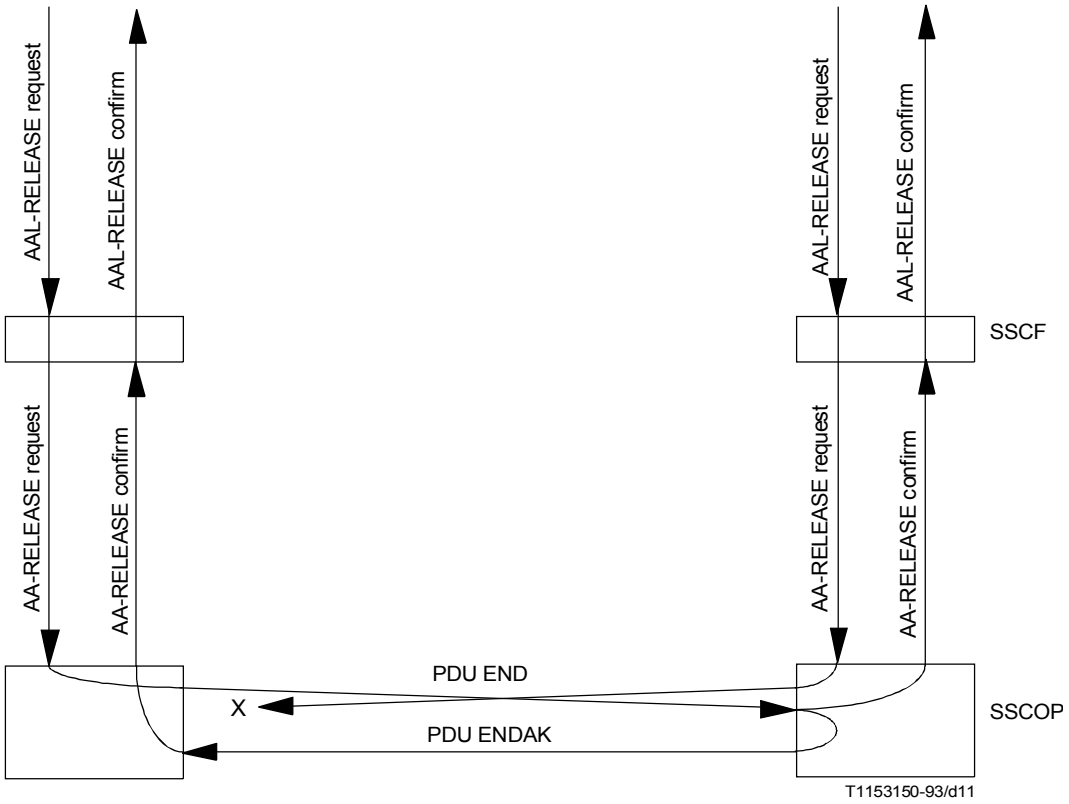


FIGURE I.8/Q.2130

Sequences for release of AAL connection in case of peer-to-peer release collision with corruption of PDU END

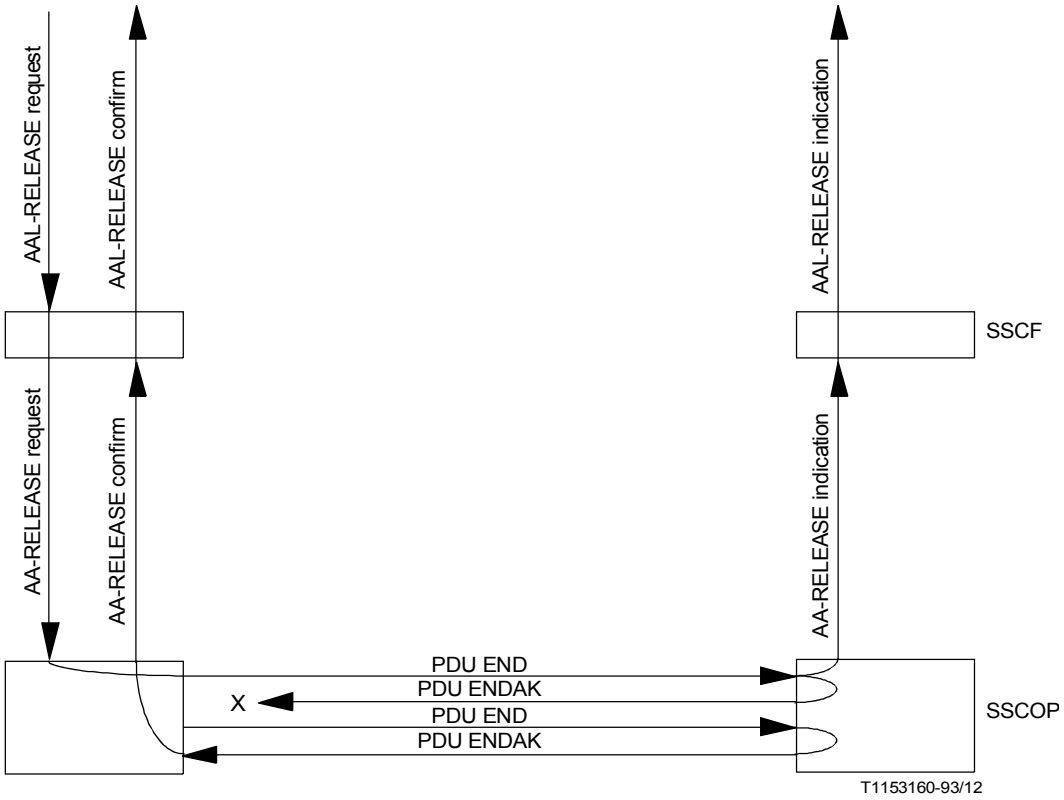


FIGURE I.9/Q.2130

Sequences for release of AAL connection in case of corruption of PDU ENDAK

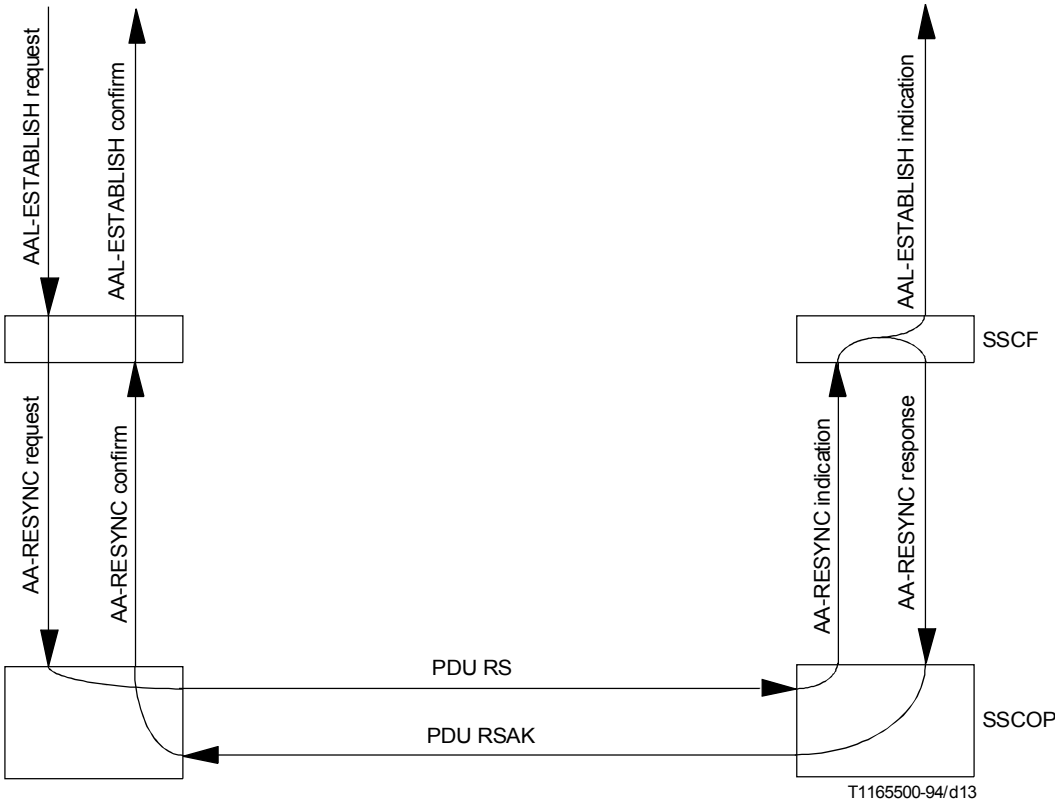


FIGURE I.10/Q.2130

Sequences for re-establishment of AAL connection

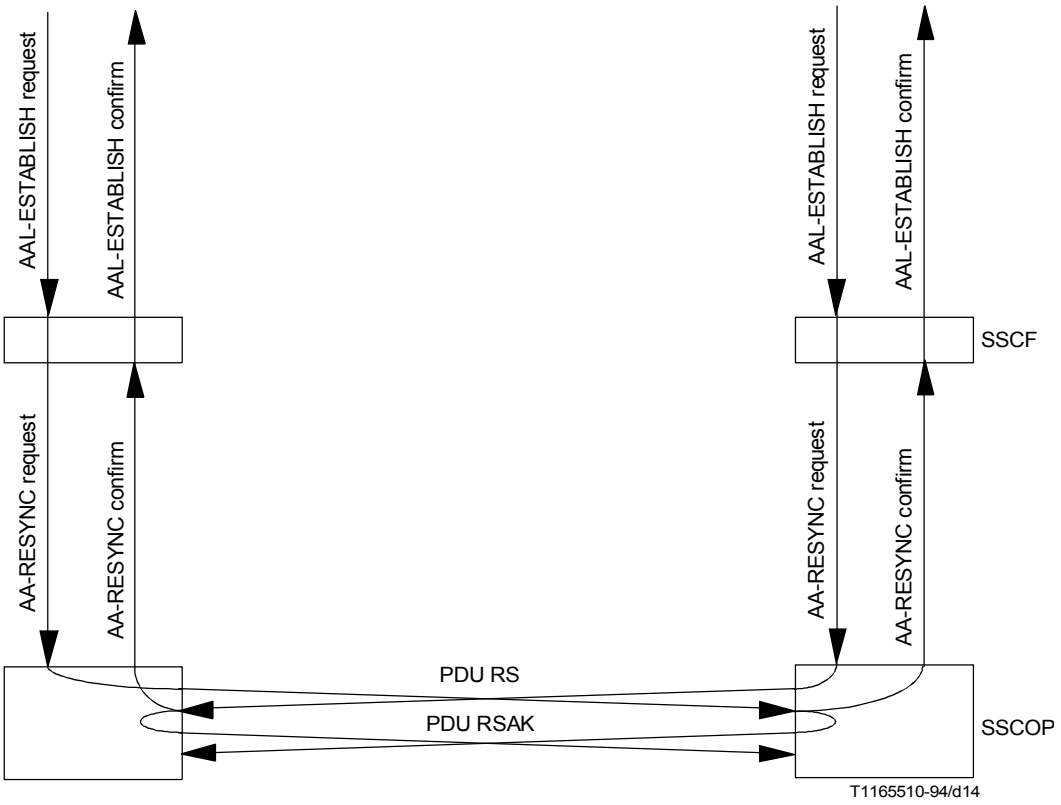


FIGURE I.11/Q.2130

Sequences for re-establishment of AAL connection in case of peer-to-peer resynchronization collision without corruption of PDU RS

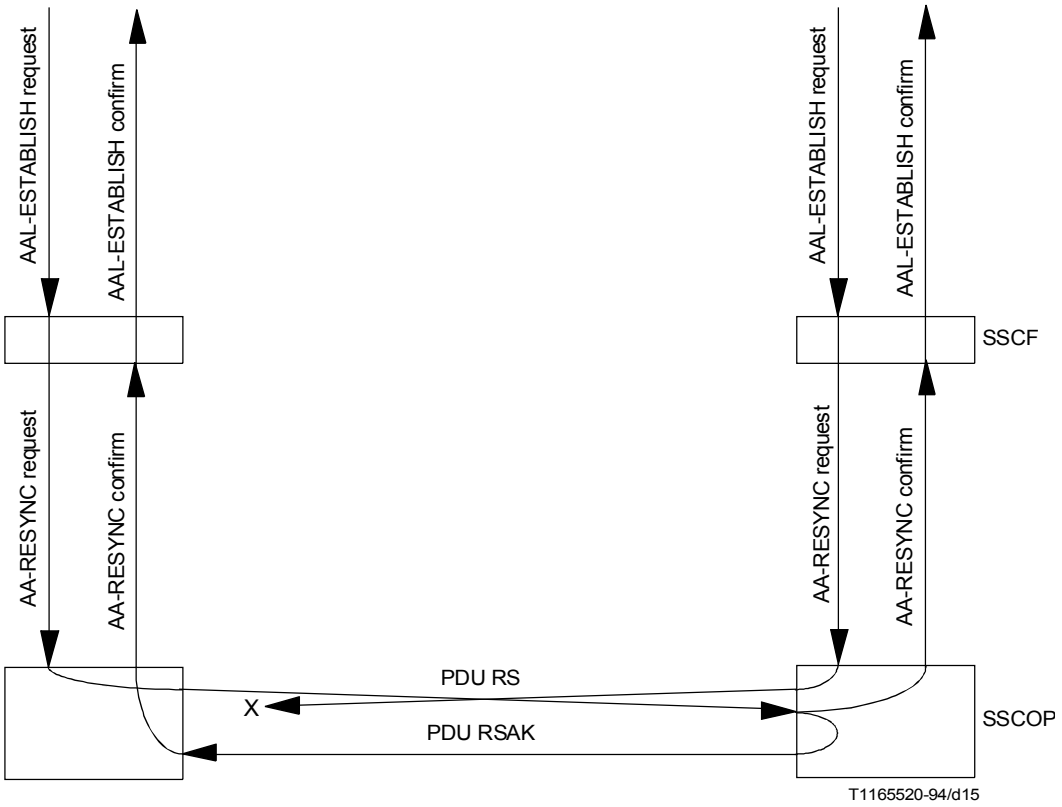


FIGURE I.12/Q.2130

Sequences for re-establishment of AAL connection in case of peer-to-peer resynchronization collision with corruption of PDU RS

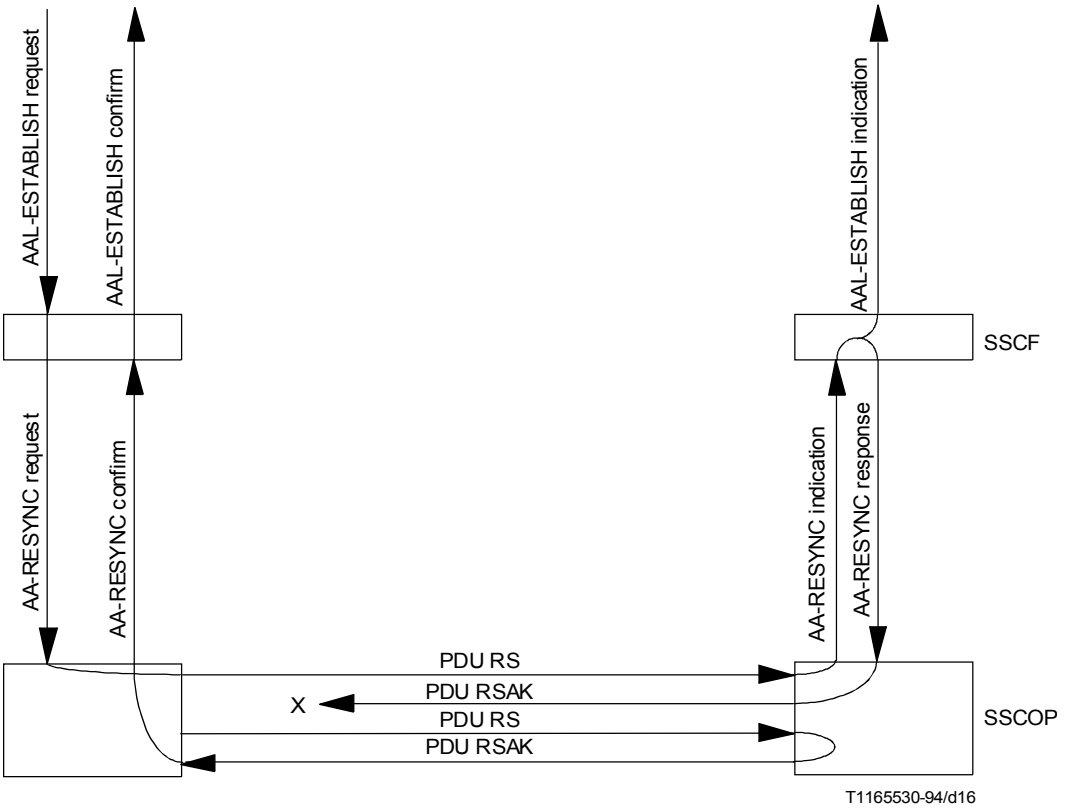


FIGURE I.13/Q.2130

Sequences for re-establishment of AAL connection in case of corruption of PDU RSAK, but without outstanding PDU SD

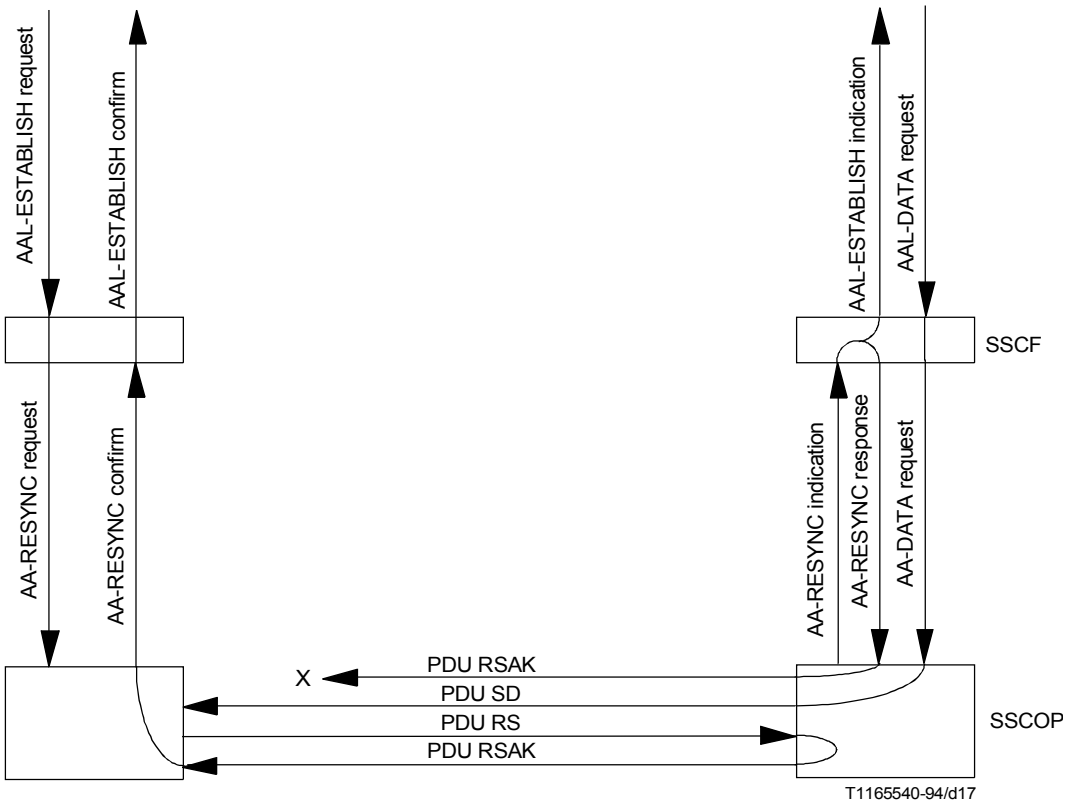


FIGURE I.14/Q.2130

Sequences for re-establishment of AAL connection in case of corruption of PDU RSAK, and with outstanding PDU SD

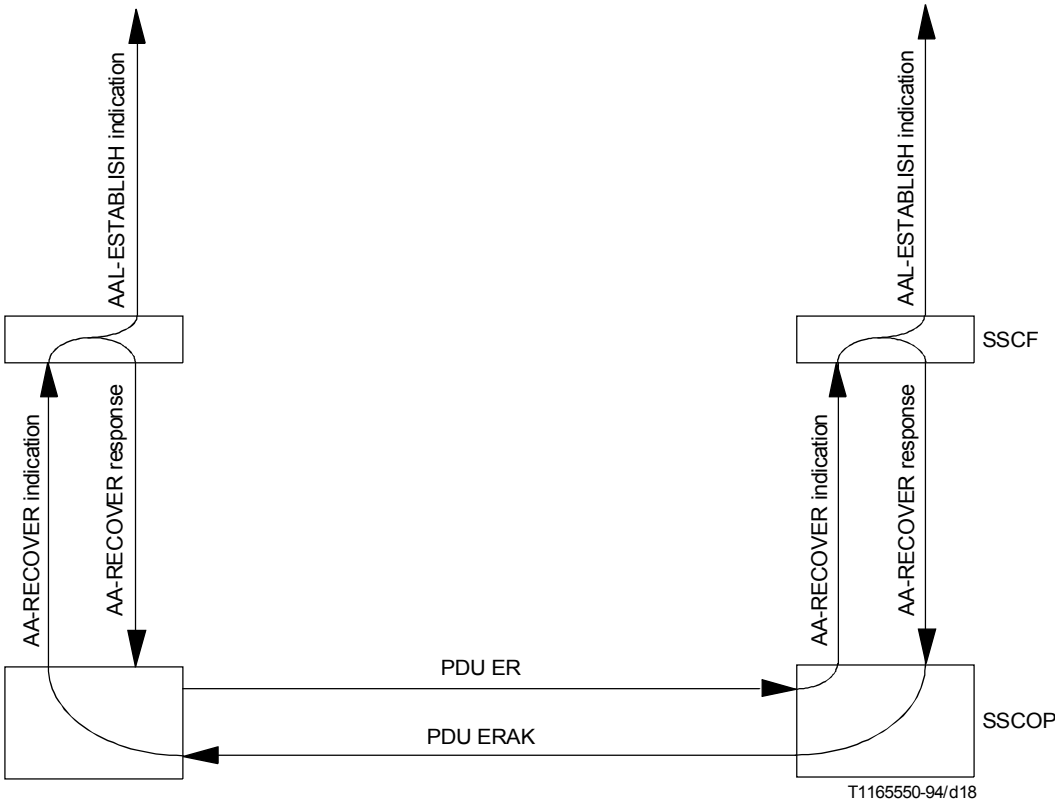


FIGURE I.15/Q.2130

Sequences for recovery of AAL connection

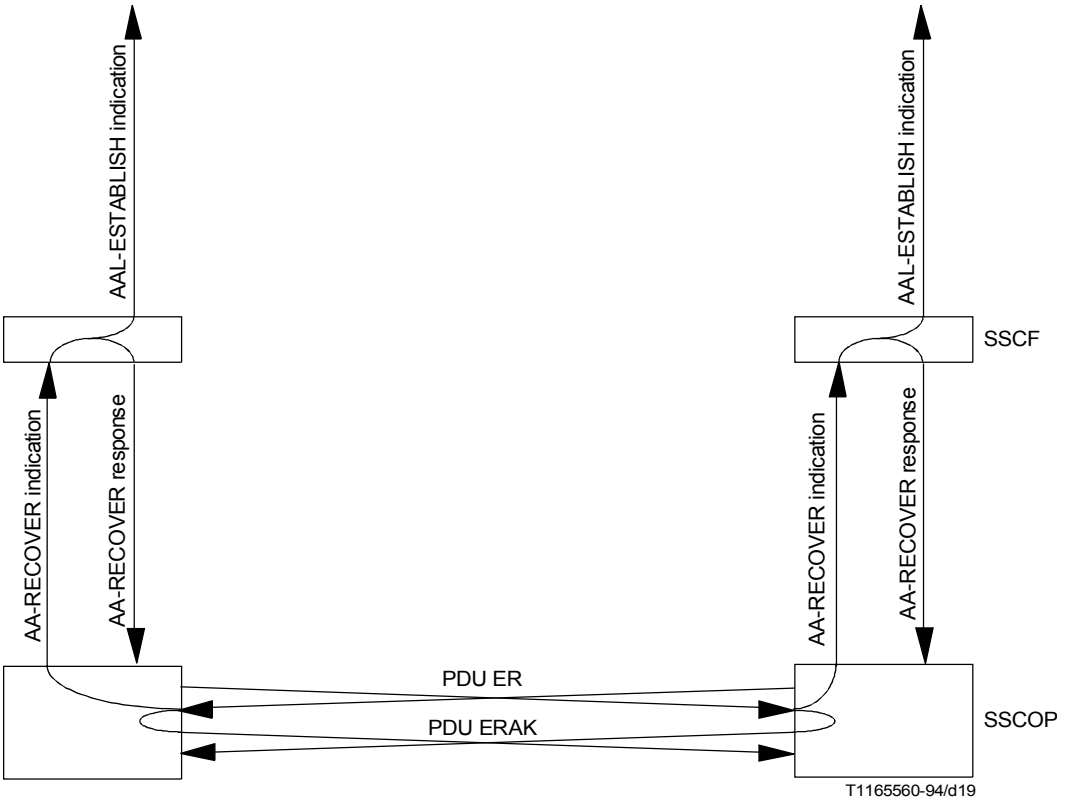


FIGURE I.16/Q.2130

Sequences for recovery of AAL connection in case of peer-to-peer recovery collision without corruption of PDU ER

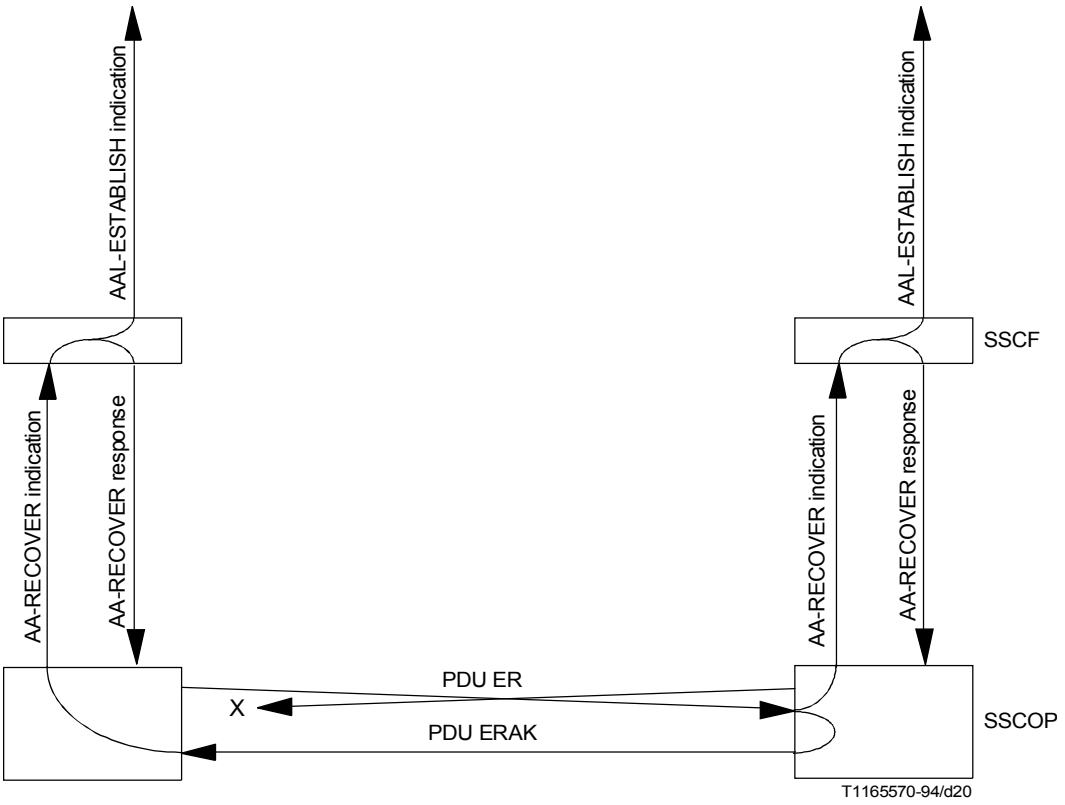


FIGURE I.17/Q.2130

Sequences for recovery of AAL connection in case of peer-to-peer recovery collision with corruption of PDU ER

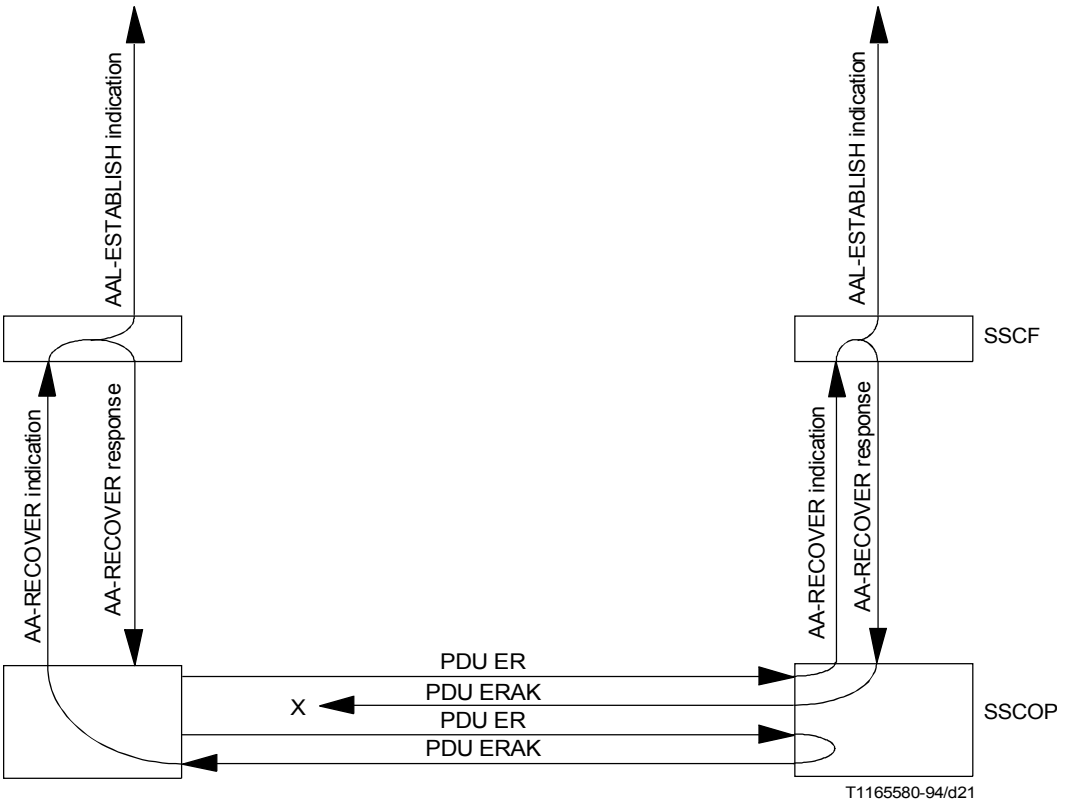


FIGURE I.18/Q.2130

Sequences for recovery of AAL connection in case of corruption of PDU ERAK

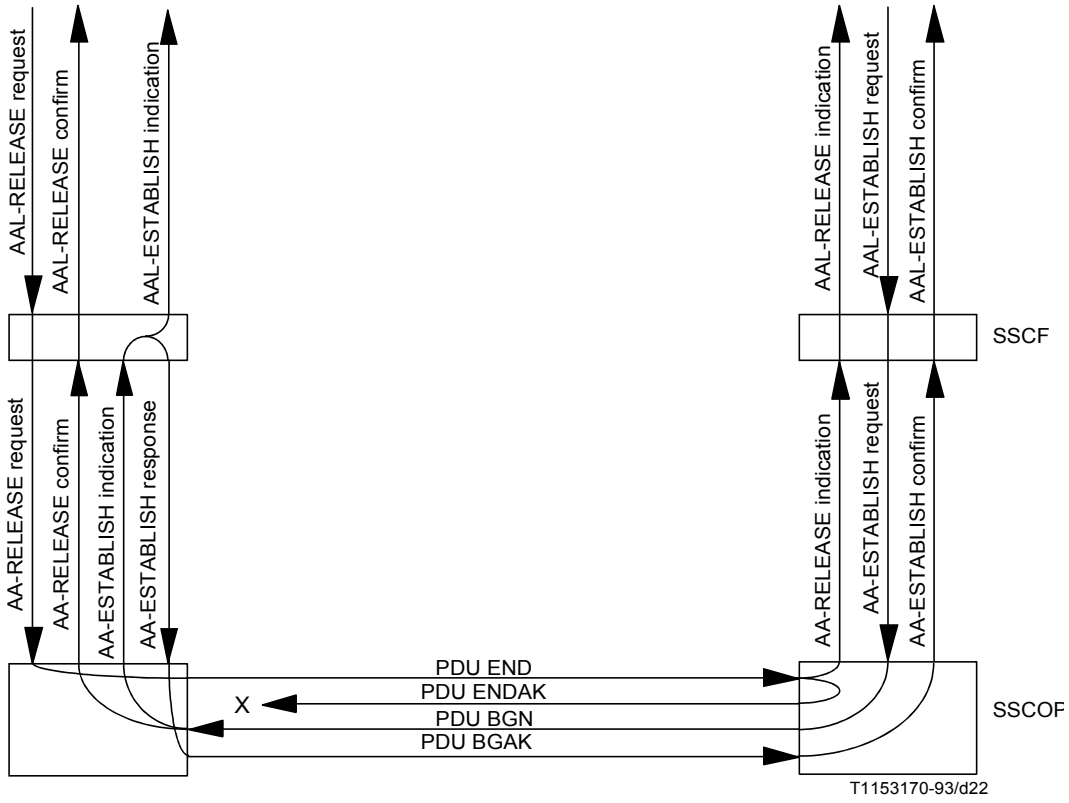


FIGURE I.19/Q.2130

Sequences for release of AAL connection with corrupted PDU ENDAK followed by connection establishment with PDU BGN arrival before retransmission of PDU END

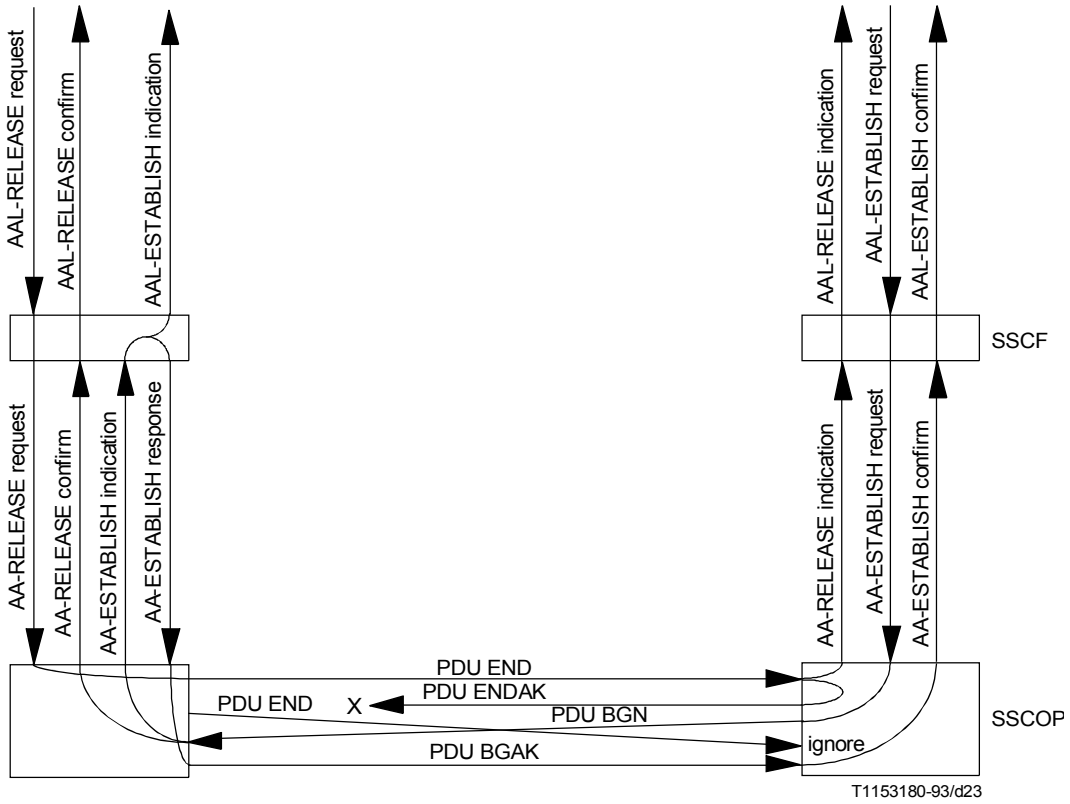


FIGURE I.20/Q.2130

Sequences for release of AAL connection with corrupted PDU ENDAK followed by connection establishment with PDU BGN in collision with retransmitted PDU END

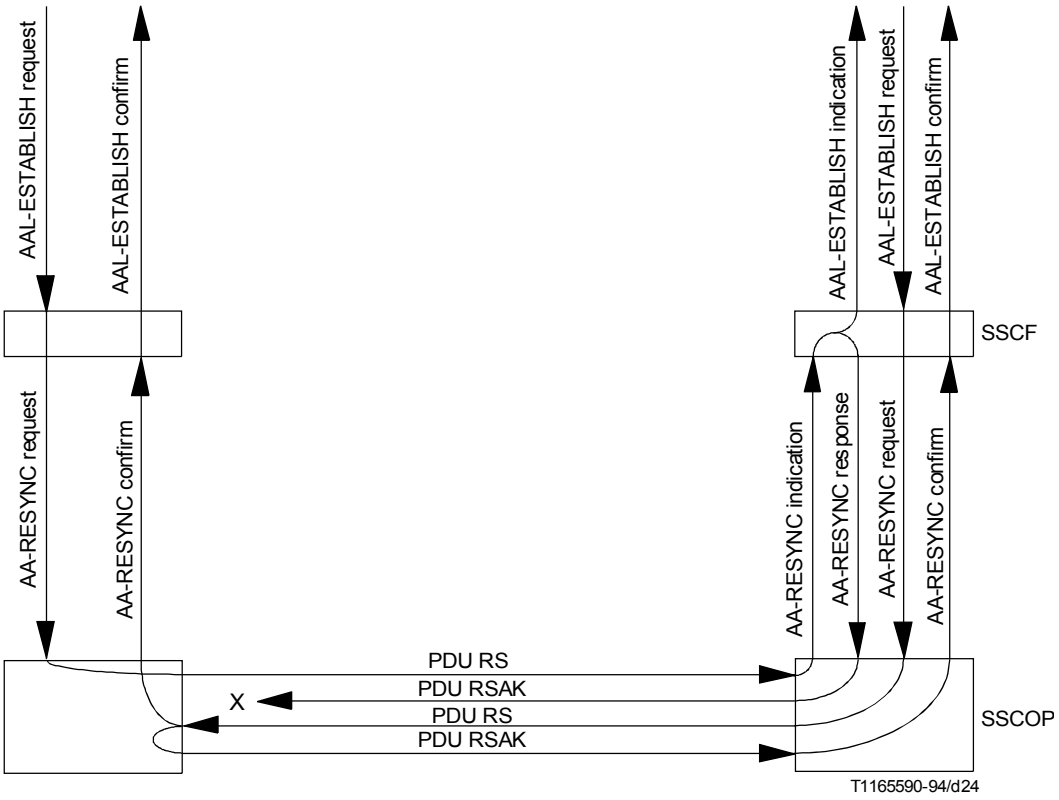


FIGURE I.21/Q.2130

Sequences for re-establishment of AAL connection with corrupted PDU RSAK followed by connection re-establishment with PDU RS arrival before retransmission of PDU RS

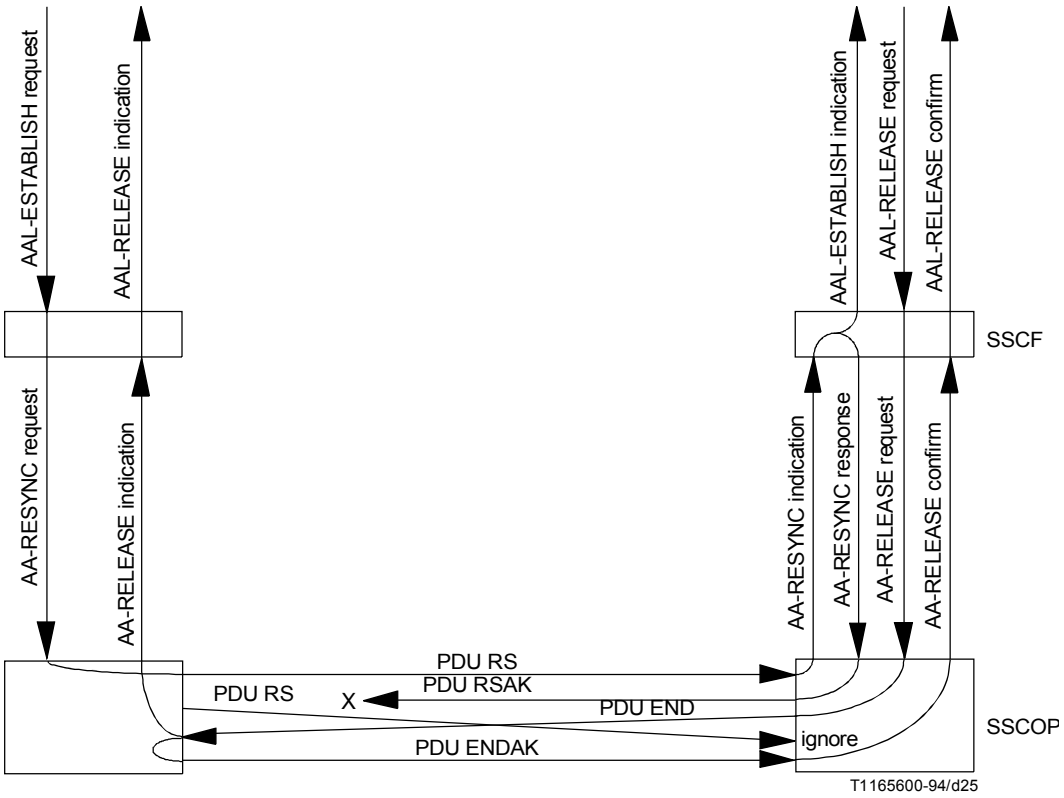


FIGURE I.22/Q.2130

Sequences for re-establishment of AAL connection with corrupted PDU RSAK followed by connection release with PDU END in collision with retransmitted PDU RS

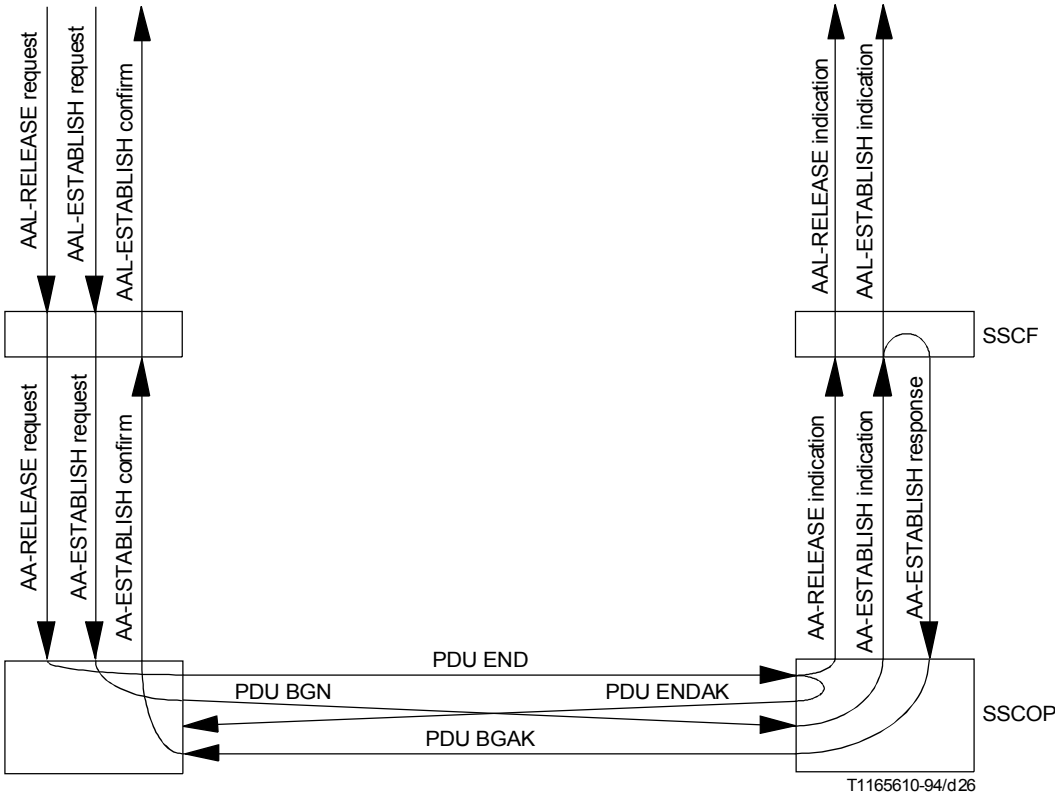


FIGURE I.23/Q.2130

Sequences for release of AAL connection followed by connection establishment while release is pending with peer-to-peer collision of PDUs ENDAK and BGN

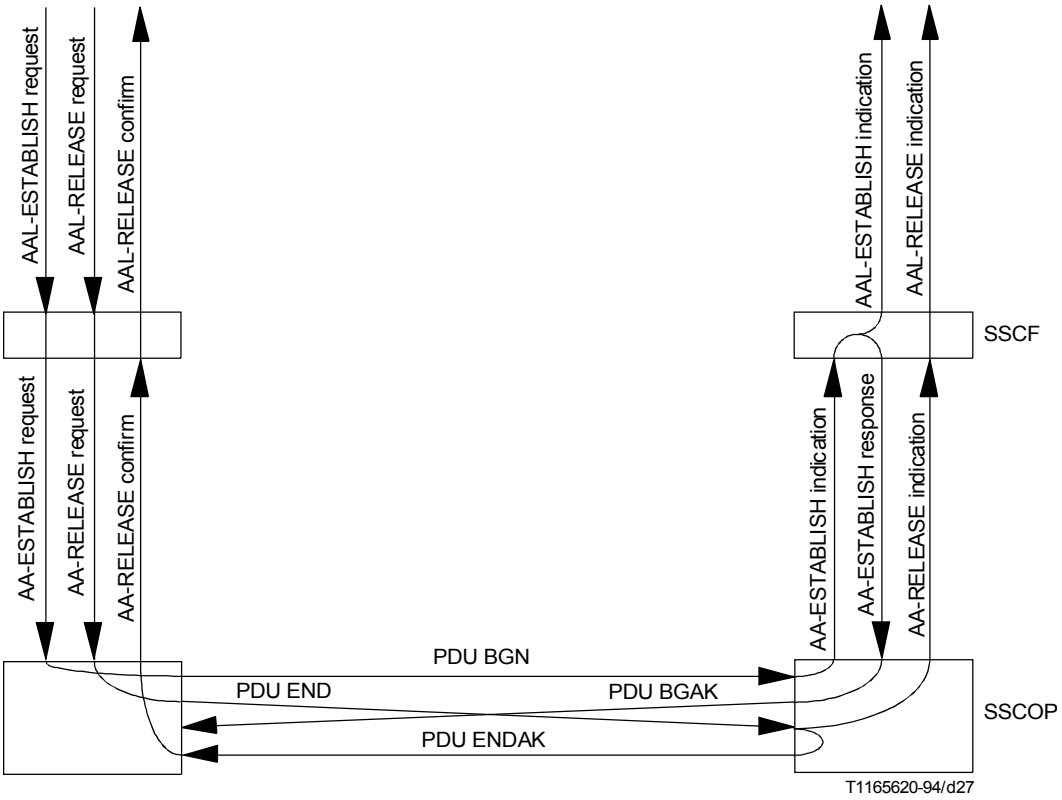


FIGURE I.24/Q.2130

Sequences for establishment of AAL connection followed by release while establishment is pending with peer-to-peer collision of PDUs BGAK and END

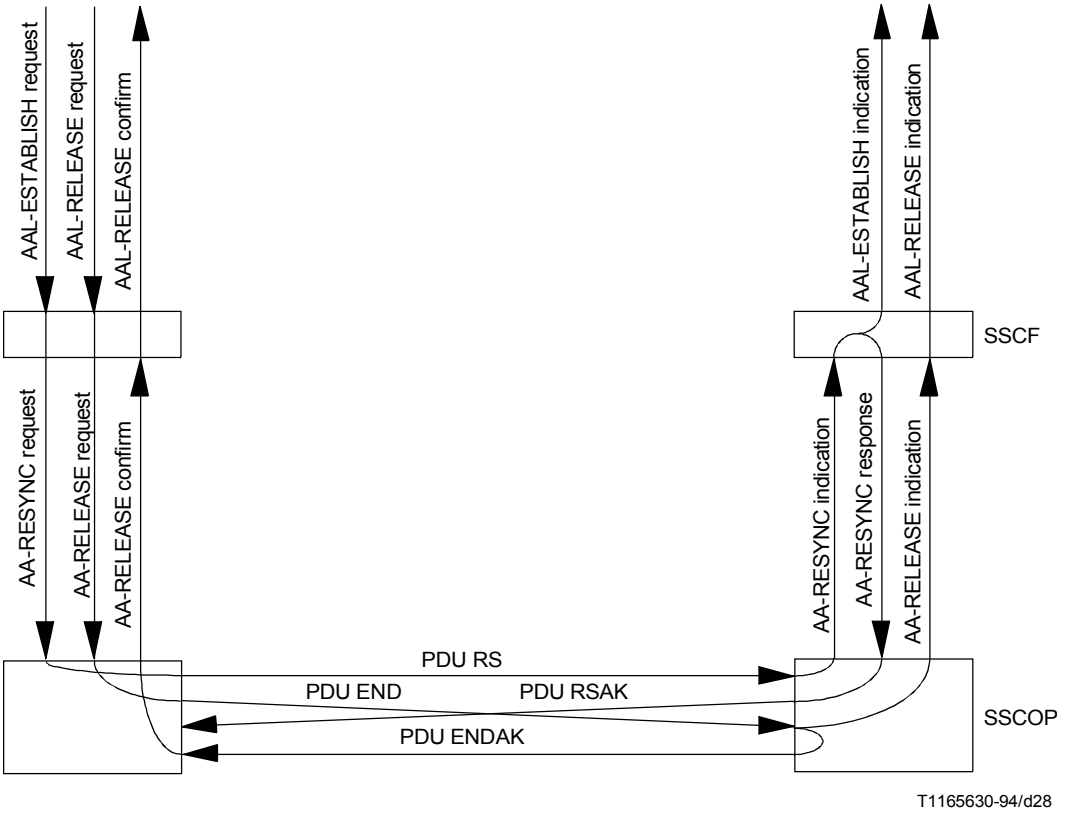


FIGURE 1.25/Q.2130

Sequences for re-establishment of AAL connection followed by release while resynchronization is pending with peer-to-peer collision of PDUs END and RSAK

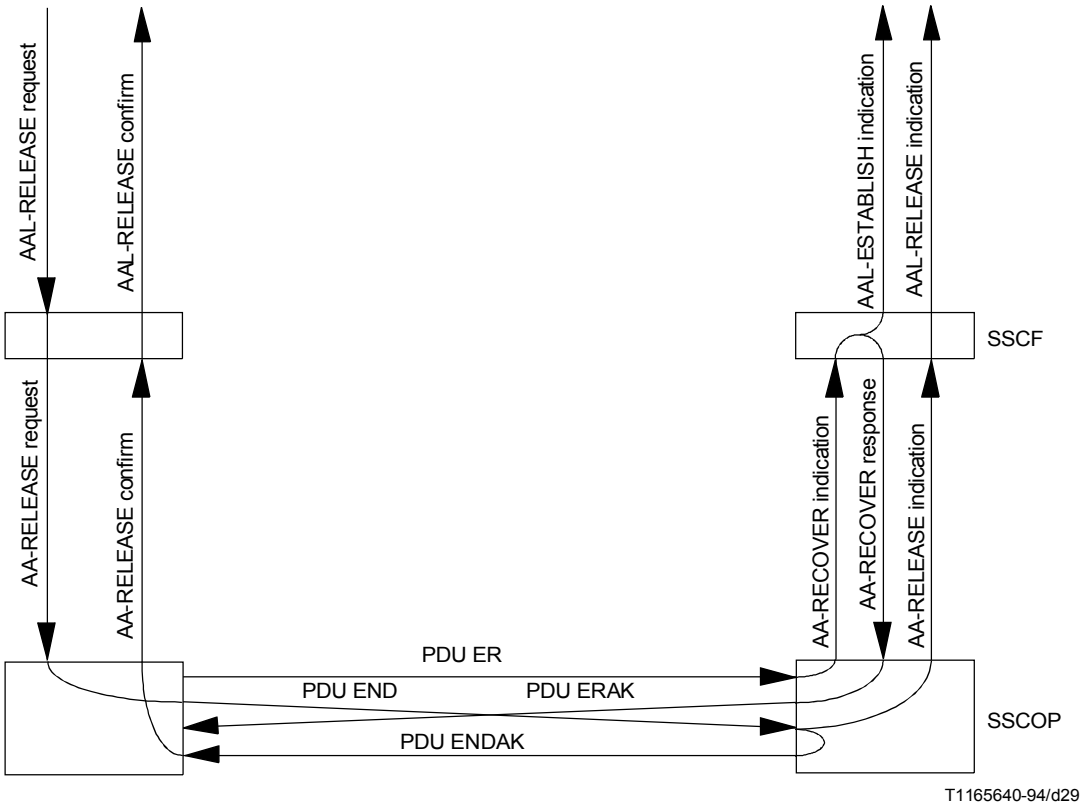


FIGURE I.26/Q.2130

Sequences for recovery of AAL connection followed by connection release

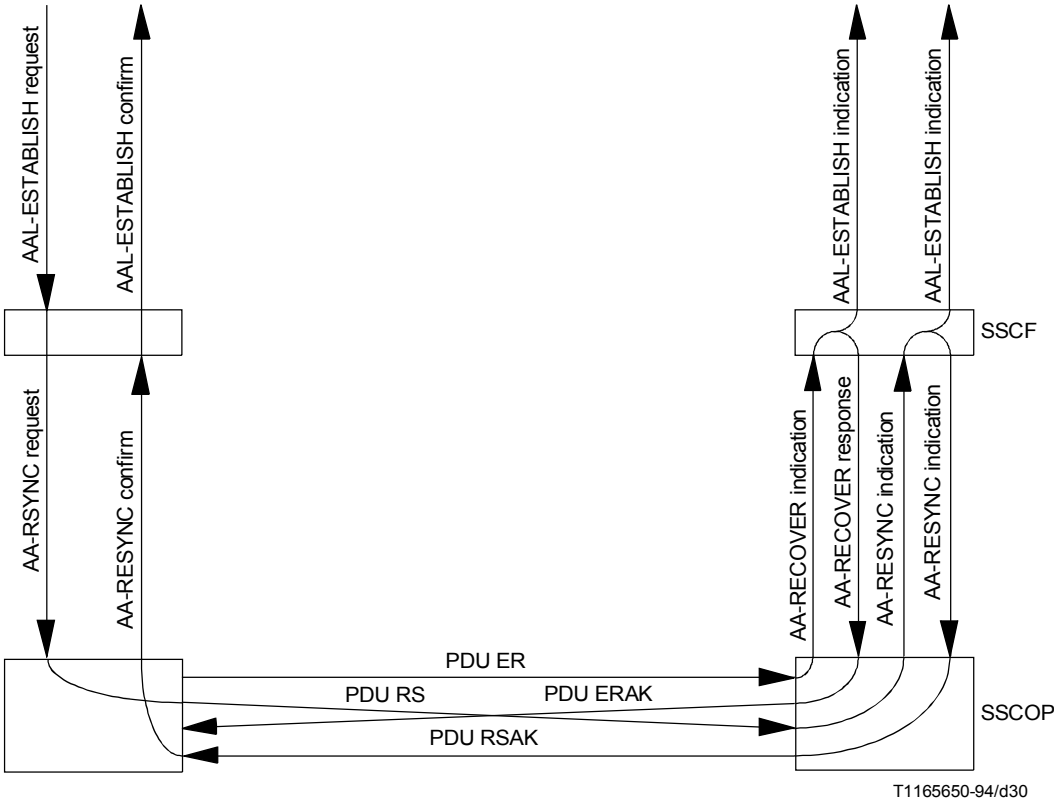


FIGURE I.27/Q.2130

Sequences for recovery of AAL connection followed by user initiated connection re-establishment

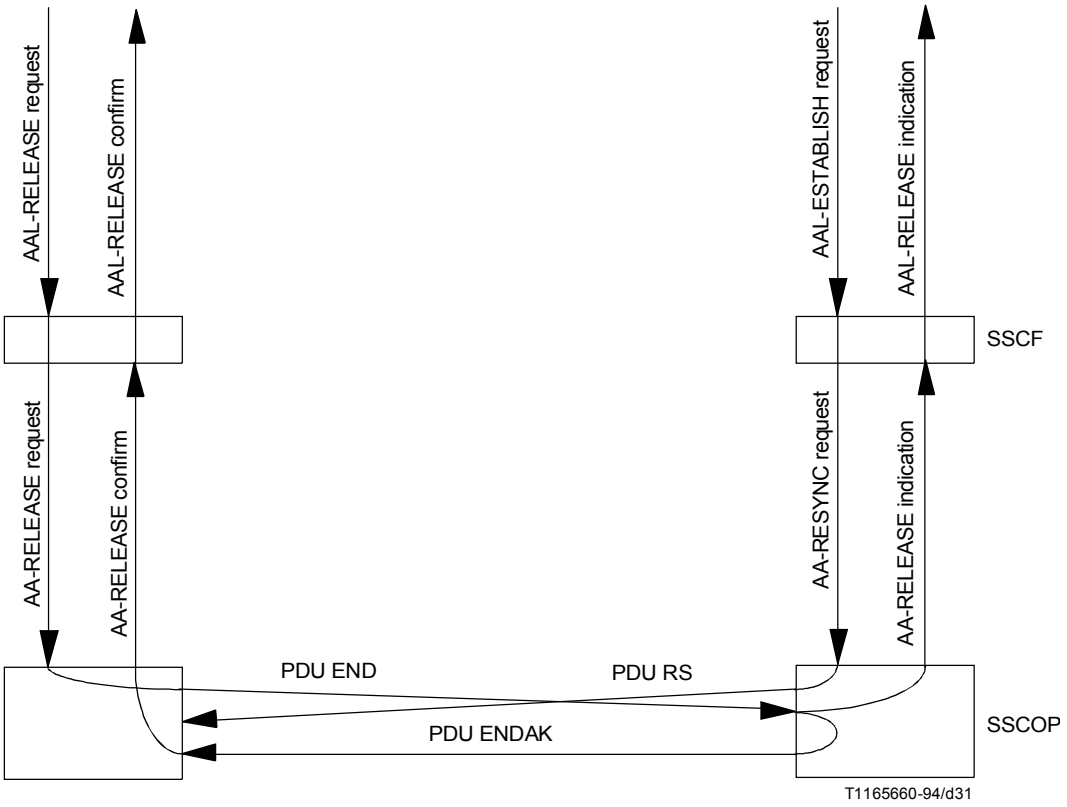


FIGURE I.28/Q.2130

Sequences for release of AAL connection in case of concurrency with re-establishment invoked by peer

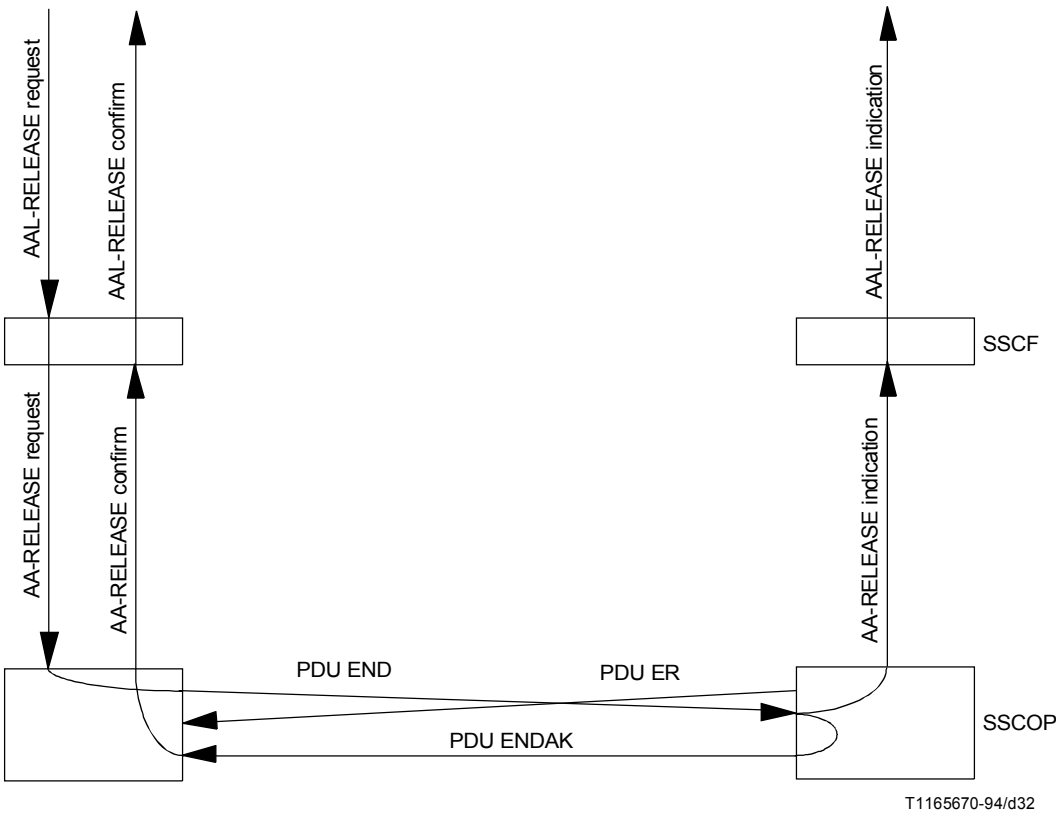


FIGURE I.29/Q.2130

Sequences for release of AAL connection in case of collision with recovery invoked by peer

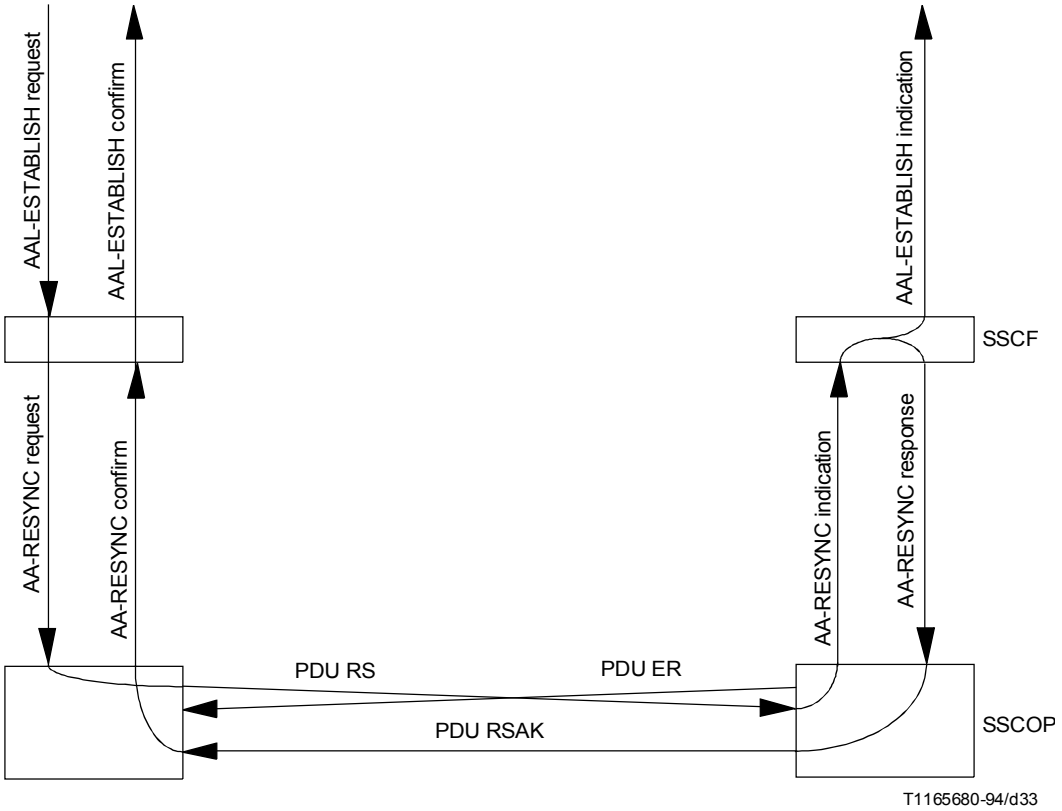


FIGURE I.30/Q.2130

Sequences for recovery of AAL connection in peer-to-peer collision with user initiated re-establishment

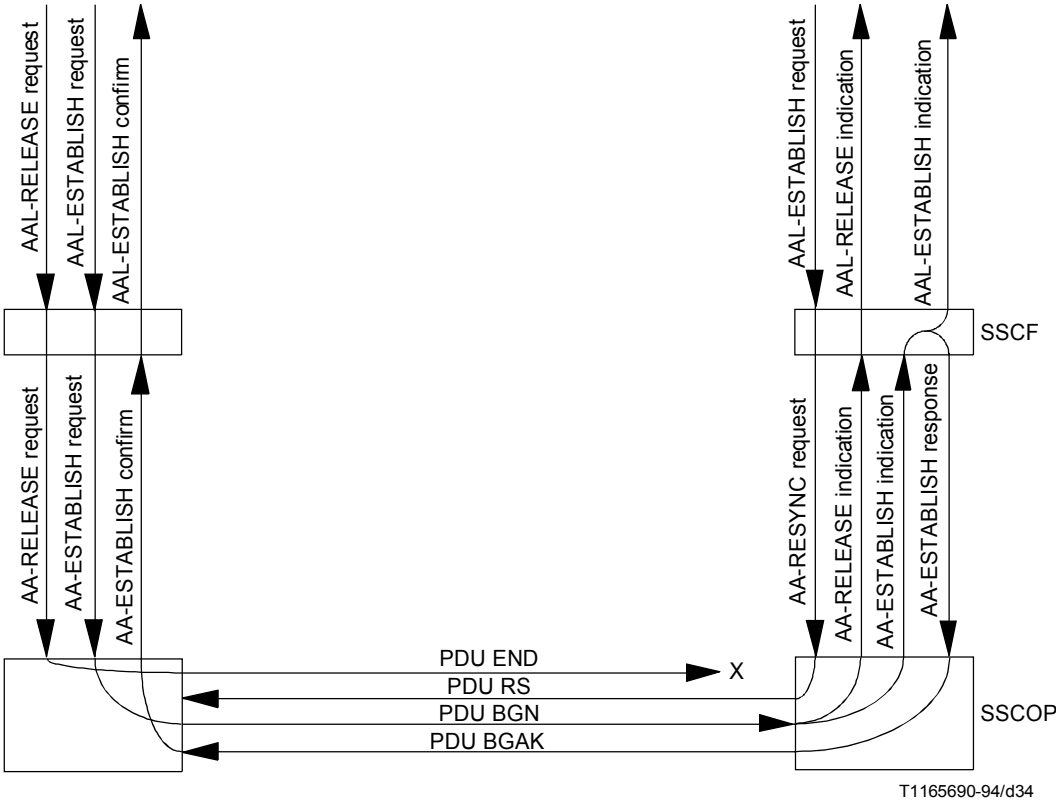


FIGURE I.31/Q.2130

Sequences for release of AAL connection with corruption of PDU END in concurrence with re-establishment followed by establishment overruling release

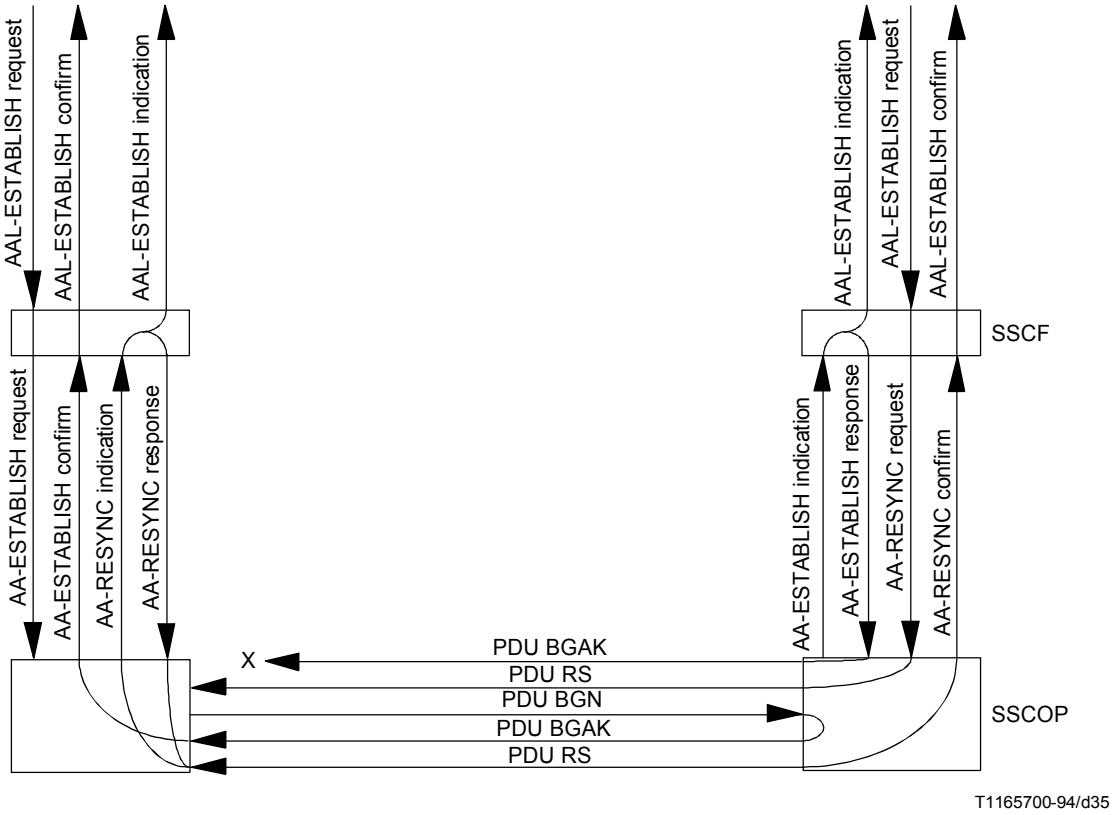


FIGURE I.32/Q.2130

Sequences for establishment of AAL connection with corruption of PDU BGAK followed by re-establishment invoked by peer